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American Machinist

A PRACTICAL JOURNAL FOR MACHINE CONSTRUCTION

ISSUED WEEKLY

VOLUME XLVII

July 1 to December 31, 1917

146674
31/7/18

McGRAW-HILL CO., Inc.
10TH AVENUE AT 36TH STREET
NEW YORK

EXPLANATORY NOTE

Illustrated articles are marked with an asterisk (*), book notices with a dagger (†). Cross references to a particular initial word may apply also to its derivatives. The cross references condense the matter and assist the reader, but are not to be regarded as complete or conclusive. So, if there were a reference from "Milling" to "Jigs and fixtures," and if the searcher failed to find the required article under the latter topic, he should look through the "Milling" entries, or others that the subject might suggest, as he would have done had there been no cross reference. The plural of any given item may not necessarily follow the singular immediately, as the items are listed in alphabetical order. All articles written by any given author are listed directly under his name. Articles that are not credited to any author, or are credited to "Special Correspondence," may be found under the heading "No author."

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The Lewis Machine Gun

SYNOPSIS—*The Lewis automatic machine gun, which has proved its worth in the present war, is a gas-operated device with a positive air-cooling system. The magazine is of the rotating-drum type, with a capacity of 47 cartridges. Its net weight is 26 pounds 12 ounces, while equipped with tripod mount and magazine it weighs 30 pounds 2⅛ ounces.*

THE barrel is surrounded by, and throughout its length is in direct metallic contact with, an aluminum radiator. The radiator has high longitudinal radial fins, and it is inclosed in a steel radiator casing that is open at both ends and extends forward beyond the muzzle of the barrel. The barrel mouthpiece, secured to the barrel by a left-handed thread, contains a cup-shaped aperture designed to direct the muzzle blast into the forward extension of the radiator casing so as to induce suction of air from breech to muzzle inside the radiator casing and along the surfaces of the fins. Near the barrel muzzle and in its under side is a port through which powder gas at barrel presure is admitted during the time required for the bullet to pass from the port to the muzzle. The powder gas passes into a gas chamber and thence into a gas cylinder beneath the barrel and parallel with it, in which it drives a piston rearward. The piston is pinned securely to the rack, which is provided with teeth on its lower surface meshing with teeth in the periphery of the gear.

The receiver is secured to the barrel by a large square thread and is pierced longitudinally by two bores, one above the other. These bores are connected by a narrow slot from the rear of the receiver almost to its front end. The piston travels in the lower bore of the receiver, which forms a rearward extension of the gas cylinder under the barrel. The upper bore in the receiver forms the boltway in which the bolt travels. The bolt is suspended on and operated by the striker post at the rear end of the rack. The striker is pinned in the striker post, which fits into a cam slot in the bottom of the bolt. This slot is cut away toward the axis of the bolt for the striker, and the face of the bolt is pierced axially from this slot to permit the striker to reach the primer of the cartridge in the chamber. Suitable delays in the action, after locking the bolt and before firing, and after firing and before unlocking, are provided by the longitudinal portion of the slot for the striker post in the bottom of the bolt. Locking and unlocking are accomplished by the cam angles at the rear of the slot in the bolt. Breech closure is by rotary locking, the breech bolt having four locking lugs that are turned in the corresponding locking recesses in the receiver. Under the receiver at its front end is fitted the gear case, which contains the gear and the mainspring. The latter is of the ribbon type and is wound up on the opening, or rearward, stroke of the action by the meshing of the teeth of the gear with the corresponding teeth under the rack. The spring tension so obtained is the means for the closing stroke of the action by rotating the gear in the opposite direction and so driving the rack, which is part of the piston, forward.

Above the receiver and pivoted on the magazine post is the feed-operating arm. It is driven by the upper lug of the feed-operating stud (attached to the rear of the bolt and with its upper lug traveling in a slot through the upper surface of the receiver), which engages a groove under its curved rearward extension so as to swing the feed-operating arm to the left during the opening movement of the bolt and to the right during its closing movement. The feed pawl on the feed-operating arm engages and rotates the magazine, and the cartridge opening in the feed-operating arm receives and guides the cartridge delivered to it.

The feed cover is secured to the top of the receiver. At the rear end it carries the rear sight base, and under its front edge are fitted the stop and rebound pawls and their spring. The function of the stop pawl is to engage with an outer projection of the magazine pan, which is rotated by the feed pawl on the operating arm, and prevents too great a movement. The rebound pawl engages with another projection of the magazine pan and prevents its rotation in the reverse direction, so that the magazine is accurately indexed and positively locked by each cycle of operation. A forward projection at the left side of the feed cover carries the cartridge guide, to which the feed-operating arm delivers the cartridge in loading.

The bolt carries two extractors lying in recesses in its top and side, and the ejector is pivoted in a recess in the receiver at the left of the boltway. The piston is operated by hand by the charging handle, which is fitted in it at the rear of the receiver when the buttstock is removed and which travels in the slot in the left side of the receiver. The safety is a plate sliding vertically in ways on the left side of the receiver. In its upper edge are two recesses designed to engage with the charging handle, one in its forward (uncocked) and the other in its rearward (cocked) position. To put the gun when cocked on safe, raise the safety and pull the trigger. The charging handle engages in front of the recess in the safety and prevents its accidental movement. This locks the gun against operation or discharge. To put the gun in action, draw back the charging handle to cock and press the safety down. The safety also, when raised, closes the slot in the left side of the receiver, in which the charging handle travels, and prevents sand, mud, dust, etc., from getting into the action.

The trigger is contained in the guard, which is a pistol-grip form. It is attached to a sear which, when the trigger is released, engages a notch in the under side of the rack and holds the action open at the very beginning of the closing stroke. The buttstock is usually of a form similar to a rifle buttstock, but a spade grip may be supplied. Either rifle buttstock or spade grip is attached by interrupted thread to the boltway in the rear of the receiver. The butt-tang or spade-grip tang locks up the entire rear end of the receiver and takes the thrust of the recoil of the piston.

THE MAGAZINE

The magazine is a circular steel drum in which the cartridges are arranged radially, bullet ends toward the center. The magazine center is of aluminum. It has a deep spiral groove in it, in which the bullet ends of the cartridges engage and by which they are controlled. When the magazine is latched in place on the magazine post, the magazine center is keyed to the magazine post and held stationary. The magazine pan carrying the separator pins and the cartridges is rotated around the center during the operation of the gun, so that the spirally arranged column of cartridges is driven down the groove of the magazine center until each cartridge is successively reached by the feed-operating arm.

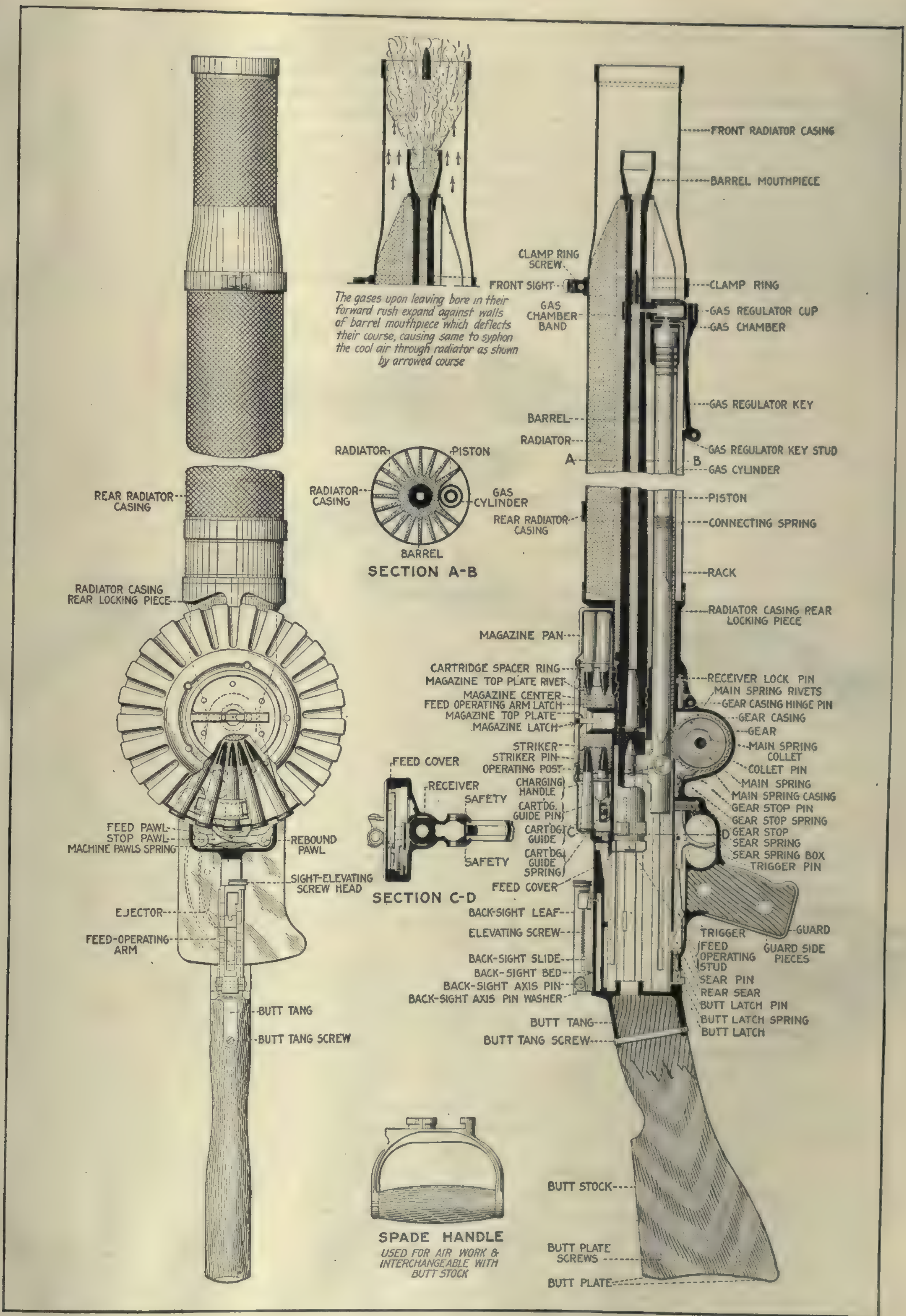
The action of the gun is as follows: Commencing with the gun in the "ready to feed" position, a filled magazine being latched on the magazine post and the charging handle having been drawn fully to the rear by hand so that the sear engages the rack and holds it back, the trigger is pressed. This releases the rack, which is driven forward by the spring-actuated rotation of the gear.

The striker post, by pressure of its neck against the left side of the cam slot in the bolt, drives the bolt (which cannot be cammed around because of its lugs traveling in the correspondingly shaped grooves in the boltway) straight forward in the boltway. The feed-operating stud carried forward with the bolt cams the feed-operating arm to the right, the feed pawl slipping over a projection on the rim of the magazine and engaging behind it. The spring stud on the feed-operating arm presses the stop pawl back to prevent its intercepting a projection of the magazine. The head of the bolt now reaches the head of the ejector, which it presses back into the ejector cut, causing the rear of the ejector to be pivoted out into the boltway behind the bolt. The face of the bolt now strikes the base of the cartridge, which is held ready for it in the loading ramps of the receiver, and it drives the cartridge before it into the chamber. The extractors spring over the rim as soon as the cartridge seats. Just as the cartridge seats, the locking lugs of the bolt clear the front of the cruciform part of the boltway formed by their guide grooves and reach their locking recesses. The bolt face now lies against the rear end of the barrel and the head of the cartridge, and the striker post still pressing against the left side of the cam slot in the bolt now cams the bolt to the right, turning the locking lugs fully into the locking recesses of the receiver. As the bolt locking is completed, the striker post enters the longitudinal front part of its cut and carries the striker against the primer of the cartridge in the chamber, firing the cartridge.

THE EFFECT OF FIRING

Firing develops the power for another cycle of operations. As soon as the bullet has passed the gas port near the muzzle of the barrel, gas under pressure is driven through the gas port into the gas-chamber gland and chamber and through the hole in the gas-regulator cup onto the head of the piston, driving it rearward in the gas cylinder. Driving the rack teeth back over the gear teeth with which they mesh rotates the gear and extends the mainspring during the entire opening movement. During the first 1⅓ in. of rearward travel the striker post moves back with a longitudinal part of its cut in the bolt, withdrawing the point of the striker from the face of the bolt, the bolt remaining locked and stationary. In the next ⅜ in. of travel the striker post, driven still farther rearward in the bolt, strikes with its right side the cam surface in the right side of its slot in the bolt, causing the bolt to rotate from right to left, turning the locking lugs out of their recesses. The striker post now reaches the rear of its cut in the bolt, and its further travel carries the bolt directly back with it; the empty shell is held in the grip of the extractors till the feed-operating stud strikes the rear of the ejector.

The top lug of the feed-operating stud, traveling in the groove in the under side of the feed-operating arm, cams the feed-operating arm so that it swings across the top of the receiver from right to left. The feed pawl, acting against one of the outer projections of



The gases upon leaving bore in their forward rush expand against walls of barrel mouthpiece which deflects their course, causing same to syphon the cool air through radiator as shown by arrowed course

SPADE HANDLE

USED FOR AIR WORK & INTERCHANGEABLE WITH BUTT STOCK

DETAILS OF THE LEWIS MACHINE GUN

the magazine pan, carries the magazine around sufficiently to drive the first cartridge down into the cartridge opening in the feed-operating arm by the rotation of the magazine pan and interior separators around the stationary, spirally grooved magazine center. The cartridge opening of the feed-operating arm, with the cartridge it has just received, now commences to pass under the upward projecting arms of the feed cover, which carry the cartridge guide; and these arms commence to control the cartridge as soon as it leaves the magazine. Further leftward travel of the feed-operating arm brings the cartridge under the cartridge guide and its downward spring tension. At this point, the spring stud on the feed-operating arm clears the stop pawl, which is then pressed forward by its spring and prevents further rotation of the magazine.

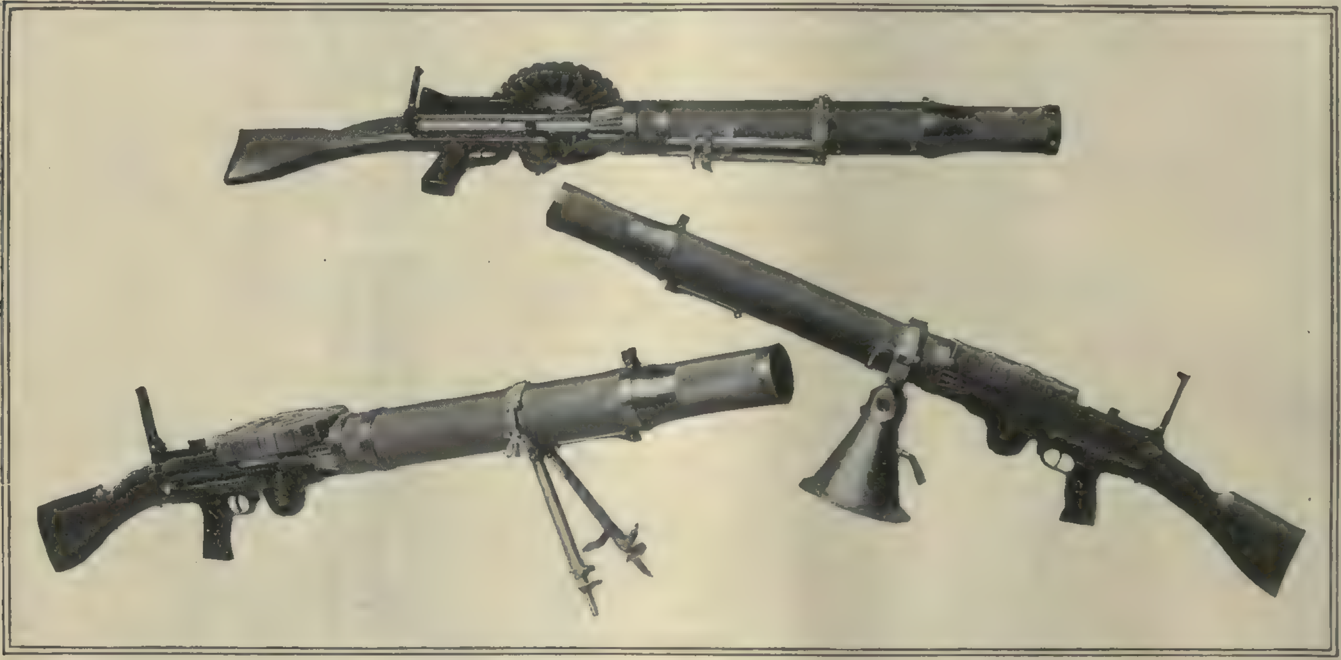
The lug on the left of the feed-operating stud now strikes the rear end of the ejector, driving it into its slot and pivoting the head of the ejector out so that it strikes the side of the empty shell, which has still been carried by the extractor, and throws it through the ejector port out of the receiver to the right.

Toward the end of the rearward travel of the rack, the bent (downward projection of the lower surface of the rack whose space forms the cocking notch) rides over the nose of the sear, temporarily depressing it against the tension of the sear spring, which immediately rises again. The rear end of the rack then strikes the butt tang, terminating the opening stroke. The feed-operating arm is now at the extreme left, the cartridge has been brought over the cartridge opening in the top of the receiver against which the cartridge guide presses it, the rebound pawl engages an exterior projection of the magazine so as to prevent backward rotation, and the mainspring is in full tension.

If after its first pressure the trigger has been instantly released, the piston and rack will be intercepted by the engagement of the nose of the sear with the cocking notch or bent in the lower edge of the rack, suspending the operation of the gun in the "ready to feed" position. If pressure has been maintained on the trigger, the closing stroke will instantly be repeated; and automatic operation of the gun will continue until the cartridges in the magazine are exhausted or pressure is removed from the trigger.

Feed is absolutely positive and unaffected by the position of the gun. The cartridge is under complete mechanical control during every stage of feeding. The functioning of the gun is unaffected by pointing it straight up or straight down or turning it on its side or upside down. Ejection is also positive.

The forms of gas port, regulator cup, cylinder and piston permit functioning the gun by a materially smaller volume of gas and at much lower pressure than in gas-operated mechanisms of previous design. As a result, shock and strain of parts are minimized, and retraction of the breech mechanism by hand is facilitated.



THREE VIEWS OF THE LEWIS MACHINE GUN

The gun may be entirely dismounted without other tools than a cartridge and a small spanner. Removing the buttstock and withdrawing the rack, piston and bolt leave the barrel and cylinder ready for cleaning. This permits inspection of the barrel or insertion of the cleaning rod into the barrel from either end.

Semi-automatic fire (single shots) or automatic fire may be obtained at will without extra parts or special adjustment.

Vibration of the barrel is so damped and broken up by the radial support afforded the barrel by the mass and structure of the radiator that single shots are fired on the same line of sight as that of full automatic fire.

The muzzle blast, directed by the barrel mouthpiece onto the interior of the radiator casing in front of the muzzle to induce the air current through the radiator, exerts a forward pull on the radiator casing which neutralizes the recoil to such an extent that the gun may be fired from the shoulder with accuracy and without inconvenience.

The absence of recoil and vibration permits satisfactory use with a very light mount or with no mount. The bipod mount furnished with the gun weighs only

1 lb. 14½ oz. and is intended to remain attached to the gun during transportation. It does not interfere with carrying, operation or cleaning and is adapted to satisfactory use under widely varying conditions. Mounts especially designed for naval and aërial use may be supplied, and the gun may be adapted to any existing form of tripod, if desired.

The gun is absolutely mobile. Besides its ability to function normally at any angle or in any position, it may be carried, loaded and locked by one man, who can commence firing as quickly and easily as with the Model 1903 service rifle.

A magazine may be placed on the magazine post and latched, or may be unlatched and removed with one hand. The magazine latch is conveniently operated by the thumb of the hand that puts the magazine on the magazine post or removes it from the post. No delicate adjustment is necessary in putting the magazine on the post and preparing to fire, and it may be done with as much speed in total darkness as in daylight.

Time Studies for Rate Setting on Gisholt Boring Mills—I[*]

By DWIGHT V. MERRICK

SYNOPSIS—*A definition of terms used in time-study work, and a classification of machine-shop operations. Analysis of the fundamental operations on a line of Gisholt boring mills, and an example of the method used for combining time studies.*

FROM the explanation of the methods of taking time study given in the first article of this series it is evident the results can be used to facilitate the preparation of instruction cards showing the best method of doing any piece of work and the time that should be required for it. It is also evident that every piece of work can be divided and subdivided into a number of elementary operations in exactly the same manner that the English language can be divided into words and re-subdivided into the twenty-six letters of the alphabet. By recombining the elementary operations in varying sequences and combinations, the operations necessary to the completion of any conceivable piece of work may be outlined. If opposite each of the separate items of this combination of elementary operations were set down the length of time required for its performance by a skilled workman, we could arrive at a definite conclusion as to what would be the proper length of time necessary to the performance of the work. This is the process followed, to a greater or less degree, in the writing of instruction cards.

We have already discussed the making and use of operation time studies. We propose now to take up machine time studies, falling within class (2). The method of recording and analyzing the data is the same as in class (1) studies, and has been considered in the first article of this series.[1] We will here confine ourselves to those features of time study that are peculiar to class (2).

The following terms, which will recur frequently, are, for the purposes of this work, used with the following meanings:

Element—The smallest subdivision of the work that is to be studied. Elements are combined to make up fundamental operations. Example: Loosen nut, lay down wrench.

Elementary Operation—The same as element.

Fundamental Operation—A sequence of elements comprising the performance of some definite portion of a job. A single fundamental operation may apply to several different classes of work or to several different sizes and types of machine. Example: Put tool in tool post; remove tool from tool post; move head along rail, etc.

Complete Operation—A division of machine work that is complete in itself. It is made up of one or more fundamental operations.

Job—The combination of complete operations necessary to the completion of the work in a single machine. Example: Boring a cylinder; planing a lathe bed; milling the teeth of a gear.

Right Hand (of a Machine)—That portion of the machine that is at the right of the workman as he stands in front of and facing it.

Left Hand (of a Machine)—That portion of the machine that is at the left of the workman as he stands in front of and facing it.

ANALYSIS OF THE WORK

The taking of a machine time study consists in the analyzing of the complete operations that are possible on a machine and determining the length of time, by means of a stop watch, required for the performance of each of these operations. Thus, in machine-shop practice, work can be divided under the following heads:

1. Preparing the machine to receive work (from normal condition).
2. Hoisting and landing work in the machine.
3. Squaring and leveling, and making work run true.
4. Clamping or otherwise holding the work in the machine.
5. Setting tools.
6. Manipulating the machine to start cut. (Includes calipering and gaging.)
7. Machining—that is, removing metal.
8. Manipulating machine at end of cut.
9. Removing tools.
10. Loosening and removing clamps.
11. Hoisting and removing work from the machine.
12. Restoring machine to its normal condition.

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[*] Copyright, 1917, McGraw-Hill Publishing Co., Inc. This is one of several articles by the same author on the general subject of time study. The other articles appeared in the "American Machinist" on pp. 171, 221, 269, 407, 628 and 1061, Vol. 46.

[1] "American Machinist," p. 221, Vol. 46.

The foregoing sequence is followed in the preparation of instruction cards.

In time-study work a normal condition is assumed for each machine. This normal condition is that which will enable it to accommodate, without change, the greatest number of jobs that will come to it in the regular work of the shop. For instance, in the case of a boring mill the rail will be left at a certain elevation above the table, the heads at either end of the rail and the rams set at right angles to the rail. At the conclusion of each job, the machine should be restored to its normal condition. The purpose of thus restoring it to its normal condition is to facilitate the setting of tasks on the machine by giving the man who writes the instruction cards a definite starting point in laying out the work. As will become apparent later, a large percentage of the time involved in most machine work is concerned with the preparation of the machine for work. All instruction cards and task times will be inaccurate if the machine is in any other than the normal condition when the workman commences work upon it. In taking time studies also a normal position should be assumed for the workman—that is, the position in which he would ordinarily be found at the commencement of the operation in question. Thus, in machining work on a boring mill, the workman would naturally take his place at the end of the cross-rail, and this position would be his normal position for the beginning of the following operation—that is, loosening and removing clamps.

STANDARD CONDITIONS ESSENTIAL

Too much stress cannot be laid on the fact that standard conditions should be established and maintained in the shop if time studies are to be made and used with any degree of success. With the fine subdivision of work that is made in taking time studies, and with the close reading of time (frequently to less than 0.01 min.), results can be duplicated in the actual performance of work only when the conditions established for the work are the same as those established at the time that the time studies were taken. Any failure to maintain these conditions will result almost invariably in the lengthening of the time required by the workman in the daily performance of his job, with a consequent failure to maintain the production and earn a bonus.

Standard conditions involve not only the determination and maintenance of a normal condition of the machine and normal position of the workman, but also the maintenance of tools, measuring instruments and other equipment in good working condition and the supplying of them to the workmen at or before the time they are needed. Standard conditions also involve the placing at the machine, before the completion of the workman's previous job, the necessary raw material for the following job. They also contemplate the determination of the economical manufacturing quantities.

It is obvious that there is a difference in the time required to machine one piece and one thousand, which is not proportional to the number of pieces. For instance: In the case of a turret lathe it requires just as much time to tool the machine and otherwise prepare it for the machining of one piece as for the machining of one thousand. It would be equally incorrect to determine the time for setting up the machine and machining one piece and multiplying by one thousand to determine the rate for one thousand pieces as it would be to determine the time for one thousand and divide by that quantity to ascertain the time for a single piece. It is therefore essential that good manufacturing demands the predetermination of what proportion of time can be allowed respectively to preparation and to actual work, and that the number of pieces in a single lot be based upon this proportion.

The standard condition of tools and other auxiliary equipment demands that the machine be provided with cutting tools that are sharp and ground to the proper cutting angles, and that these tools be of the same size as those used when the time studies were taken that fixed the standard condition. Standard conditions also require that auxiliary fixtures such as bolts, clamps, etc., be in perfect order and of the proper size for the work or machine on which they are to be used. It is obviously improper to require that a workman run a nut down on a clamping bolt for a distance of 2 in., when the thread is battered, in the same time that it took the man on whom the time study was taken to run a nut down a distance of ¾ in. on a sharp and well-oiled thread. In the first case the man would require a wrench, and in the second he would be able to use his fingers. The time in the former case would be much greater than in the latter. If in taking time studies open-end wrenches were used in tightening all the nuts, open-end wrenches should be furnished the workman in the regular course of his work. The time allowed for tightening nuts includes the procuring and fitting of the wrench to the nut. It is evident that a workman will consume more time in fitting a monkey wrench to a nut than in using an open-end wrench. The manufacturer who would make and use time studies with any degree of success must so arrange his shop that the work will always be done under the same conditions as those under which the studies were originally taken.

CLASSIFICATION OF OPERATIONS

The various items of the classification of work outlined may be more thoroughly defined as follows:

1. Preparing machine to receive work: This includes all adjustments of the machine necessary to fit it for the reception of work, such as the adjustment of chuck jaws, the removal or placing of faceplates or chucks, the adjustment of the tailstock, etc., in the case of lathes; the raising of the rail, the movement of the heads, etc., in the case of planers and boring mills, and similar operations that can readily be called to mind on other machines.

2. The hoisting and landing of the work in the machine: This item includes the lifting and placing of work in position ready for clamping or otherwise fastening in the machine by hand. Or, if the piece is too heavy for movement by hand, the attaching of slings, the hoisting by means of block and chain hoist, pneumatic hoist or crane, the movement or traverse of the lifted work to the machine, the landing of it in position in the machine and the removal of the slings.

3. Squaring, leveling and making work run true: This item includes all operations necessary to make the

surface that is to be machined conform approximately to the path of the cutting tool.

Squaring involves the operations necessary to make the principal edge of the work parallel to the edge of the table or to the path of the cutting tool where one or the other has a reciprocating motion; used principally in connection with planers, shapers and slotters.

Leveling involves those operations necessary to bring the working surface parallel to the platen, or table, on which the work is supported. Work is leveled on the tables of planers, boring mills, drilling machines, shapers, etc. Although using the term in its strict sense, work clamped to the faceplate of a lathe is not leveled, nevertheless the operations involved in making the working surface parallel to the faceplate are the same as when the work is clamped to a horizontal surface, and such operations in regard to lathe work are properly classified as leveling.

Making work run true involves those operations required to make work carried on centers, or supported on a rotating surface, as a lathe faceplate or boring-mill table, assume the same axis of rotation as the machine itself.

4. Clamping or otherwise holding the work in the machine: This item includes the tightening of chuck jaws on the work, the placing of clamps and blocks and the tightening of the bolts and nuts that hold them on the work, the tightening of vise jaws and setting and making firm all attachments that hold the work in position for the cutting tools.

5. Setting tools: This item includes the placing in the post, ready for work, of all cutting tools. It does not, however, include the manipulation of the machine in order to bring the tool in position with relation to the work where it is ready to begin removing the metal.

6. Manipulating the machine and adjusting the cuts: This item involves all machine movements, including those necessary to bring the cutting tool in its proper relation to the work, and the preliminary operations of the machine necessary to turn short lengths on cylindrical work, to obtain the space necessary for calipering to ascertain whether or not the tool is in the correct position. It also comprises the starting of the actual machining operation by throwing in the feed gears at the beginning of the cut and the releasing of them at its completion.

7. Machining: This item involves only the removal of metal and has little or no relation to the time involved in machine movements.

8. Manipulating machine at end of cut: This item includes the fundamental operations necessary to disengage the cutting tool from the work and to bring it to a position where it can be removed or reset for another cut. In general it is the reverse of (6).

9. Removing tools: This item includes the elements required to loosen the devices holding the tool in place and to remove it to the tool stand. In general it is the reverse of (5).

10. Loosening and removing clamps: The operations under this subdivision are the reverse of those comprised under item (4).

11. Removing the work from the machine: The items involved here are the same as those involved in item (2), excepting that they are performed in the reverse order.

12. Restoring the machine to its normal condition: The operations comprised in this item are practically identical with those comprising item (1), and in addition it includes the operation of cleaning the entire machine.

The time studies in which the various elements are classified as above permit of the widest use. For instance: The same studies on clamping may be applied to several different types of machine. The work may be held with U-clamps on the table of the planer, boring mill, drilling machines or shaper. It makes no difference what machine is involved, so long as the character of the work to be clamped and other relative conditions are the same. The time for clamping should be uniform. Another instance is that of calipering. The time required to caliper a piece of work depends but little upon the machine in which the work is placed, but depends very largely upon the size of the work itself. Studies on calipering in one class of machine are equally applicable to other types of machines. In hoisting and landing it makes but little difference whether the work is landed in the machine on centers or lowered in position on the table.

The weight and distance a piece is to be moved will make quite a difference, and time studies on hoisting and landing, therefore, are classified first with respect to the method of handling—whether by hand, chain, pneumatic or electric hoist—second, with respect to weight, and third, with respect to the distance moved. Classified in this manner the different groups of time studies can be combined one with another in varying combinations and sequences, as outlined in the opening paragraphs, to fix the time required for practically every class of work. There will, of course, be necessary additional time studies peculiar to the machine in which the work is placed. That is, in addition to studies of hoisting, landing, calipering, etc., applicable to all classes of work, there must be studies in machine manipulation for the different machine tools, such as lathes, planers, etc., and studies of tool setting for these various machines.

Analysis of the Gisholt Boring Mill

These general considerations being understood, we may now examine the method of analyzing a machine time study. The time studies forming the subject of this and the subsequent articles were made by first dividing the operations on Gisholt boring mills into their fundamental operations such as: (1) Preparation of the machine, including oiling of the mill, raising and lowering of the rail, swiveling of the ram, changing position of the tool post, etc.; (2) manipulation of the machine, including rapid travel of the head and rail, revolving of the turret, operating speed and feed levers, etc.; (3) hoisting and landing work on the machine; (4) clamping work; (5) setting and starting cuts which included some machine manipulation already stated in (2), and some machine elements not stated elsewhere. The studies were made on a series of machines ranging from 30 to 84 in. in diameter, and all of the operations outlined were studied on each machine.

Each of the fundamental operations comprised in the foregoing subdivisions was analyzed into its most elementary motions, and the sequence of operations from start to finish as revealed by this analysis was tabulated.

An example of this is a study made on the turning of chuck jaws end for end. The elements are as follows:

1. Obtain wrench from tool stand.
2. Loosen two ⅝-in. setscrews in first jaw.
3. Remove jaw from slot.
4. Clean slot.
5. Turn jaw end for end and reënter it in slot.
6. Set jaw to line on table.
7. Tighten two ⅝-in. setscrews in jaw.
8. Turn table 120 deg.
9. Loosen two ⅝-in. setscrews in second jaw.
10. Remove jaw from slot.
11. Clean slot.
12. Turn jaw end for end and reënter it in slot.
13. Set jaw to line on table.
14. Tighten two ⅝-in. setscrews in jaw.
15. Move table 120 deg.
16. Loosen two ⅝-in. setscrews in third jaw.
17. Remove jaw from slot.
18. Clean slot.
19. Turn jaw end for end and reënter it in slot.
20. Set jaw to line on table.
21. Tighten two ⅝-in. setscrews in jaw.
22. Return wrench to tool stand.

COMBINING OPERATIONS

The fundamental operations can be combined one with the other in varying numbers and sequences to give a complete tabulation of the operations involved together with the time required for any job that can be done upon a boring mill.

In the studies that have been made, and that will be presented in subsequent articles of this series, the following have been considered as fundamental to the operation of a boring mill:

1. Preparation—Oil, raise and lower rail, swivel head to angle, remove from and replace tool post or bar in ram, raise or lower tool post in ram, set chuck jaws on table, remove chuck jaws from table.

2. Manipulation—Change position of head, start motor, stop motor, start table, stop table, change feed gears, change speed gears, ratchet head back.

3. Setting Tools in Post—Set tools in tool post in right-hand head for cut on outside diameter: (a) Round nose roughing tool, (b) square finishing tool. Set tools in tool post in right-hand head for cut on face: (a) Round nose roughing tool, (b) square nose finishing tool. Set tools in tool post in left-hand head, tools set for cut on outside diameter: (a) Round nose roughing tool, (b) square nose finishing tool. Set tools in tool post in left-hand head, tools set for cut on face: (a) Round nose roughing tool, (b) square nose finishing tool.

The following are common to many types of machines, and must be used in preparing instruction cards for boring mills, planers, shapers, drilling machines, etc.

4. Hoisting and Landing—On centers, by hand; on centers, by hoist; in chuck, vertical, by hand; in chuck, vertical, by hoist; in chuck, horizontal, by hand; in chuck, horizontal, by hoist; on table or platen, by hand; on table or platen, by hoist; on table in V-blocks, by hand; on table in V-blocks, by hoist; in vise, by hand; in vise, by hoist; on arbor, by hand; on arbor, by hoist.

5. Clamping—Clamping work in chuck jaws, clamping with U-clamps, clamping with goose-neck clamps, removing work from chuck jaws, removing U-clamps, removing goose-neck clamps.

6. Squaring and Leveling and Making Work Run True—In chuck, in chuck and steady rest, on centers, on platen, on faceplate.

COMBINING THE TIME STUDIES FOR VARIOUS JOBS

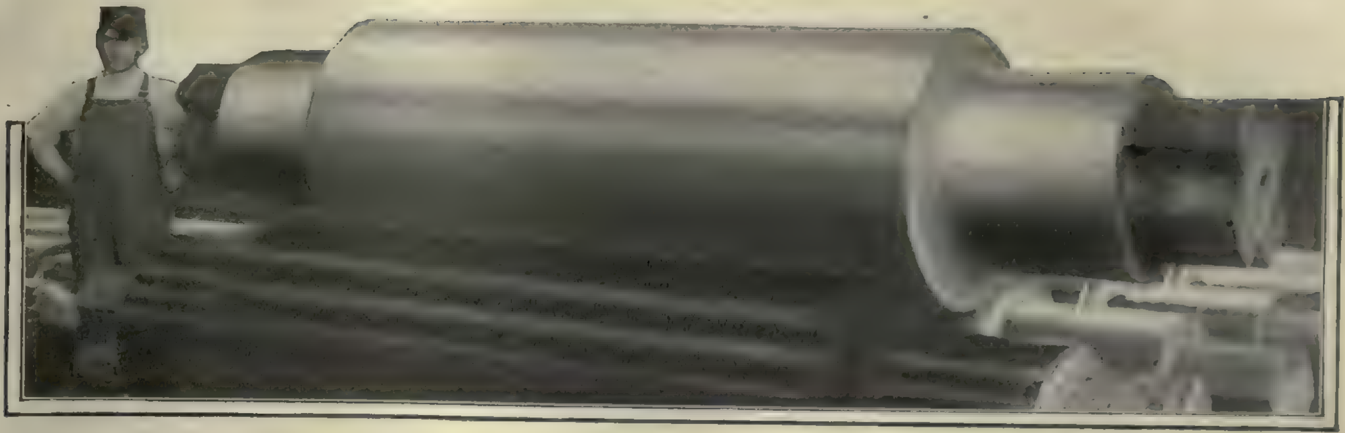
The foregoing fundamental operations will be combined later with outlines of other operations that can be taken as the usual sequence in the great majority of jobs on a boring mill, such as setting and starting roughing and finishing cuts on outside diameters and on face of work, boring, and performing other operations that will readily be called to mind. For instance: In preparing an instruction card for making a cut on the outside diameter, we would combine the following operations in the preparation of an instruction card, assuming that the work was to be held in the chuck jaws:

1. Raise rail to proper height.
2. Set chuck jaws on machine.
3. Hoist and land work on chuck jaws.
4. Tighten chuck jaws on work.
5. Set tool in post in right-hand head.
6. Rapid travel head over and down to work.
7. Change speed and feed and start cut.
8. Machine.
9. Rapid travel head back from work.
10. Remove work from chuck jaws.
11. Land work on floor.
12. Restore machine to normal condition.

The method of selecting the various items from the elementary tables that are outlined above will be described in subsequent articles, following the presentation of the elementary tables. These explanations will be accompanied by examples of instruction cards built up from the elementary tables.

THE ELEMENTARY TIMES

A word of explanation is in order at this point, in regard to the time set opposite the elementary items in the tables that follow: It will be observed that in some instances the time is given to four decimal places of a minute, although the stop watch that was used in taking the studies was subdivided to read only to two decimal places. In taking the averages of the individual times, however, the process of division permitted the average to be carried to as many decimal places as was desired. The results of all of our computations were plotted to a large scale on cross-section paper, and smooth curves drawn from which the values appearing in the tables were read. The scale adopted in drawing these curves was so large that it was easily possible to read to four places of decimals. In making up the tables of fundamental operations and complete operations, however, the limits of practice and of common sense were borne in mind and final results are given only to 0.01 min. It should be remembered that the results given in these articles were obtained under the conditions of a scientific investigation in which greater refinements were possible than are either necessary or desirable in ordinary shop practice, and it is for this reason that some of the figures were carried to four decimal places.



Grinding Rolling-Mill Rolls

BY HOWARD W. DUNBAR

SYNOPSIS — *This article outlines the function of rolling-mill rolls, calls attention to various methods of finishing and goes into particular detail with respect to dressing by grinding. Numerous practical points are emphasized, and up-to-date practice is described.*

ROLL grinding is a term applied to the finishing of rolls used in rolling mills where plate and sheet metal are manufactured. It is essential that roll grinding be as accurate as any work in the grinding field. The rolls must be absolutely parallel where they bear together, in order to insure uniform thickness throughout the entire length of the sheet of metal they roll. When it is necessary to grind a taper in the face of a roll, it must be perfect within very close limits in order to accomplish its purpose.

Rolls vary in size from very small ones for rolling ribbon stock, which may be 8 or 12 in. on the face and from 6 in. up to 10 in. in diameter, to rolls for rolling armor plate and very wide sheet steel, which range in diameter from 18 in. up to 60 in., and in length are 14 ft. to 15 ft. on the roll face. They also take various forms.

Ordinarily, in rolling ribbon stock the face of the roll must be slightly crowned. In long rolls of small diameter it is the practice to taper the face slightly from both ends, keeping the highest part in the center of the roll. Other types of rolls are simply ordinary cylinders with extremely large overall dimensions.

Each of these various types of rolls takes its shape for some technical reason in the production of the particular kind of material that it is to handle, and these technicalities have a bearing on the grinding problem only in so far as they affect the problem of handling them in the grinder.

Rolls are commonly made from either chilled iron or steel, the former being more common.

Rolls are used in the rolling mill by placing them one above another in various combinations, sometimes two high, sometimes three or four high, depending upon the type of roll mill and the quantity and kind of material being produced. They have various names, depending upon the function they perform. Some are known as "backing rolls," others as "reducing rolls." The backing rolls are the rolls that back up or give support to the extreme pressure and weight brought to bear when this operation is being performed, and the reducing rolls are those through which the hot billet is passed in reducing it in thickness or size.

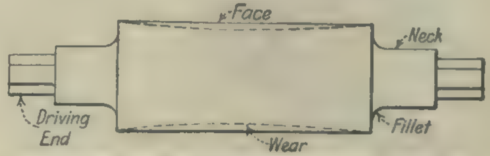


FIG. 1. MANNER IN WHICH THE ROLL WEARS, WHICH NECESSITATES TRUING UP THE FACE

Some call the large diameter of the roll the "face," others the "body"; "neck" is a common term for that

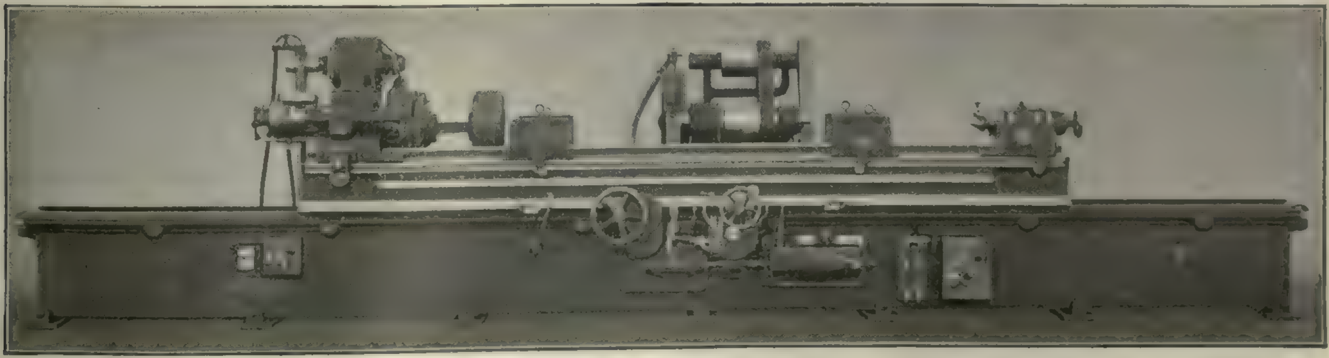


FIG. 2. FRONT VIEW OF REGULAR TYPE OF CYLINDRICAL GRINDER ARRANGED FOR ROLL GRINDING

part of the roll commonly known to most mechanics as the "journal."

Rolls have to be removed from the mill periodically, because of wear. They are then trued up to the desired form, which operation is known as roll dressing.

The two common methods of dressing rolls are by means of the heavy roll lathe and the modern grinder. Grinding as a method of dressing rolls is a very old practice, but up to the time of the modern roll grinder this practice was merely what would be termed a "polishing operation," primarily because the machines employed were so light in construction as not to be capable of rapid production. The grinder as a means for removing a large amount of material was never employed until recently.

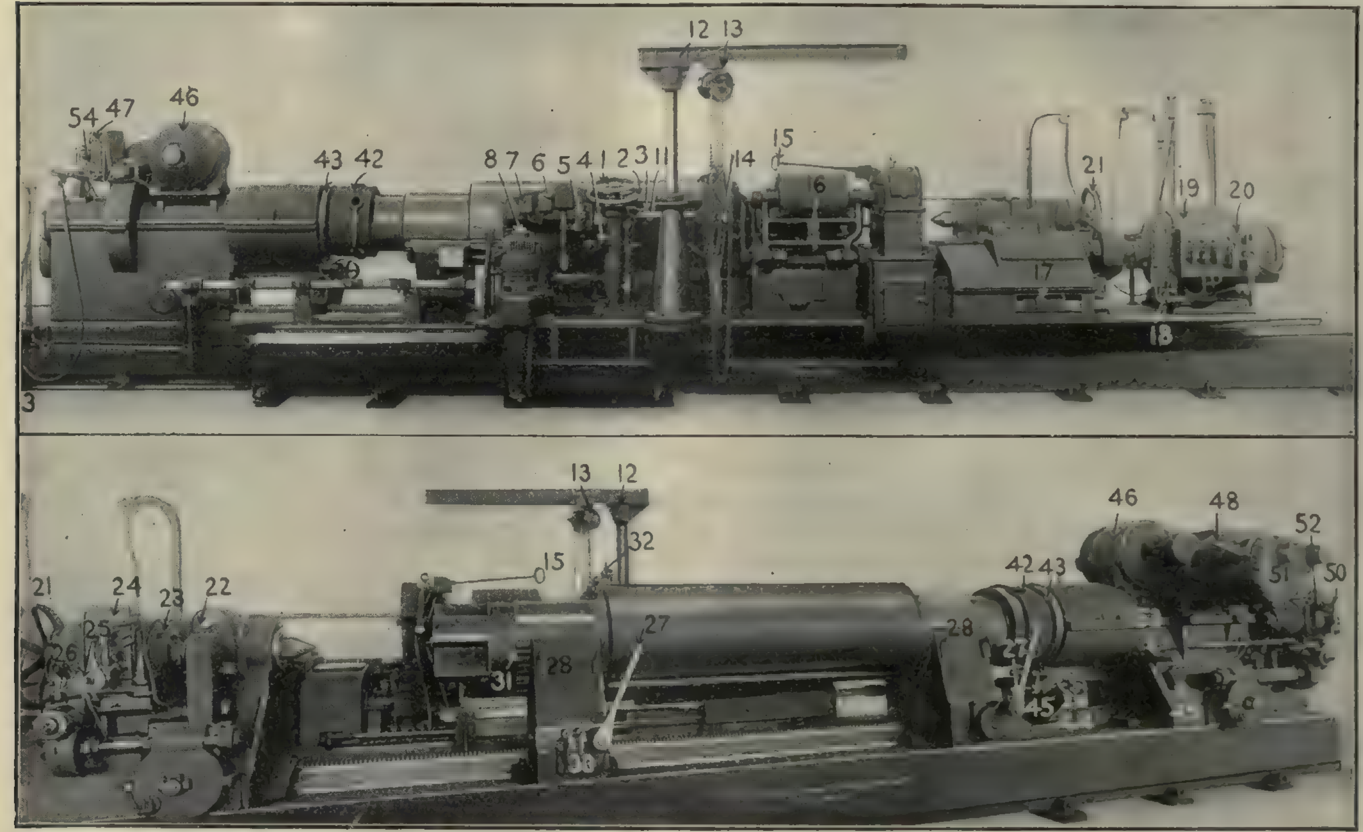


FIG. 3. VIEWS OF SPECIAL ROLL GRINDER WITH TRAVERSING WHEEL; ROLL IN POSITION

1, wheel slide control handwheel. 2, wheel table control handwheel. 3. lever to throw from hand to power feed. 4, power wheel traverse. 5, reverse lever. 6, electric switch controlling footstock. 7, electric switch controlling headstock motor. 8, pump motor. 11, crane handle for feeding wheel in and out. 12 and 13, crane and fall for lifting wheel or wheel spindle in or out of the machine. 14, special hook to engage wheel when lifting out. 15, lever for stopping movement of table. 16, belt tightener on wheel spindle frame. 17, speed shift lever for table travel. 18, switch for starting wheel-drive motor. 19, motor driving wheel and wheel table. 20, rheostat for starting. 21, footstock hand wheel. 22, footstock binder bolt. 23, footstock motor. 24, footstock motor control. 25, switch handle for footstock traverse. 26, reversing lever for footstock traverse. 27, neck bearing ratchet for moving journal rests. 28, neck bearing supports or journal rests. 30, screws for moving upper part of journal rest. 31, bolts for moving shoes in journal rests. 32, water pipe control. 42, union for driving roll. 43, support for supporting universal joint. 44, handwheel for support rest on universal joint. 45, rolls on support rest. 46, headstock motor for work drive. 47, work-drive motor-starting mechanism. 48, speed change lever control. 49, headstock-motor starting switch. 50, headstock-motor control. 51, headstock motor. 54, work-drive motor switch. 52, headstock-motor control.

Rolls wear hollow in the center (Fig. 1), and in dressing, the most material is removed from the edges and the least from the center, the diameter at the end being from $\frac{3}{32}$ to $\frac{3}{16}$ larger than at the center. The roll is generally considered finished when the center has been cleaned up.

In dressing rolls, every thousandth of an inch that can be saved on the diameter increases the life of the roll. Take, for example, a roll 39 in. in diameter and 140 in. on the face. This roll is worth approximately $1800. The chill is about 1 in. deep. The life of the roll is the time of service before this chill has been exhausted, so that every thousandth of an inch retained on the diameter means considerable money saved. It has been estimated that a roll dressed by grinding has 50 per cent. longer life than one dressed by turning, and a comparison of experiments in turning and in grinding shows that it takes approximately $\frac{1}{64}$ in. more off the diameter to true up the same roll in the lathe than in the grinder. and sometimes as much as $\frac{1}{8}$ in. more.

By the grinding process, the necks and the roll face are concentric with each other within very small limits, which results in quite a material saving in babbitt because of the truth of the journal or neck, and less wear in the bearings. The exact amount of this saving is not known, but is reported to be quite a factor in large plate mills.

It is possible with large grinders to produce rolls that will be accurate within 0.00075 in. for parallelism and roundness, which, when considered in comparison with the usual accuracy found in such work, is very nearly perfect.

The degree of finish required for hot- or cold-rolled plate varies materially. In hot-rolled plate the finish on the roll need not be as fine nor as smooth as on rolls for producing cold-rolled plate. In the latter case the face of the roll must be absolutely true, smooth and free from scratches, as every imperfection in the face of the roll is reproduced in the surface of the metal being rolled. In hot-rolled plate varying finishes are required in the different materials, depending on the conditions, the type of roll, material being used and the personal bias of the roll-mill operator or superintendent. Some desire a rough mat finish because they feel that it drags the plate through the mill more easily; some desire a smooth finish, while more are not so particular. In all cases, however, roundness is insisted upon regardless of the finish on the face of the roll.

There are two methods commonly employed in grinding rolls. In one the roll is supported on centers, one in the head and one in the footstock of the machine. The other method is to grind them revolving on their own neck bearings, in specially designed supporting blocks, commonly known as pillow blocks or roll neck bearings. The first-mentioned method is usually employed on light rolls that can be supported on centers with but little difficulty. For example, rolls up to 20 in. in diameter and 60 in. long on the face are commonly handled by grinding on the centers and there have been cases where rolls as large as 30 in. in diameter and 120 in. long in the face have been successfully ground by this method. But the better way for the larger type of rolls is to support them on neck bearings, in the same manner that they are supported when in use in the rolling mills.

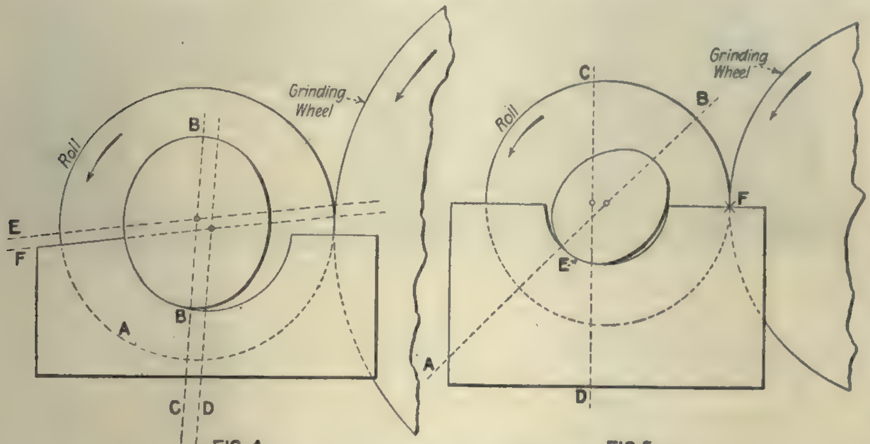


FIG.4 FIG.5

FIGS. 4 AND 5. DIAGRAM SHOWING ERRORS DUE TO BEARINGS OUT OF ROUND WHEN USING JOURNAL RESTS

It does not always follow, because a roll is round and concentric with its axis and ground while rotating upon its own journals, that it is practically a perfect roll. The degree of perfection depends largely upon the accuracy of the center holes on which the journals or necks are turned; that is, whether these journals or necks are round and in line with each other. A frequent cause of error is found in the imperfections of the lathe spindles on which the necks were turned, or the eccentricity of the center point in the rotating spindle. Careful tests with a good indicator reading to thousandths would probably show nearly every roll lathe to have a spindle bearing not round and a center point not true; also, an examination of the center holes in the rolls will show that very few are true.

It is customary for all mechanics who grind really accurate work in toolmaking, machine building, etc., to grind on two dead centers, which is the only method of obtaining perfect work. With a view to ascertaining the truth, certain tests have been conducted in connection with both methods of grinding—that is, grinding with the roll supported on two dead centers and grinding with the roll turning on its own journals—which resulted in the following conclusions:

1. If the necks or journals are perfectly round over their entire length and if the two necks are in perfect line with each other, the grinding of the roll when rotating on the necks will give perfection; not otherwise.

2. Not a single roll examined had necks that were round or in line.

3. Not a single roll examined had round center holes on which to produce round journals or necks.

4. When the center holes were scraped to remove the imperfections, the necks could be made round only by grinding them while rotating on these perfected holes and on two dead centers, which were also ground perfectly round.

5. When the center holes were near enough round to grind the necks perfect when rotating on perfect center points, the body of the hole could be ground perfectly round and concentric with the necks while rotating on the same centers.

6. A grinder rigid enough to grind perfect necks on centers is also rigid enough to grind perfect bodies on centers.

The illustrations, Figs. 4 and 5, show some of the things that occur when grinding a roll which rotates on journals that are not round. Referring to Fig. 4, the journal is shown oblong in shape in order to illustrate what may happen. The bearing *A* may be a perfect half-circle of a diameter equal to the largest diameter of the journal *B*. As the roll turns in the direction of the arrow and the grinding wheel is pressing against the roll body, the axis will assume the position shown; that is, one side of the center of the bearing, or at *C*. When the roll is rotated one-fourth of a turn, its axis will have moved toward the grinding wheel at *D*. It will also have dropped from *E* to *F*.

The raising and lowering of the axis of rotation cause a variation of distance from the cutting face of the wheel to the bearing point of the journal.

Referring to Fig. 5, when the line across the greatest diameter *AB* is in the position shown, the axis is moving to the left toward *CD*, the position it will assume when the roll has made a part of a rotation. During this movement of the axis to the left, the journal is rolling on the part of the box marked *E* and for an instant is not really turning on its axis. This causes a high place where the wheel cuts during that movement.

When this roll is put to work in its housings, if the boxes of the housings are of the same size as the box used to grind in, this same motion will occur; but when the axis moves to the left and the journal rolls on the part *E*, the work being rolled will not be at *F* where the grinding wheel has cut the roll, but rather at *C*. Now, when the high place on the roll at *F* (caused by this movement of the axis to the left while grinding) shall have reached *C*, or the point where the work is done, the distance from the working face of the roll and the supporting surface of the journal will be greater than at *C;* therefore, there will be greater pressure on the work, causing a "thin" place. To grind successfully on centers, the center must be big and strong and made of good material. The center holes in the ends of the rolls must be perfectly round, true and large enough to engage a sufficient surface on the center to insure the roll being supported without springing the center and to present a large surface for wear. Center holes should have a drilled clearance hole for the point of the center. The most successful practice is to use center holes of a 60-deg. angle in the work with the mouth of the angle large enough for a center of the necessary strength to support the heaviest work. It is not uncommon for the rollmaker to use a special center of 90-deg. angle or some other angle more obtuse than 60 deg. as a preventive against breakage of the center point. Care should be taken that the center holes are round, and they should be guarded against damage in the mills. This is extremely important. In truing up the roll necks (which is always done in order to keep them round and concentric with the roll face), the two methods are also employed. The most common method, however, is to support the roll on centers, although specially designed neck bearings have been made, making it possible to grind the necks while they are revolving on their own bearings. This operation of grinding necks requires that the corner of the wheel be trued to a radius in order to produce the fillet which takes the thrust of the roll, when the rolls are in operation in the rolling mill. Such fillets range from ⅜ to 3½ inches.

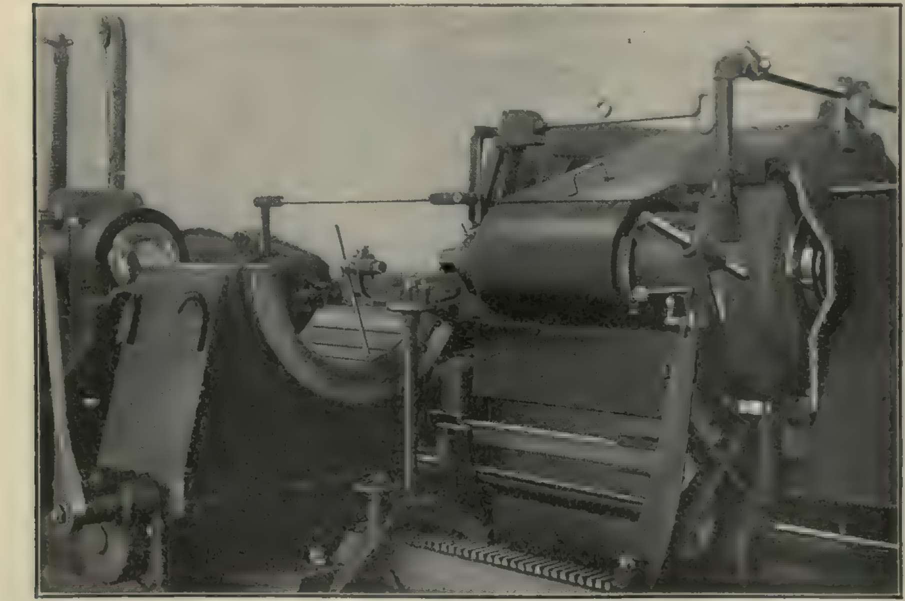


FIG. 6. METHOD OF POSITIONING JOURNAL RESTS AND RADIAL DEVICE USED FOR TRUING THE FILLET RADIUS ON THE CORNER OF WHEEL

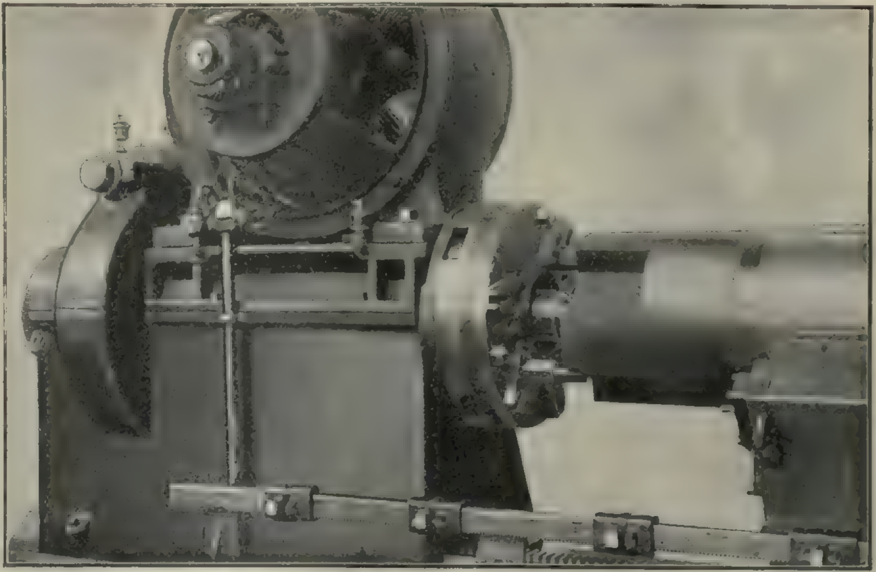


FIG. 7. SIMPLIFIED TYPE OF HEADSTOCK SOMETIMES USED ON THE ROLL GRINDER

This headstock differs from other types in that it is fixed rigidly on the machine base by bolts and is not moved by power along the ways to any position on the base. The illustration shows a variable-speed motor for getting speed changes of work revolution, and compensating work-drive plate that acts as a universal joint

The ordinary type of cylindrical grinder is commonly employed for producing rolls of small diameter and light weight. The method is no different from that ordinarily used in grinding cylindrical work. In Fig. 2 is shown a front view of the Norton type of cylindrical grinder arranged for roll grinding. A notable difference between this machine for grinding comparatively small rolls and the special machine, shown in Fig. 3, for handling the larger rolls, is this: In the regular machine the work is supported on a moving table and travels in front of a fixed wheel, whereas in the larger type of machine the work is fixed on the work base and the wheel is traveled back and forth over the surface being ground. The latter method is more convenient in handling large rolls of several tons' weight. When the work table becomes so heavy that it is not an economical proposition to move it, the work should be fixed and the lighter member, which is the wheel, reciprocated. It will be noticed also that, in a machine for large-roll grinding, the operator is positioned on a carriage opposite the wheel so that he can with ease control the operation of the machine and at the same time see the point where the wheel comes in contact with the work. Where the work is small, this, of course, is not a matter for consideration, as the operator can look over the moving table and down to the point of contact of wheel and work. The large-roll grinder, illustrated in Fig. 7, is designed exclusively for the finishing of rolls for rolling mills. This machine employs the method of moving the wheel back and forth over the face of the roll being dressed. The wheel is supported on a carriage upon which the operator stands, where he is in full view of the wheel and can readily see the point where it comes in contact with the work. Although this wheel is moved instead of the work, it is just as much fixed in relation to the work being ground as though it were mounted upon a stationary base. The essential elements of this machine for the dressing of large rolls are a work-carrying base with supporting heads, in the form of centers or journal rests or pillow blocks; means for revolving the work; a base for supporting the wheel (which must be adjustable in and out from the work); and the necessary control mechanisms, adjustments and conveniences consistent with the design.

Rolls are usually revolved at a surface speed ranging from 100 to 200 ft. per min., and the wheel is revolved usually from 4500 to 6000 surface feet per minute. The table travel or wheel travel is regulated so that the distance of travel for every revolution of the work is just slightly less than the width of the wheel in order to obtain the maximum production.

The Norton wheels that have proved successful on chilled-iron rolls are 24 combination J Crystolon, 20-24 grade K Crystolon, 16-20-24 L Crystolon. For steel rolls, 80-J Alundum is very successful. The latter wheel is especially good for a fine finish free from scratches, but is not as good a producer as the 24 combination K Alundum. The 24 combination L and M Alundum wheels have also been successful in production on steel rolls when a fine finish is not important.

It is common practice in rough grinding rolls to remove as much as 4 cu.in. of material a minute. The wheel wear, of course, depends upon many things, such as the proper use of the wheel, material being ground, etc. The following are typical examples of relative wheel wear to metal removed, the finishing operation being included:

1. In removing 1802 cu.in. of stock on chilled-iron rolls in 15½ hours, 167 cu.in. of wheel were worn from the diameter of a 20-24 J Crystolon wheel.
2. In removing 685 cu.in. of stock on chilled-iron rolls in 8½ hours, 113 cu.in. of wheel were worn from the diameter of a 16-20-24 K Crystolon wheel.

FORMED ROLLS

The forming of rolls is accomplished either by special attachments on the machine or by certain changes in the machine construction. It is possible to make a concave or a convex face on the roll. It is possible to taper the roll from one end or from both ends, or to grind the roll perfectly straight.

Some work, especially rolling ribbon stock, requires that the face of the roll be crowned slightly. There are two methods of producing a crown on the small rolls: First, by forming the desired shape in the face of the wheel, then feeding the wheel straight in against the roll face; second, by means of an attachment on the machine for controlling the movement of the wheel slide, so as to produce the desired shape as the wheel travels back and forth across the roll face. Tapers, or irregular forms of this nature, are not very great as compared with the diameter of the roll. For instance, on small rolls for rolling ribbon stock the crown may be from 0.001 to 0.015 in. high. On large-diameter rolls, 36 in. in diameter and 90 in. long, the taper may amount to $\frac{1}{16}$ in. in length of the roll face.

Machine-Tool Failures

BY DONALD A. BAKER

In the past few months I have taken notice of a small lathe that was recently put on the market, sometimes only one in a shop and sometimes in batteries of half a dozen or more. In almost every case I have been struck by their state of neglect and general appearance of misuse. As a matter of fact, I find that they have been universally condemned both by workmen and by foremen.

Leaving aside the question of quality or adaptability of the tool itself, there is at least one point that I would like to see discussed, as I have often been criticized in this matter—that is, the belt lengths in proportion to widths. Take these lathes as an instance. They are driven with very narrow belts, say 1 to 1¼ in. wide. The pulleys of the countershafts are themselves very narrow, hardly wider than the belt, in fact. The distance from the lineshaft to the countershaft and from the countershaft to the lathe is in some cases as great as 16 ft. In all cases that I have seen, the countershaft is mounted on the ceiling, regardless of how high that happens to be.

The result is this: Attempts to take cuts of any size at all on these lathes invariably result in the running of the belts off the pulleys, usually those overhead. Consequently, it is necessary to use a belt stick continually—a pastime that the average toolmaker does not indulge in with any particular relish. After a few mishaps of this kind the job is usually yanked out of the chuck, the chuck wrench thrown on the floor and everybody from the millwright to the maker blamed.

If that is not trouble enough, the next man comes along with a pin to polish. In an attempt to get all the speed out of the lathe that he can (he has already hunted the belt stick and replaced the overhead belt the other fellow left off), he tries to shift the belt to the high-speed cone by the usual process of "cuffing" it. Anyway, he has to chase the belt stick for the second time or else put up with what speed he has. No thanks to the machine.

What is the answer? You can go into shop after shop that has purchased bench lathes that came supplied with wall countershafts; and you can find these same countershafts mounted, not on the wall, but on the ceiling, even though it was some trouble to arrange elaborate pulleys over which to lead the wires or chains down to the foot treadles. The excuse you always get, if you happen to be so bold as to criticize the arrangement, is that they get more power by having the longer belt. But do they? Nix. Take a walk through a modern toolroom or a watch factory where these tools are at home. Do you find narrow belts running over pulleys 16 ft. between centers? Well, hardly. Six feet, and less, is plenty. And you never hear any complaint of lack of power, though you can see the lathes being run constantly.

My own rule for setting up a bench-lathe countershaft (wall) is that I must be able to reach to the cone on the countershaft and be able readily to slip the belt on or off by hand while standing on the floor. In other words, that amounts to between 36 and 40 in. higher than the work bench on which the lathe is set up. This is particularly the case where a grinding countershaft is also used, making it an easy matter to slip the grinder belt on and off. When running at high speed, this belt, being short, does not come whistling and snapping through the air like forked lightning. Neither does it have a tendency to run off the pulleys as frequently as a longer belt.

With the shorter belts we get sufficient power. They are easily within reach, so are quickly replaced without resorting to step-ladders or belt shifters; and they are considerably cheaper. The machines are always running when there is work for them, and the operators stick with them and seldom cuss, except about the loose pulleys. But that is another story.

The answer is, get those countershafts down off the ceilings. Get them where a tall man can squirt oil into the loose pulleys without having to stand on a piece of paper or climb on the bench. Then, having a lathe that you can keep running continuously, you will have the opportunity of demonstrating whether the lathes are any good or not.

A Question of Obligation

By Robin Duff

To what extent should a man offer freely, to his employer, patentable ideas? This question was brought forcibly to my mind today by a friend who has just been discharged from his position because he had patented a special machine. It seems that he had been employed as a machine designer, had been very successful in increasing the factory's output through automatic machines he had designed to replace the hand machines, had designed special machines to do operations that had been done previously by hand and had justified a presumption that he was worth the increased salary for which he had asked.

Then came the big conception of his life. He made the drawings at home, evenings, and had the thing patented. It was a machine that had a great deal to do with the product his firm was manufacturing and, because he would not sign over his rights to his employers, as a condition of employment, they discharged him. He is now making plans to place this machine on the market in his own name and undoubtedly, in time, will be prosperous; but in the meantime he must live. His resentment against the treatment he received from his old firm sounds genuine, so genuine, in fact, that I find myself debating which of the two parties concerned is in the right, or if they are both right.

According to his lowest estimate, the patent rights are worth $50,000. He holds that there was no legal obligation, no patent contract, whereby he should dispose of his ideas to his employers, and that the moral duty toward the future of his children, his wife and himself overbalances any moral duty that he owed to the shareholders of the manufacturing firm. This argument was backed up by the fact that the machines he had heretofore designed for the company were showing a net profit of $15,000 a year over the older types of machines.

He told me this story in the presence of a man who had also worked as a designer, but who is now relegated to another job in the same factory, where his varied duties are so confining that he cannot follow up his natural inclination, which is the designing of special machines.

This second man's achievements culminated in a machine worthy of any man's boast. Each day, as he looks at a large battery of these machines, each one producing triple the amount of work of the older type, he feels that he has not been duly compensated for his contribution toward the firm's prosperity. Of course, time alone will show whether or not his belief is true, but in the meantime he contends that advanced radical improvement should be met with radical promotion or a radical salary increase.

The life incidents of these two men are in such direct contrast to my own story that I believe I will tell mine by way of comparison.

Being a machinist first, last and all the time, I have contributed freely to whatever company I have worked for, any idea that has presented itself that would increase output, facilitate handling or make the operation less dangerous. This I have done as a part of the day's work. Whatever success I have attained I know to be due in part to these voluntary suggestions. These ideas have been the rounds in the ladder on which I have climbed. Yet the motive in being charitable with my ideas was not altogether selfish. My pride in my work would have dictated that I give cheerfully the best that was in me. Still, these were small ideas. The big temptation has never been mine. I wonder how far the pride in my work might determine my course of action. Is it a matter of dollars? Does the fact that I am a machinist and not a designer alter any moral obligation I may have?

Through my ideas I have risen to an equal height with these designers. Is it fair to the designer that I should have far greater possibilities in the same factory?

Are Ambitious Men Really Wanted?

By Entropy

According to his story on page 602, Vol. 46, E. P. Baker found that employers are not looking for ambition without anything to back it up. Probably every manager, even in pretty small shops, sees candidates for his own job every day, many of them men with plenty of ambition, but bringing no evidence that they would have the energy or the common sense to make a success of a big job if it were handed to them.

As a matter of fact which Mr. Baker and a number of other people may like to know, most men that have attained any appreciable degree of success have made their own jobs. They start out with a little job and then they annex some of the surrounding territory. They may do this while the other fellow is asleep, and find that the other fellow thinks himself lucky to be rid of a distasteful job. They may take over some other work and find that the chaps that are sitting on those particular jobs are just as much alive and as keen as they are, in which case they can fight it out, or withdraw and hunt up other sleepy men to pilfer from.

It is hard to imagine a live shop where a man with ambition, plus a willingness to go ahead one step at a time and to work his passage, is not welcome. The man who is ambitious to vault into the manager's chair at a single jump is trying to sell something alongside of which blue-sky mining stock is a stable and valid investment.

Inspectors and Inspection

By A. L. HAAS

SYNOPSIS—*In the internal economy of a shop of any size the inspector holds a position at once onerous and peculiar. If he happens to be the individual selected for the beginning of a new order of events, or the alteration of an existing system, he finds his job an uphill task. Hostility at any change is usual, and throwing a brick at a newcomer because he is a stranger is all too common.*

THE inspector occupies the position of a buffer, subject to pressure from above and resentment from beneath; and to be successful and conciliate all hands demands special qualities. It is not enough to be merely competent; the job demands character and personality, which must be shown by both firmness and tact.

The great thing in the introduction of an inspection method is that the relative position and responsibility of both foreman and inspector be clearly defined. To turn a newcomer into an established concern as inspector, without a clear definition of his duties relative to the existing staff, is to invite hostility; and it always fails to secure coöperation. It is the duty of the management to so reconcile the executive and inspection departments that undue difficulties will not arise. Neither can be subordinate to the other, for obvious reasons; they occupy independent but not necessarily hostile orbits, one being the complement and not the opposite of the other.

GET THINGS STRAIGHT AT THE START

Unless the matter is made perfectly clear at the outset, the inevitable troubles due to inspection are vastly increased by the needless troubles of a more personal order. It is, of course, the duty of all to sink personal prejudice and concentrate on the work in hand. The fewer the disputes that have to be arbitrated by the final referee, the more comfortable the atmosphere. Much depends upon the individual inspector; it is quite easy to "rub in" honest mistakes in a manner calculated to cause future friction. A hypercritical attitude, combined with disparaging inference as to capability, will certainly cause trouble. It is the spirit of fair play needed in all personal relations which counts most, combined with clear proof of ability; the two make a combination which will give respect.

Under the best possible conditions the position of works inspector is unenviable. He must decide, and his decision must stand. But there must always be reason, justice and common sense to back his rejection when made. The reason must be obvious to those concerned; unless this is the case, respect for his position will be wanting.

Whether the job is fit for service is of more consequence than finding errors. For this reason, experience of a practical type is of more value than the determination of fine limits and the possibility of further refinement. One drawback, which is a serious matter relative to the system of independent inspection inside a shop, is that too often the spirit of getting it past the inspector is engendered. If he is of the wrong type, if he has succeeded in rousing such an attitude, he may find all hands conspiring to defeat shop inspection. Foremen and men combine against him, making his troubles more acute than necessary. Undue stringency is as much a proof of incompetency as undue leniency.

It is seriously questioned by many able men whether the usual system of work inspection is not likely to defeat its own ends. When the foreman or other executive is in full control he is apt to keep his faculties more alert than where the responsibility for fit and finish is in other hands. With the foreman confined to questions of output and generalship, and the inspector responsible for workmanship, there is apt to be conflict in the two spheres of effort.

RIGID INSPECTION FOR INFERIOR LABOR

The executive is held to account for production and does not take the same pride or interest as when solely responsible for the entire results. Moreover, the question is one relative to size of shop and the goods made. With inferior labor the need for rigid and adequate inspection is correspondingly increased. With superior labor of a highly skilled order its need is less evident.

In some manufactures with low-priced piecework, where repetition in large quantities and speeding up is the rule, these would inevitably cheapen the product out of existence but for rigid inspection at every stage. On the other hand, with every job different, calling therefore for a high degree of skill and much more dependence upon the actual workman, there is little need for extensive inspection.

In other words, no system can be applied indiscriminately without analysis of conditions. The less skilled the laborer, the greater the cost of supervision.

The duties of an inspector need not clash with the work of a foreman; their functions are quite different, and mutual dependence and not mutual hostility is to be fostered. The position of a foreman varies so much in different locations that a more exact definition is required. A competent general foreman is altogether a different article from a man in charge minus responsibility, yet both are classed under the same description.

FOREMEN WITH AND WITHOUT AUTHORITY

The powers delegated by the management differ so much that it is possible to find alleged foremen devoid of any shred of real authority. Elsewhere an entire section of management reposes in the custody of a so-called foreman who is more justly a departmental manager. It may be objected that nomenclature is unimportant if the pay be satisfactory, but this is to take a very limited view of affairs. Classification has a real and tangible value; rank rightly bestowed has a marked effect upon the individual and those under his control. The position of an inspector in a works really demands more sympathy than that given the foreman. The interests of the foreman and his men are more or less identical. The inspector, on the other hand, has only the opportunity of rejecting bad work and the chance of suggesting remedies. Amendment of practice and the putting into effect of his prescription lie in other hands. For him, the man must be approached through his foreman; and if it is impossible to get the latter to share his views, then recourse must be made to a higher authority.

Personality is the asset tending to smooth over difficulties. Character is of the greatest value to both foreman and inspector, and its realization in practice is perhaps of more value than ability.

A first-class mechanic may prove an utter failure as a foreman, though he may prove an invaluable inspector. A successful foreman may be a failure as a works manager, though he might make an expert salesman. The head of a successful engineering business might conceivably prove incompetent in any of the subordinate posts. A knowledge of human nature is quite as necessary (at times more so) than high technical qualifications. Ability to organize or originate is often found in the most unlikely quarters, and it often makes its appearance at times when it is the least expected.

The Traveling Inspector

There is another type of inspector. This is the qualified and experienced engineer who is delegated to examine and test finished productions, upon the results of whose satisfactory report the customer takes over the job and pays the bill.

Such men have a unique experience as to the methods, workmanship and reputation of the firms they visit. Their conviction as to first-class design, honest dealing and workmanship help to equate by recommendation those firms whose products are good. Not every firm whose market price is low can understand why orders pass them by, but reputation and good work bring their reward in due season. The majority of such men cannot be experts in all the work coming under their charge, but shoddy and inferior workmanship and poor showing under test find them qualified judges.

Such men occasionally meet, and the consensus of opinion with regard to the standing of firms often proves unanimous. In fact, with few exceptions, the identity of opinion is remarkable.

The Effect of Resenting the Visits of Inspectors

To show resentment at the visits of such inspectors, to be loath to carry out specified requirements, to be generally unpleasant in the ordinary relations extended to a customer, is to invite reprisals. Yet there are firms that adopt so stupid an attitude, to their own eventual detriment.

Inspection is a vexed subject, but one worthy of ventilation. The human aspect as it affects production and the wider relation of the various elements in the complicated organization necessary to modern manufacture are of considerable interest. To coördinate conflicting elements and secure the greatest good will and productive activity depends, as in more directly technical matters, upon small adjustments. It is the function of management in its administrative side to care for such matters.

Some Hardening Kinks

By George Handyside

Most of the articles on heat-treating and hardening are for the fellows with up-to-date furnaces and pyrometers and all that go with them. There is nothing for the little fellow who has only a forge in which to do his heat-treating and hardening. Here are a few kinks we have developed in a small toolroom where we have only a forge for such work. A few requisites for a forge are some pieces of channel iron, 6- and 4-in. sizes, say about 12 in. long, some good gas coke, a barrel of water and a tank of quenching oil. There should be a wire basket that can be easily lifted out. This is very handy and allows a number of pieces to be handled at once.

High-Speed Steel Taps

High-speed taps are difficult to harden because of the chance of blistering. The best method we have found is to use a piece of heavy channel iron in the fire, bank the fire around it and cover with a plate. Preheat the taps in the channel iron to a good red heat, using a moderate blast. Then with the poker make a hole in the fire under the channel iron and shut off the blast. This gives a small retort that is white hot. Hold the tap in this. It will quickly come to a yellow heat and can then be quenched in oil. To keep the tap from scaling, I use a compound of the following ingredients: 50 per cent. of corn meal, 20 of borax, 20 of common salt and 10 of crushed resin. When the tap gets a dull red heat, I put it in the compound for a minute and then put it back in the channel iron. This forms a coating that protects the threads and is easily washed off.

Carbon-Steel Tools

The same treatment can be used successfully for high-speed cutters. I also use the channel iron for hardening all carbon steel. If there are a number of small pieces, they can be all put in together, with no fear of burning them. To harden a long reamer, it is best to use a new piece of channel iron or one that is perfectly straight. Lay your reamer in the bottom and keep rolling it from side to side of the channel iron until you get the right heat. Then quench straight down in the water, moving the reamer slowly up and down until you feel that the steel has finished sizzling. Then take it out and let it cool in a warm oil bath. With a little practice you will be able to get the reamers nearly straight. Before hardening anything round that has to be ground, I drill a hole in the end about ⅜ deep. After hardening I plug up the hole and then have a soft center to help get the piece fairly true. Be sure to plug the hole with a little putty before hardening.

A hard thing to make in the average small shop is a chuck wrench of the box type. The average chuckmaker does not leave enough room to permit a good heavy wall on the wrench. The result is that when the machinist gives his chuck an extra tightening, away goes his wrench. For box wrenches I have the most success with chrome-nickel steel. To heat-treat it, bring it to a good cherry heat and quench in oil until cold; then draw to a light blue.

Automatics Used Advantageously in the Machining of Starter Parts

SPECIAL CORRESPONDENCE

SYNOPSIS—*Illustrating and describing some of the machining operations performed on Warner & Swasey, Acme, Jones & Lamson and Potter & Johnston machines. The sequence of operations and the average production for the different parts are included.*

Many of the parts comprised in an automobile starter are of such a nature that they can be successfully machined on automatics and semiautomatics, and Fig. 1 shows this operation being performed on a bearing cage. The machine illustrated is a Warner & Swasey. The casting is placed in a special fixture, which is designed to hold the part by its flange. The sequence of operations then followed is: Bore; turn diameter; rough and finish face; ream. It will be noticed that the boring bar and reamer are provided with pilots, which are guided in bushings during the machining operations. The production is 125 in 9 hours. Bearing-cage castings are shown at *A* and *B*.

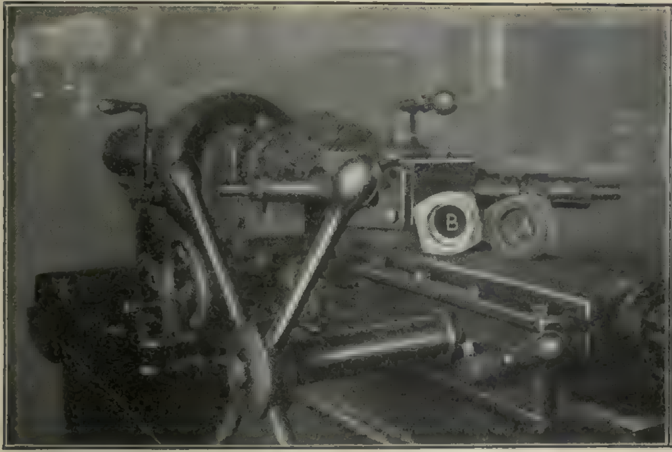


FIG. 1. MACHINING PART OF THE BEARING CAGE

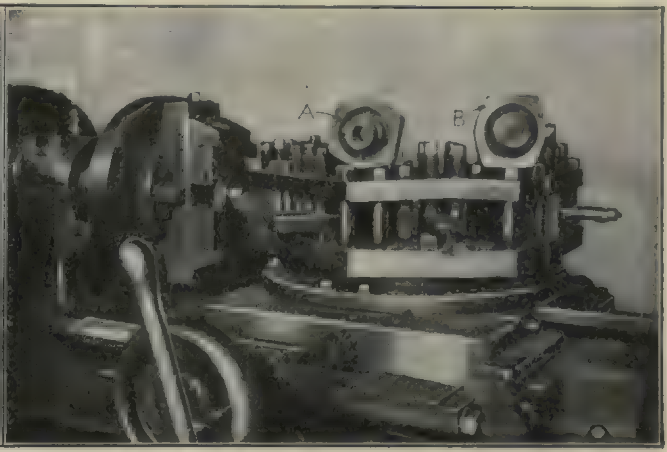


FIG. 2. MACHINING THE OPPOSITE PART OF THE CAGE

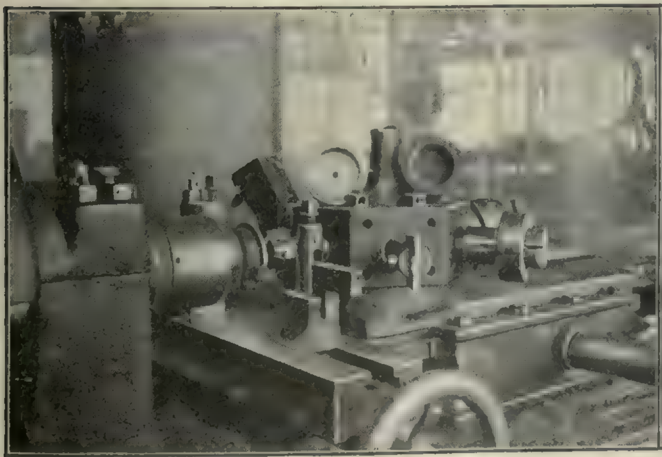


FIG. 3. FIRST OPERATION ON THE IGNITION HOUSING

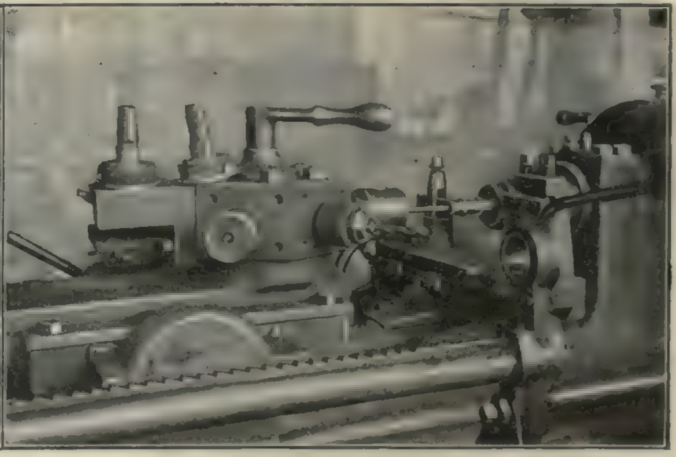


FIG. 4. SECOND OPERATION ON THE IGNITION HOUSING

The machining of the male bearing cage is performed on the Acme shown in Fig. 2. The casting is held by the flange in a special two-jawed chuck, as shown. The sequence of operations followed when machining this piece is: Turn shoulder and face flange; rough bore and turn boss; finish bore and turn boss; form recess; ream.

One of the castings before it has been machined is shown at *A*, while the one marked *B* shows a casting after it has been machined. The production from this machine with the tool set-up illustrated is 70 in 9 hours.

Machining the Ignition Housings

The first operation when machining ignition housings is performed on the Warner & Swasey, Fig. 3. The casting is held in the chuck by its shank. The following operations are then performed: Rough bore and form inside recess; finish form recess; turn shoulder and outside diameter; finish base; drill. Castings before and after machining are shown on the turret. The rate of production for this piece is 45 in 9 hours.

The second operation on the ignition housing is performed on the Warner & Swasey shown in Fig. 4. The casting is located in the chuck by means of the turned shoulder that was machined in the previous operation.

The following sequence of operations then follows: Rough and finish face shoulder; center; drill; bore; ream; face end; turn on three diameters. On this machine, with the tool set-up shown, 50 of these castings are machined in 9 hours.

In Fig. 5 is shown an Acme set up for performing the first machining operation on end caps. The casting is held in a three-jawed chuck. The sequence of operations on this part is: Rough face on three surfaces; finish face on three surfaces; turn small boss; finish large diameter; bore; form recess. The last sub-operation is performed with the tool *A*. Castings before and after machining are shown on the turret of the machine. The average rate of production on this piece is 45 in 9 hours.

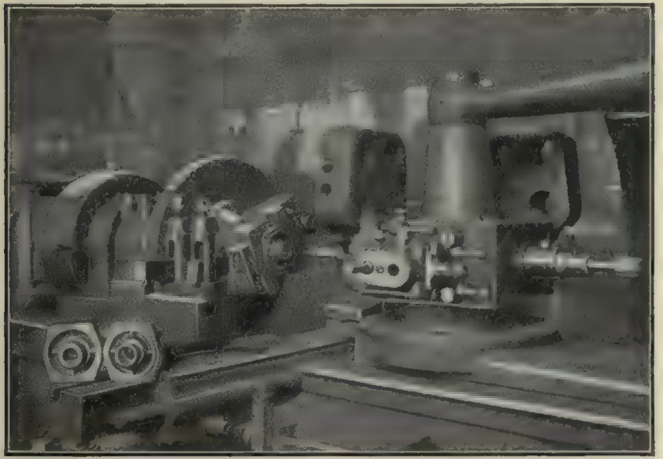


FIG. 7. ANOTHER SET-UP ON BEARING CAGES

The second operation on the end caps is done on the Jones & Lamson shown in Fig. 6. The casting is located in the fixture by means of the projection that was machined in the preceding operation. The casting is located in the correct relative position by means of the adjustable stop *A*. The two belts *B* hold the casting in the fixture securely. The following operations are then performed: Rough bore; finish bore; ream. The sliding member of the fixture is then pushed down, the two positions being determined by an index pin and two bushings, and the sub-operations repeated. An average of 50 end caps may be machined in 9 hours.

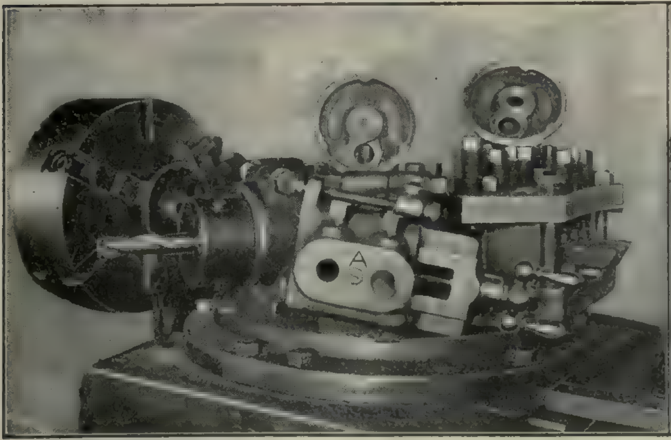


FIG. 5. FIRST OPERATION ON THE END CAPS

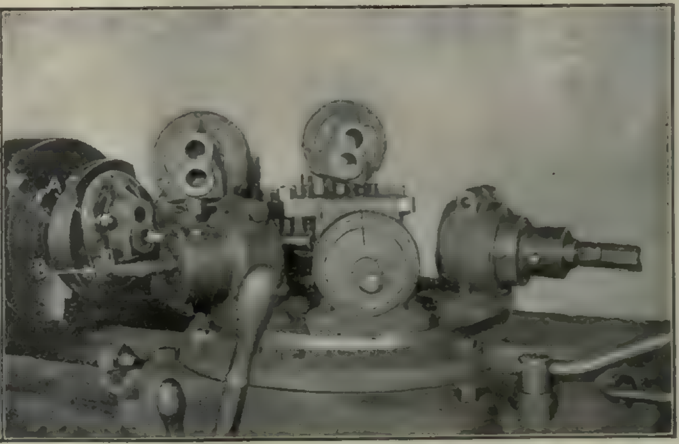


FIG. 6. SECOND OPERATION ON THE END CAPS

In Fig. 7 is shown how the bearing cages are machined on a Potter & Johnston. The casting is held in a special two-jawed chuck, which fits on the contour of the piece. The sub-operations then performed are: Rough bore, rough turn and rough face on two diameters; finish face, bore and turn; form recess and ream. The production from this machine and tool set-up is 50 castings an hour.

Fixture for Grinding Relief on Formed Milling Cutters

By Walter G. Groocock

The automobile has been responsible for many innovations in machine-shop practice. It has probably led to the use of more special tools and appliances than all other mechanisms put together. In the gear box of the automobile the splined shaft has of recent years practically superseded the square shaft, and this item alone has led to the introduction of many special tools. The methods of producing these splined shafts vary a good deal; but speaking quite generally, all such methods are but variations of three older processes—hobbing, planing and milling with formed cutters. Some shafts are also ground to a finish. Each method has its advocates, but there are drawbacks to them all.

Hobbing is limited to roughing out, because of the impossibility of producing hobs that will give the desired results. Planing is an excellent process, and so is grinding; but both are slow. For these reasons the majority of high-class spline shafts are cut with a machine-relieved milling cutter; this system, however, also has its drawback.

Those who are intimate with the production of accurate splined shafts will know that it is almost impossible to purchase cutters that will mill shafts to a tolerance of, say, from "size" to "minus 0.001 in." on both body and splines. Yet this is quite a recognized tolerance for this class of work. To get such results the cutters must obviously be more accurate than the tolerance imposed. As I have said, from a variety of reasons the cutters that one can purchase will never give these results without considerable humoring.

When machine-relieved cutters are examined, the errors usually found are: (1) Inaccuracy of form; (2) eccentricity, which is quite common; and (3) wabble or untruth sidewise. Inaccuracy of form is ordinarily due to bad workmanship—or supervision—

at the backing-off machine. Occasionally, however, such errors may be the result of hardening. Eccentricity usually arises from careless setting up when the hole is being bored. Some cuttermakers attempt to correct this kind of error by touching up the tips of the teeth on a cylindrical grinder and then grinding from the faces of the teeth enough to bring them each to a cutting edge; that is, they attempt to cure one fault by the introduction of another—unequal spacing. The great disadvantage of this method of correction is that there is nothing stable about it. If the backs of the teeth are also ground from the corrected face, then the backs may be used as a guide for subsequent regrinding.

Unfortunately, this never gives consistently satisfactory results. The third error mentioned, wabble or untruth sidewise, cannot be corrected except by some abrasive method. One such method is to find out the high teeth and rub them down with an India oilstone. At its best this is a slow and unsatisfactory process. Another error that has been frequently noticed on such cutters is that some teeth are higher than others. Such high teeth are, no doubt, due to the fact that on some relieving lathes the cam has multiple rises. If these rises are not exactly alike, the result will be unequal height of the teeth generated.

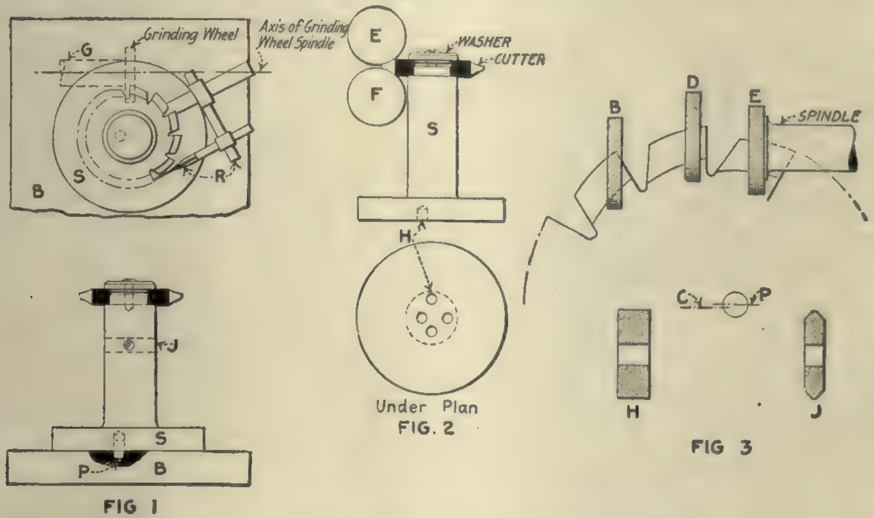


FIG 1

FIG. 2

FIG 3

FIGS. 1 TO 3. IMPROVISED RIG FOR GRINDING CUTTERS

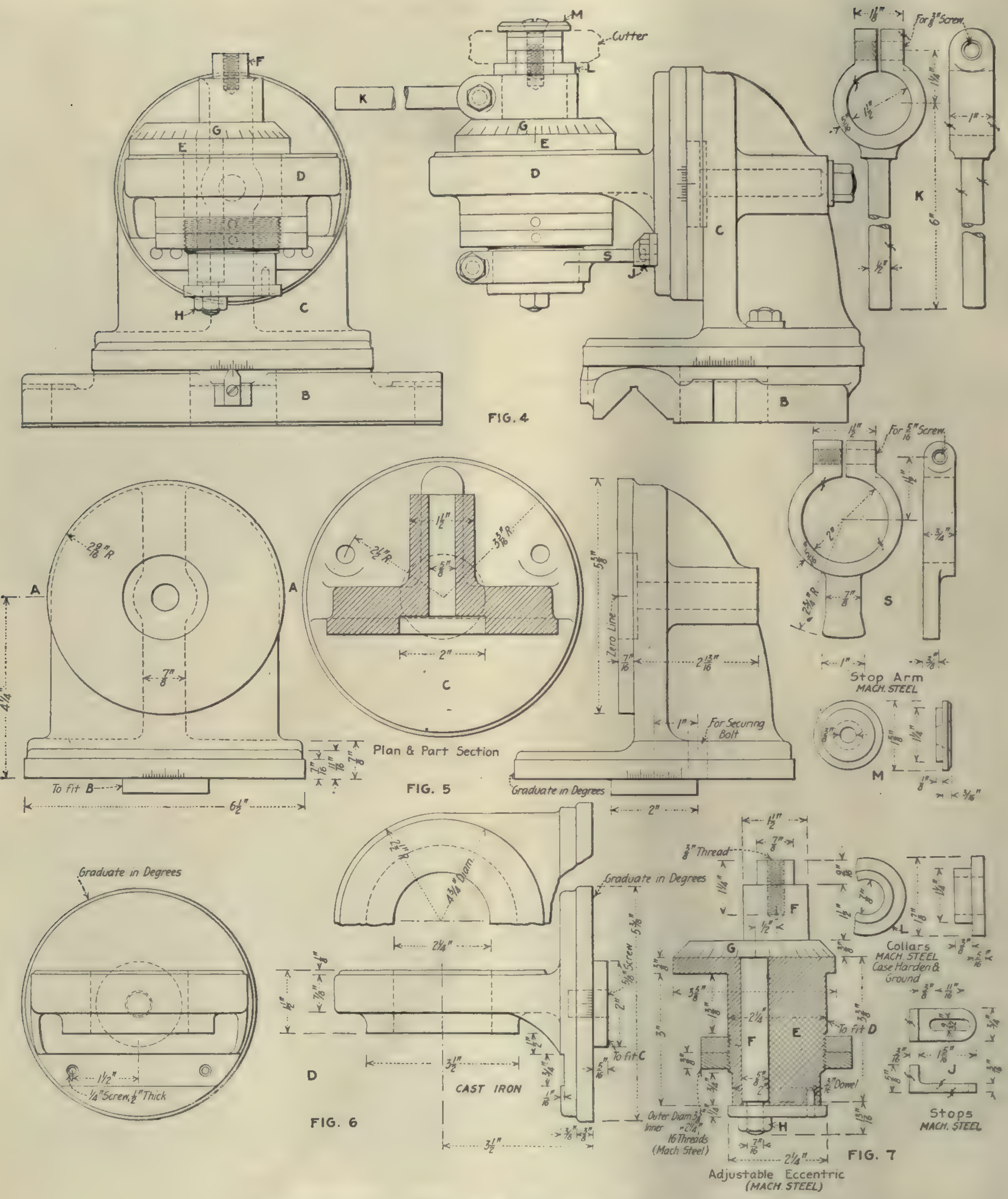
After contending for some time—more or less unsatisfactorily—with the problem of correcting machine-relieved milling cutters I decided, so far as spline cutters were concerned, to grind the form all over. This necessitated some means of following the relief. First attempts were made with the improvised rig shown in Fig. 1. Here *S* is a stem to carry the cutter to be corrected; it has a flange at one end to act as a base. In the bottom of the base (see underplan, Fig. 2) several ¼-in. holes were drilled at varying distances from the center of the stem. The baseplate *B*, Fig. 1, was of cast iron, and in the center of it a short ¼-in. diameter pin was driven. When the fixture was in use, this peg went into one of the holes in the base of *S* and formed a pivot about which the center of the stem could be oscillated. The stem was drilled at *J* to take a short round bar on which a tooth rest *R* was fitted.

The method of using this fixture may perhaps be best explained by describing how we corrected the pitch-line thickness of a batch of 5-diametral-pitch involute cutters. These had, owing to a mistake, been supplied 0.02 in. too thick on the pitch line; and as they were urgently needed, we decided to correct them by grinding.

It is a well-known fact that the curve of an involute cutter approximates very closely to a true arc for all numbers of teeth over 30. This fact was taken advantage of in correcting these cutters. A small grinding wheel was selected that approximated the curve and was mounted on the machine spindle, as indicated in Fig. 1 at *G*. The base *B* of the fixture was secured to the table of a No. 13 Brown & Sharpe tool grinder, and the standard *S* was placed on it with the peg *P* in the hole that gave the nearest approximation to the relief curve of the cutter tooth. By oscillating each tooth of the cutter in turn under the grinding wheel (see *E*, Fig. 2) and gradually lowering the grinding wheel onto the cutter, half the excess thickness was removed from one side. The grinding wheel was then lowered to position under the cutter (see *F*, Fig. 2) and the operation repeated. The cutters so corrected were for cutting the teeth in gears that had to be subsequently ground, but the accuracy of the tooth shape that we developed was remarkable. The shape was as a matter of fact much nearer to the gages than many that were supposed to be accurate when purchased. To get this accuracy of form, the size of the grinding wheel must vary, naturally, with the cutters for each different number of teeth. We found further, as might be expected, that different results could be obtained by using the same size of wheel set at varying angles. Again, we found that the width of the wheel was another factor governing the shape that could be generated.

The diagram, Fig. 3, is given to illustrate these points. Here *C* is the center of the cutter and *P* is the point about which it would be oscillated. At *B*, *D* and *E* three grinding wheels are shown, each of the same diameter and width, but each lying at a different angle with reference to the tooth on which it is imposed. Under these three conditions three different curves would be generated. Again, suppose the wheels shown at *H* and *J* were used instead of those shown in contact with the teeth. Although the diameters would be the same in both cases, each would give different results from the other and different from those obtained from wheels *B*, *D* and *E*. By tilting the cutter so that its axis makes more or less than 90 deg. with the axis of the grinding-wheel spindle more variations of the curves may be obtained.

It will be seen from this that a large number of combinations are available for obtaining a close approximation to the correct involute curve. While my experience in this direction is too limited at present to formulate definite combinations to suit cutters of different pitch and various numbers of teeth, I am convinced that this could be done for the coarser pitches after a sufficient number of experiments.



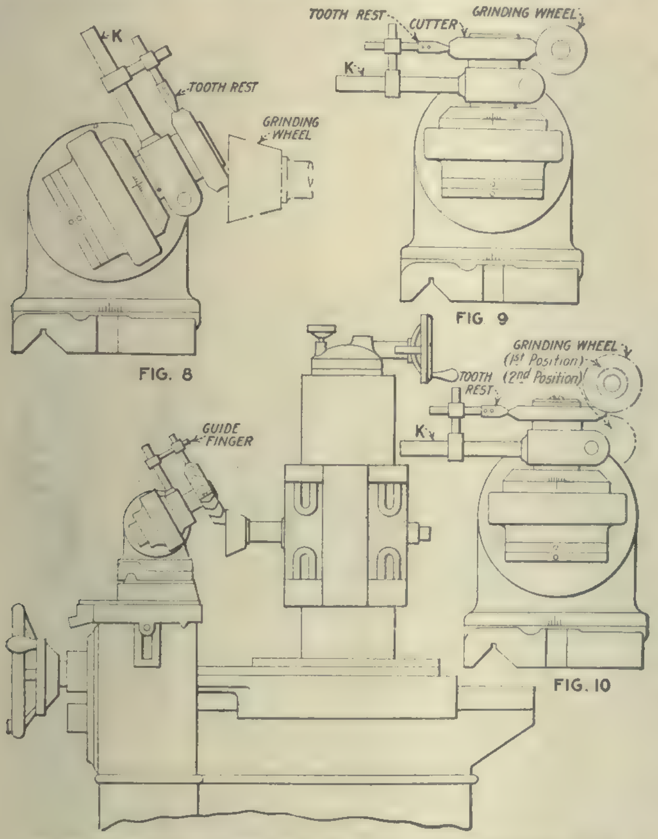
FIGS. 4 TO 7. ASSEMBLED FIXTURE AND DETAILS

The improvised fixture just discussed was used for some time to grind the whole form of milling cutters for spline shafts. For this work a round wheel was used for the throat, while the angular sides were ground with a small cup wheel. To grind the sides, however, necessitated the fixture being used on an angle plate swiveled to the necessary angle. Although the work done on this improvised fixture was perfectly satisfactory, the process was slow, first because of the time taken to set the arrangement up, and secondly because it was awkward to handle when rigged up.

The foregoing consideration led the writer to design the fixture shown in Fig. 4, the base *B* of which is the base of the universal grinding head supplied by Brown & Sharpe with their No. 13 universal tool-grinding machine. While Fig. 4 shows the assembled fixture, Figs. 5, 6 and 7 show the details, which bear the same reference letter in each figure.

The cast-iron standard *C* is turned to fit into the base *B*, on which it swivels, and is graduated in degrees so that it can be set at any desired angle with reference to the base. At right angles to its base this standard is bored and faced to take the bracket *D*. This bracket, also of cast iron, is turned with a spigot to fit into the vertical face of *C* and is graduated around the periphery in degrees so that it can be set at any angle with reference to the standard *C*.

The overhanging part of the bracket *D* is bored and faced to take the adjustable eccentric device that carries the work arbor. As designed, this adjustable eccentric will give a maximum eccentricity of 1 in. Referring to Fig. 7, it will be seen that the eccentric is composed of the outer portion *E*, which is bored ½ in. out of center, to take the inner part *F*. The arbor, or work-carrying part, of *F* is turned ½ in. eccentric to the stem. Obviously, these two eccentrics may be set either to neutralize each other or to give the sum of their two eccentricities; that is, we can set them to give any eccentricity between zero and 1 in. The throw of the eccentric is calibrated and graduated on the beveled edge of *F* at *G*. The two parts of the eccentric are locked together in any desired position by means of a nut *H*, and the combined eccentric is secured to the bracket *D*, Figs. 4 to 7, by means of two locknuts so adjusted that the eccentric arbor can be freely rotated within the desired limits.



FIGS. 8 TO 10. FIXTURE SET UP ON GRINDER AND METHOD OF SETTING IT

To limit the travel of the eccentric so that the grinding wheel does not foul the face of the tooth next to the one being ground, the stop arm *S* is provided. This is clamped to the outer part of the eccentric. The sleeve and the movement are then limited by the position of one or both of the small angle stops *J*.

The stem *K* is provided for carrying an ordinary tooth rest, and this is shown in position in Fig. 4. This stem, like the stop arm *S*, can be locked in position by tightening a screw when the setting of the cutter is completed.

The method of operating this specially designed fixture is practically the same as that used with the improvised rig already described. The spline cutters to be ground are first of all ground over the tooth faces, to insure that the teeth are equally spaced. Since the dividing is done from here, this is important. Then a cutter is mounted on the arbor with the special collars *L* and *M*, which are so adjusted that the cutter can be just rotated without any slackness sidewise.

The fixture is then swung over to the necessary angle, as shown by the diagram, Fig. 8. The next move is to set the eccentric to give the desired throw—that is, to follow the existing relief—and the tooth rest is set at the same time. After this the stops are set by the use of a small cup wheel. The operator, with his hand over the stem *K*, holds the cutter to be ground back against the tooth rest and oscillates the cutter tooth across the face of the wheel within the limits imposed by the stops. At the same time the wheel slide is brought forward either to a stop or to a predetermined position, as shown by the micrometer feed wheel. After one tooth is ground, the cutter is indexed one tooth, by springing a tooth under the tooth rest, and the operation is repeated.

GRINDING THE SECOND SIDE

When one side is ground, the cutter is reversed on the arbor. The tooth rest and stops are now moved to such a position that the eccentricity of the arbor is reversed also. This method enables both sides to be ground without changing the angular setting of the fixture and incidentally insures symmetry of figure. When the batch of cutters have been ground on both angular faces, the throat is ground with a small wheel of the correct radius, as indicated by the diagram, Fig. 9. It will be seen that for this operation the fixture is set so that the axis of the arbor is vertical. While this is not absolutely necessary, it is the most convenient position for both grinding and gaging the cutter. Gaging is important at this stage, as it will be obvious that in grinding the throat, if too much is taken off, then the sides must be reground to get the correct width.

For correcting involute cutters on this fixture both sides may be ground without reversing the cutter. The diagram, Fig. 10, illustrates the fixture set up for correcting an involute cutter, the two wheel positions being indicated by circles. When the fixture is used for this purpose, the tooth-rest stem *K* should be set in such a position that it does not foul the grinding wheel when the under side of the cutter is being ground.

In using this fixture there is one point that must not be lost sight of, and that is that for any given setting of the eccentric the relief obtained varies according to the position of the grinding wheel with regard to a line or plane that passes through both the center of the cutter and the center about which the cutter is oscillated. A little thought coupled with a knowledge of the action of eccentrics will reveal why varying relief may be obtained. The same analysis will also show the importance of the correct setting of the tooth rest, when a cutter is reversed on the arbor, so that the equivalent angular position of the other side, as it were, of the eccentric is used. This it is that insures equality of relief.

The fixture is a proved success and will soon pay for the cost of its installation in those plants where many spline cutters are used, more particularly so when the manufacturing tolerances are fine. Apart from spline cutters it has other possibilities, one of which has been given. Having made and examined a good many formed milling cutters, I had never had any delusions about the accuracy of such cutters. I never realized fully, however, how inaccurate such cutters were until I started to grind them.

Drafting Room Versus the Shop

By Charles Thompson

In reply to Mr. Tate's article on page 387, Vol. 46, I wish to say that my experience, which covers 18 or 20 years in the shop and drawing room, has been that the average designer—not draftsman—tries to take into consideration all manner of construction in reference to the pattern, castings, machining and assembling of his machine; he also looks at it from an artist's standpoint. He will, at times, sacrifice good design for the sake of ease of manufacture and cheapness. You will also find that the designer invariably has good reason for his so-called radical ideas. I have found that the average designer is continually asking advice of the shop foreman about the different methods of machining work, and the pattern maker for the best way to make a pattern. He does not do this because he does not know, for he has in mind how he would do it; but the shop man knows how he can best handle it, and it saves time and perhaps special tools later.

The only feature I have noticed in shops where there seems to be friction is where a man will step over his foreman and interfere. When his superior is consulted, if the man is a good mechanic, the foreman will call him into consultation; and he, for the time being, will be considered as competent to judge as the foreman himself. Such a man's ideas should be respected and his suggestions should be thrashed out. If they are found to be better, or even as good and cheaper to put into effect, they should be adopted.

A designer is not afraid to use an eraser. I have known men to throw away two or three days' hard work after some one offered a suggestion, which perhaps was not adopted, but which led to better ideas. The designer is not doing his work because he is a white-collar man, but because he is competent and can be depended upon anywhere in the plant. Take the man we call a draftsman—he is in many cases not a designer and never will be, because he is lacking in shop practice and does not care to get his hands dirty. This man makes designs that are hard to carry out and, in some instances, parts that cannot be machined with the ordinary tool equipment. I have found this class hard to get along with, as they think because they are "draftsmen" they "know more than anyone else" and should not be criticized. In this class is found the man who always complains when told of a better way of doing something. When a designer is criticized, he at once considers whether or not his adviser is competent and experienced along that line of work. I have found that the man depended upon to design machinery and tools is, as a rule, broad-minded and always has his ears wide open for suggestions.

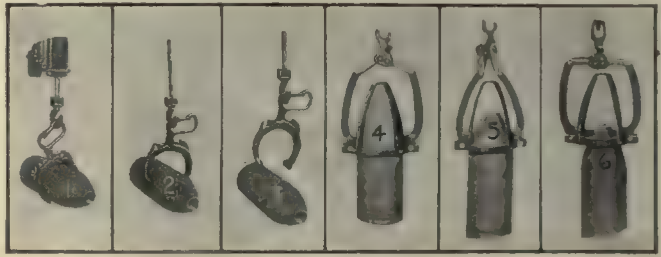
I have also found that there are few men in shops who will make suggestions they are not confident are a decided improvement over the old way. This puts it up to the designer to get the best ideas that these men have and use them to the best advantage possible, giving the credit where it belongs.

Devices for Lifting Large Shells

By G. M. Dick

Several weeks ago there appeared in the *American Machinist* an article on a shell grab that we used in handling 8-in. shells; since then we have made two others that are very useful.

The one for lifting horizontally (Figs. 1, 2 and 3) consists of three parts—two arms and a link—all steel castings. On the bottom of the link is a rocker which, when the hook lifts, by the offset of the link travels up on a lug on the one arm, at the same time locking on a lug on the other arm, thereby holding the shell securely. When the link is lifted by the end directly over the shank it releases the rocker and the arms swing free. The main points are the shape of the link and the eccentric curve on the lugs.



FIGS. 1 TO 6. VARIOUS SHELL-LIFTING DEVICES

Fig. 1—Device for lifting shell horizontally. Fig. 2—Device opened to release shell. Fig. 3—Device removed from shell. Fig. 4—Vertical lifter for shells. Fig. 5—Shell released. Fig. 6—Lifter removed from shell.

The only machining necessary is the drilling of the pinhole. The advantage of this lifter is that it does not need to be slipped over the nose of the shell.

The vertical lifter (Figs. 4, 5 and 6) is used in such operations as pressing on the band, washing, etc. It consists of four strips of sheet metal which approximately fit the form of the shell and bring the jaws to grip on the right place. These strips are connected to an $\frac{11}{16}$ x $1\frac{1}{4}$-in. steel ring in two pieces. In the opening between the two parts of the ring connected by links at the top are the jaws. They have corrugated faces which grip the shell 1 in. from the fulcrum and have a leverage of 8 to 1. When the faces of the jaws are gripping, the links at the top are in a vertical position; and when it is required to lift the device off the shell, the center link on top is allowed to drop down and touch the top of the shell, thereby locking the side links in a horizontal position and opening the jaws. This lifter works very well and grips the shell securely.

Instrument Repair Work on the Canal Zone

By FRANK A. STANLEY

SYNOPSIS — *Typewriters, time clocks, time scales, motorcycles, electric fans, are among the many mechanisms that come to this tropical instrument shop to be repaired. Fourteen employees are kept busy working on Uncle Sam's instruments used in canal work.*

THE great diversity of operations carried on in the Panama Canal shops at Balboa has been referred to in earlier articles in these columns. As already pointed out, the purpose of these shops is not only to overhaul and keep up the machinery of the canal, the dredging and towing equipment, the rolling stock of the Panama R.R. and to do general shipwork of all kinds, but also to handle repairs for private companies and individuals up and down the coasts located in the Canal Zone. This means that the work must range from the very heaviest foundry, boiler-shop, machine-shop and erecting operations down to the finest instrument work, including watch and clock repairs, the overhauling of navigation instruments, meters and electrical apparatus, and an almost endless variety of precision work in general.

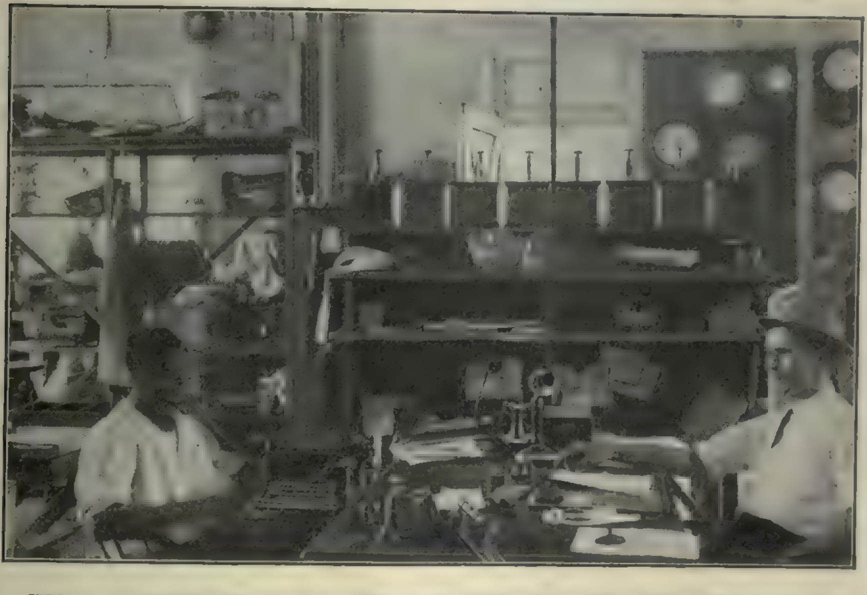


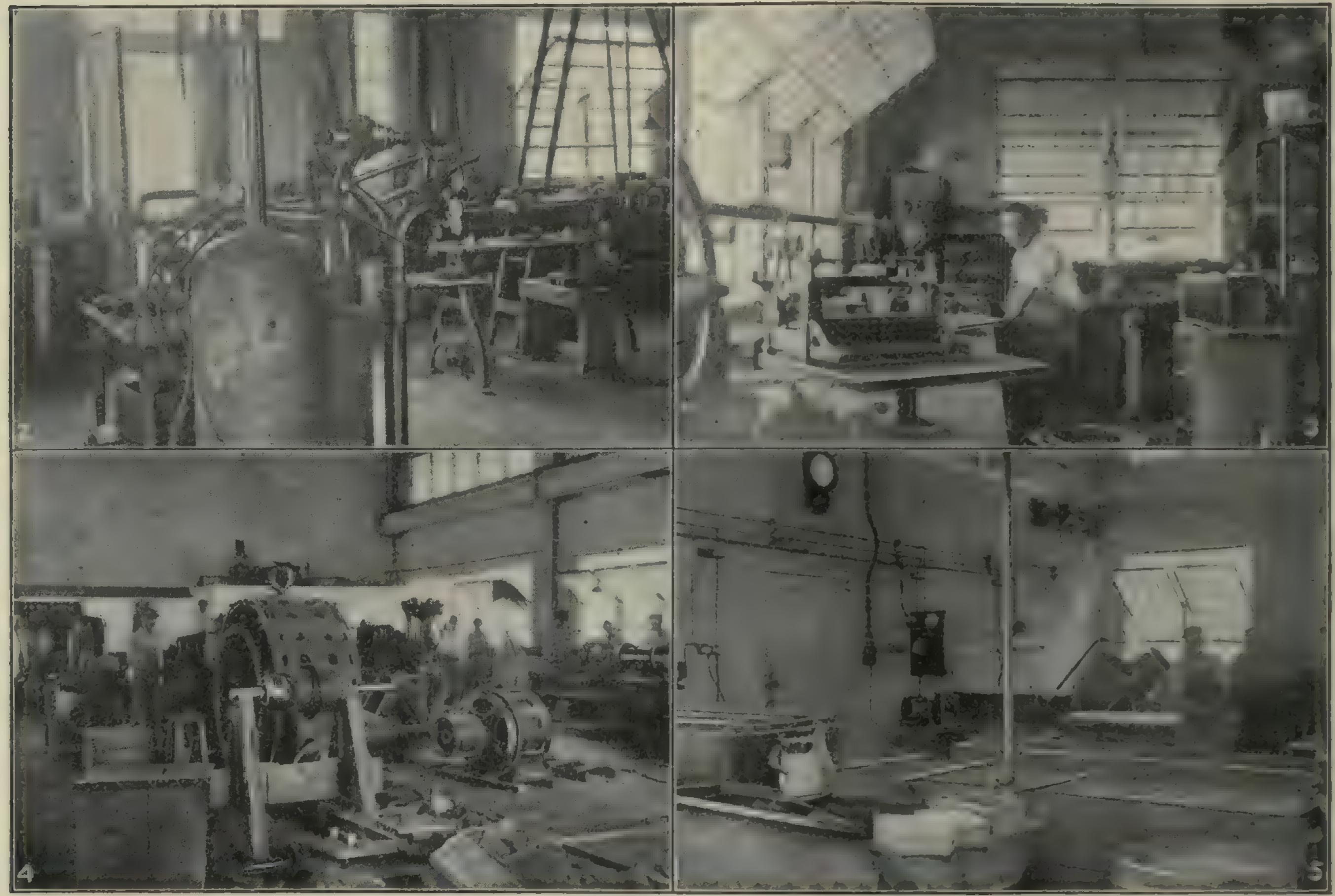
FIG. 1. TYPEWRITERS, ADDING MACHINES, TIME STAMPS AND CLOCKS ALL COME HERE TO BE REPAIRED

Perhaps no better idea of the varied character of the mechanical apparatus taken care of can be gathered than by an inspection of the operations in the instrument repair department. This department is housed in a special building, which has in the opposite end a section devoted to the upkeep of electric motors, generators, transformers and similar equipment, while between the two departments is a thoroughly equipped polishing and plating room in which parts are nickel plated, silver plated, oxidized, galvanized or otherwise finished according to requirements.

A general view in the instrument repair department is clearly presented in Fig. 1. This illustration shows some of the characteristic work always to be seen here in the line of typewriters, time clocks, house clocks, time recorders, balances, surveyors' instruments, etc. It may be remarked that precision machinery is required for this line of operations. The tools include toolmakers' lathes, bench lathes, traverse spindle grinders, sensitive drills, toolroom millers and other high-grade tools of similar character.

To facilitate inspection and repairing of typewriters and similar machines, the bench in Fig. 3 has been fitted up with a number of special tables. They are of right dimensions and height to hold the work conveniently and are mounted upon swivels so that the machine being overhauled can be swung around to any desired angle to suit the convenience of the workman. The photograph illustrates clearly one of these swiveling tables in the foreground. It also shows the provision made for adequately lighting the entire work bench through the system of swinging windows that run continuously from end to end of the shop. Fig. 4 is a general view in the electrical repair department, where a variety of motor work in various sizes will be seen under way at different points on the shop floor. This view also shows a portion of the new machine-tool equipment that enables work of this kind to be handled completely in the department. The character of the apparatus in the plating department is well brought out by Fig. 5, which illustrates the plating tanks, wash tanks, scrubbing benches, tumbling barrels, etc. To illustrate the nature and diversity of work done in the instrument repair department the following schedule of one month's operations is given: Shop repairs to 29 typewriters, 3 adding machines, 22 numbering machines, 5 vaults and safes, 1 balance scale, 3 pencil sharpeners, 2 phonographs, 3 addressographs, 1 electric fan, 100 locks, also 12 marine clocks, 4 wall clocks, 1 marine compass, 1 transit, 1 kodak, 1 meter, 1 steering gear for motorcycle, 32 pair cutting spectacles, 1 automatic clock, 1 platform scale, 21 time stamps, 1 paper punch, 1 revolution counter, 1 stop watch, 1 motorcycle frame, 1 time stamp, 1 steam-flow meter, 1 seismograph, 1 triple register, 1 sewing machine, 3 hydrographs, 2 thermographs, 1 barograph, 6 steel tapes, 1 speedometer, 2 control-board clocks, 1 Dietzgen planimeter, 1 Klaxon automobile horn, 9 watchman clocks and stations, 2 water-stage registers and 6 time recorders; outside inspection and repairs to 840 time recorders and time stamps; 126 offices visited, 94 typewriters inspected and repaired, 12 adding machines inspected and repaired, also 392 cash registers, 1 multigraph, 1 Peerless check writer, 3 Brant automatic cashiers, 2 doors repaired, 35 gages repaired and calibrated, 1 file case repaired; tested steel in razor, manufactured 160 keys, 1 electrical contact point, 3 socket wrenches, 2 templets, 2 clevises, 1 mud guard for motorcycle and 2 switch levers; nickel plated 750 pieces of various kinds; cleaned and lacquered 630 pieces, silver plated 17 pieces, galvanized 600 pieces, oxidized 9860 pieces; material carried in stock, used during the month, $319.41.

The force of men employed in this department averages 14 in all, including three toolmakers, three machinists, one instrumentmaker, two typewriter repairmen, one adding-machine and cash-register repairman, one watchmaker, two electroplaters and polishers and one apprentice boy.



FIGS. 2 TO 5. VIEWS IN THE BALBOA SHOP, WHERE UNCLE SAM'S CANAL INSTRUMENTS ARE KEPT IN ORDER

Fig. 2—Machine equipment and welding apparatus. Fig. 3—Work bench with swiveling tables. Fig. 4—Where the electrical apparatus is repaired. Fig. 5—One corner of the electroplating department

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War Draft Exemptions in England

The nation is about to raise by selective draft the first 500,000 of its new army of 1,000,000 men. Under the selective draft no man will be conscripted who may be of greater value behind the lines, where the work of supplying our army and the armies of our allies must go ceaselessly on. The adoption of the selective draft enables the Government to avoid and profit by the errors made by Great Britain in raising her levies for service in France.

Under the volunteer system Great Britain permitted indiscriminate abandonment of her industries by skilled men who sought service at the front, men whom she found it impossible to replace. Afterward it was found necessary to withdraw these men from the army as far as possible and to return them to the industries from which they had come. But this step was not taken until the looseness of the volunteer system had resulted in considerable economic waste.

England underwent the experience of having her coal output decline millions of tons at a time when her need for fuel was greatest, because she had placed no restrictions on the enlistment of miners. A belated realization of the importance of the economic forces of a country in modern warfare has resulted in the withdrawal from military service and the return to their former occupations of 116,000 of the 282,000 mine employees who joined the colors in the early days of the war.

The higher wages paid in industrial centers of the United States have been steadily draining labor away from the farms and the coal-mining sections, and lately recruiting has added to the problems of the farmers and the coal-mine operators. Unless farming and mining and many other industries which are suffering from like shortage of labor are exempted from the draft, the Government may find itself in the position of Great Britain and have to go through the same expensive process of returning men from the army to their former occupations.

After two years of costly errors, Great Britain finally listed her industries in two classes, the first called "Trades and Occupations of Primary Importance," from which no recruiting is allowed and in which no restrictions are placed upon the employment of males. The following list includes all these favored industries:

1. Mining and Quarrying—Coal mining; patent fuel works; oil-shale mining, including shale-oil works; iron mining and quarrying; copper mining; tin and wolfram mining; lead mining; fireclay and silica-stone mining and quarrying; ganister mining and quarrying; limestone quarries (mainly supplying iron, steel or chemical works).

2. Metals, Machines, Implements and Conveyances—Metal manufacture: All classes of workers engaged in the manufacture of the following metals or their constituent parts from the treatment of the ore to the production of the metal in standard forms, such as ingot, billet, bloom, bar, rod, sheet or section: Aluminum, copper, iron, steel, lead, nickel, tin (smelting only), spelter, zinc and other metals (e.g., tungsten, vanadium, wolfram) needed for war purposes, and their alloys (e.g., brass, phosphor bronze).

Tube and tube fittings, manufacture of, for use in trades scheduled on this list: Shipbuilding and engineering, including repairing; ship and barge building; marine engineering; boilermaking; railway-locomotive construction; railway-carriage and wagon building; traction engines, manufacture of; internal-combustion engines, manufacture of; motor-wagon making and repairing; agricultural implements and machinery, manufacture and repair of; electrical engineering; mining plant and machinery, manufacture and repair of; iron foundries and steel smelting works and rolling mills; other engineering works engaged in repairing machinery or plant for use in industry.

Aircraft, including engines, manufacture and repair of.

Shell forging.

Miscellaneous metal trades: Anchor making; chain-making—block chains, other chains ($\frac{7}{16}$-in. diameter and over); scythe, sickle, reaping-hook, hay-knife and agricultural-machine knife manufacture; heavy edge-tool, pick, spade, shovel and hoe manufacture; dairy-appliance manufacture; electrical-accumulator manufacture and repairing; hosiery-machine needle manufacture; scientific-instrument making; springs, volute and spiral, steel wire over 10 British wire gage, manufacture of; slag-wool making; blacksmiths and farriers, including blacksmiths' strikers; wheelwrights; wire drawing, steel and copper; wire-rope manufacture.

3. Woodworking—Felling, hauling, sawing and creosoting of timber; saw sharpening and setting; wood wool, manufacture of.

4. Pottery and Glass Trades—Chemical-ware (stoneware and fireclay) manufacture; furnace firebrick (including ganister and silica brick) manufacture; optical and chemical-glass manufacture; optical-lens and prism making; other glass manufacture (except table and decorative ware and bottles for beer, wine, spirits and aërated waters).

5. Building and Works of Construction—Building trade, Government work or licensed work for war purposes.

6. Textile and Allied Trades—Woolen and worsted manufacture and finishing; hosiery manufacture and finishing, rope and binder twine, manufacture of; silk shalloon and noils, manufacture of; transmission belting, manufacture of.

7. Chemical, Oil, Etc., Trades—Coal-tar products, manufacture of; dyestuffs, manufacture of; explosives and propellents, manufacture of; other chemical products, manufacture of; lubricating oils and other lubricants, manufacture of; oil-seed crushing; soap and candles, manufacture of; fertilizers, manufacture of.

8. Leather Trades—Hide and skin markets and fat and bone factories; fellmongery; tannery and currying of heavy leather; leather transmission-belting manufacture.

9. Transport Trades—Dock and wharf labor; bargemen, lightermen, on rivers and canals; mercantile marine; railway service; coal trade (wholesale and retail distribution); carters, lorrymen and draymen engaged in carrying heavy goods.

10. Agriculture—All occupations on farms and in market gardens.

11. Food Trades—Flour, oatmeal and rice milling; machine creameries and condensed-milk and milk-powder factories; margarine manufacture; edible oils and fats, preparation of; sugar refineries working under Government; bacon curing; cold stores.

12. Miscellaneous Manufactures—Coke, manufacture of; rubber trades; waterproofing of fabrics for war purposes and of paper.

13. Public-Utility Services—Police; fire brigades; salvage corps; electrical generating stations; tramways, omnibuses and char-a-bancs in connection with munition works; gas-works; water-works; asylums and hospitals; grave digging.

14. Unspecified Munition Trades—Munition trades not mentioned above.

The second list is of "Restricted Occupations," and severe limitations are placed upon the employment of able-bodied males therein, while women are encouraged to fill the places of men taken from these occupations for the army. The following list includes all the restricted industries:

1. Metals, Machines, Implements and Conveyances—Carriage building for private purposes (exclusive of repairs); enameled-iron advertisement manufacture; furnishing ironmongery, including bedsteads and parts thereof, manufacture of; gas and electric-light fittings, manufacture of; metal articles for garden use (other than garden tools necessary for food production), manufacture of; safes and steel office furniture, manufacture of; sheet-metal domestic utensils, manufacture of; sheet-metal japanning, lacquering and decorating; steam or hot-water heating apparatus for domestic or horticultural use, manufacture of; machinery for trades scheduled in this list, manufacture of.

2. Woodworking—French polishing; furniture and cabinetmaking and upholstery; garden seats, summer houses and horticultural buildings, manufacture and erection of; picture and showcard frames, manufacture of; show cases, manufacture of; shop fronts and fittings, manufacture and erection of; Venetian blinds, manufacture of; woodcarving; woodmolding, manufacture of.

3. Stone and Slate—Enameled-slate manufacture; stone, marble, granite, and slate quarrying; stone, marble, granite and slate cutting and polishing.

4. Pottery, Bricks and Glass—Bottles for beer, wine, spirits and aërated waters, manufacture of; bricks (other than firebricks) and tiles, manufacture of; glass beveling, embossing and silvering; glass staining and stained-glass fitting; china and earthenware, manufacture of; table and decorative glass, manufacture of.

5. House Building and Repairing—Building (including horticultural houses); house painting and decorating.

6. Paper, Printing, Etc.—Bookbinding; letterpress and lithographic printing; papermaking; wallpaper, manufacture of.

7. Textiles and Allied Trades—Carpets, floor rugs, furniture, hangings and upholstery materials, manufacture of; linoleum, oilcloth and table baize, manufacture of.

8. Clothing, Etc.—Dress, mantle and blouse making (bespoke); furs, preparing and making up; millinery; patent leather and fancy boot, shoe and slipper making; tailoring (bespoke); umbrellas and parasols, and parts thereof, manufacture of.

9. Food, Drink, Tobacco—Aërated waters, manufacture of; beer, wine and spirits, bottling of; brewing and malting; biscuits, baking of; cakes and confectionery, baking of; sugar and chocolate confectionery, manufacture of; cigars, manufacture of.

10. Miscellaneous Manufactures—Brushes, manufacture of; church-organ building; clockmaking; electroplating; fancy leather articles, manufacture of; games and sports apparatus manufacture; goldsmiths' and silversmiths' wares and jewelry, manufacture of; musical instruments, making of; photographic apparatus and materials, manufacture of; sporting guns and ammunition therefor, manufacture of; trunk and portmanteau making.

11. Commercial Occupations—All foregoing trades: Distribution and sale of products of. Other trades: Advertising agents; commercial travelers and canvassers, commission agents, hawkers and peddlers; shop assistants; clerks, except those with technical knowledge of a high

order or acting in some sort of managerial or administrative capacity.

12. Miscellaneous Occupations—Flowers and ornamental shrubs and plants, production and sale of; domestic servants, indoor, including waiters and servants in clubs, hotels, lodging houses, restaurants and cafés; domestic servants, outdoor; employees at theaters, music halls, cinemas and other places of amusement.

It will be noted that the matter has been worked out in detail so as to embrace every important occupation in the United Kingdom and obviates all possibility of a repetition of the early mistakes.

In a broad way, there is much similarity between the industries of the United States and those of Great Britain, and the above list could be followed almost identically in this country.

England has approximately 2,000,000 more women engaged in gainful occupations than she had prior to the war.—*The Annalist.*

Upsetting Heavy End on Light Rod

By J. V. Hunter

Experience with the upsetting operations on forging machines has shown that it is not advisable to attempt to gather too much stock into the upset at one stroke of the machine. The gathering power of the machine is limited, first of all, by the distance remaining for the plunger to travel after the dies have been firmly closed; for it would not do for the header to be in contact with the piece being worked before the dies have a firm grip on it, or else the header would simply be slipping the work back through the dies and doing no work upon it.

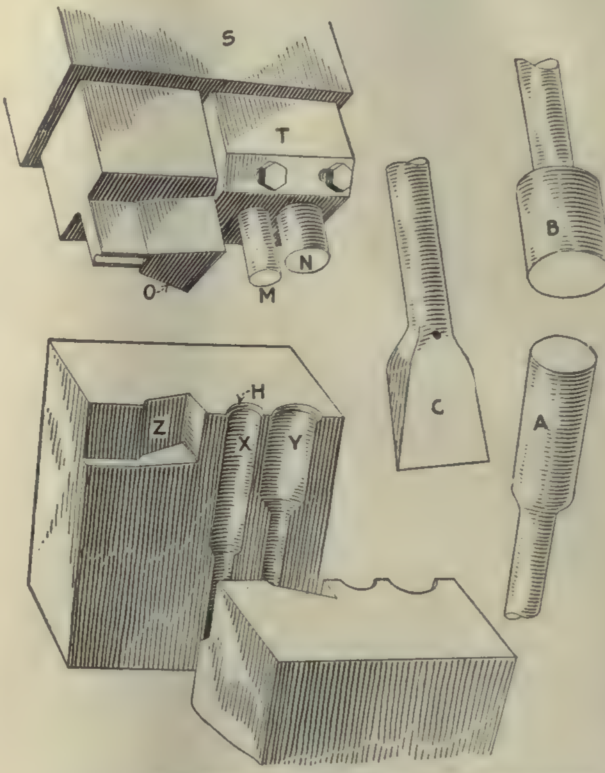
A second consideration, which is particularly true for light stock, is that too much compression (of a long piece of material into a short heavy section) will be likely to develop cold shuts or other flaws unless the stock is worked down in two or more successive stages. Usually, with very light stock, a reheating is required between the operations because the chilling effect of the dies is too great for successful working without doing so.

In the second stage of the upsetting operations it is also possible, by advancing the already upset head some distance in the dies, to gather a certain amount of additional stock at the same time that the first upset stock is further condensed.

The forging-machine dies shown in the illustration are a set that was made up for forging the lower end of a street-railway motorman's switch rod. Probably every street-railway system in the country uses a somewhat similar rod for throwing manually operated street switches. With the exception of the heavy point on the lower end, these rods consist entirely of $\frac{9}{16}$- or $\frac{5}{8}$-in. round steel, and they will run in length from 30 to 48 in., to meet varying conditions of service.

It was formerly the practice to take a bar of flat stock of sufficient width to make the pointed end, neck it down and draw out one end to the same diameter as the rod for a distance of about 4 in., then draw out the other end to an edge and shape up about as shown at *C;* the stem was then welded to a piece of straight rod of the necessary length. Each of these operations took up more or less time and added to the total cost of the work. The most objectionable feature of this method, however, was the weld, because no matter how carefully it was done it constituted the weak spot in the rod, so that when any great strain was put on the rod in a tight switch the scarf of the weld was sure to open and the rod have to be sent to the shop for repair.

To lower the cost and to eliminate this weak point in the weld the method was developed of upsetting the end in the forging machine, in the dies shown. This is a case where a relatively heavy amount of stock must be gathered at the end of a comparatively light rod. Another instance where the same method might be cited as of service would be for the heavy spear-like ends that one sees every day on steel picket fences.



DIES FOR UPSETTING HEAVY END ON LIGHT ROD

The first operation is to upset the stock to about half of its original length, in the pass of the dies at *X*. After a reheating, the stock is further upset to a very short length, in the die pass at *Y*. All dies of this nature should have a slightly wider and beveled entrance mouth, so that in case the headers do not line up exactly the bevel will throw them into line instead of permitting them to gouge out a slice of the dies (see the point marked *H*).

In a set of special dies of this nature, the supplementary header holder *T* was made up to carry the two headers *M* and *N*, because the standard header holder *S* was only designed to hold two headers. Thus it was possible to avoid making up a new one of these more elaborate holders. Likewise these headers are of ordinary cold-rolled bar stock sawed to the correct length, with a V-notch ground into their side for the holding setscrew to press against.

These two operations produce upsets on the ends of the bars as shown at *A* and *B* of the figure.

Immediately after the second operation, without reheating, the rod is raised to a vertical position, and the upset end is inserted between the dies in the pass *Z*. The header *O* then comes forward, forcing the metal to completely fill out the die, and the forging is completed as shown at *C*. If there is any surplus metal in the upset, it is forced out vertically into the rod. A little fin also forms around the header side of the forging, but this is removed by grinding, an operation that is necessary in any event as both sides are faced up on the wheel to remove the scale and put the surface in better shape for light case-hardening in a cyanide bath.

Is This the Right Man for the Job?

By A. H. Davis

A very large combination of capital is about to introduce to the public a small delivery car, which is not the simplest thing in the world to design or build. Not one shop mechanic in ten thousand will know why a certain piece is made thus and so. If it is at all clumsy or hard to make or get at with a wrench, in repairing or assembling, he considers that he is entitled to call the draftsman anything the latter will stand for. It makes no difference that the reason for the design may be the fact that the jumper may have, from long habit, become accustomed to leaving the car "on the run" with a package, and that if it were designed differently, the jumper might have an inconvenient move to make each time he left the car. The reason for this design may have been determined only after a lot of discussion among store-department heads, engineers, drivers and jumpers, all of which the shopman knows nothing about.

It may also be that, clumsy as the piece is, it is the best way to make it. The principal tenet of the commercial-car designer is to make one piece do the work of two, even if the piece will hardly lie still on the floor. Under the terrific effect of the vibration caused by dead-load, high speed, sudden starts, racking stops, rough alley approaches, etc., a joint that has to be kept tight is like so much poison to the engineering force. All this is from the standpoint of the engineer.

What the shopman does not like is to have the draftsman come into the shop fussing around the assembly job with a rule to find out whether his drawing was right or not. Then when he is asked why the piece was made so, to be treated to a profane request as to "who wants to know." Unless the engineer has been at one time, or is now, competent to take off his white shirt, put on a "union suit" and see whether the shopman's kick is well founded or not, he had far better take the shopman out to lunch, and get his ideas. The engineer may easily find that the shopman would be a corker in the engineering department. How do I know? Because I have chased the left-handed monkey wrench around the shop and have also sat behind the desk of final authority and had to square things with the directors.

The purpose of this screed is to get the shopman's opinion of something I propose to do.

I recently found a shopman who had made of himself a competent draftsman and designer. Therefore, he knows the job from both angles. I want him to take two jobs. He is to be chief engineer and chief inspector. He is a man whom I am glad to number among my friends, even though he cannot spell worth a cent.

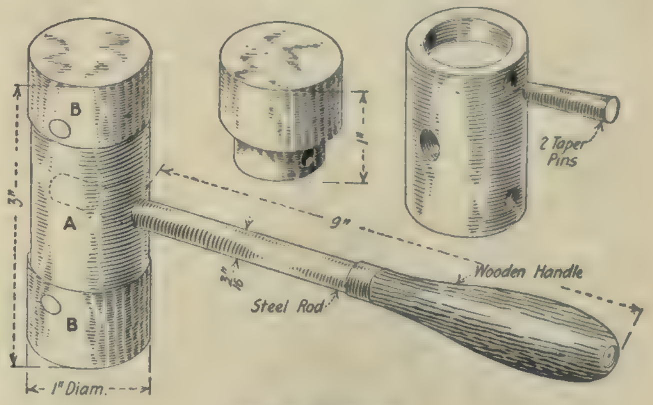
I want some shop opinions. It will be a bully thing if the experiment works out, and a costly one if it doesn't. It is now your turn, gentlemen.

Fiber Hammer

By Herbert M. Darling

The ordinary fiber hammer usually has some projection of a larger diameter than the fiber heads, so that if a workman misses hitting his work with the fiber face, he is pretty sure to strike it with the projection. Usually this projection is in the form of a threaded ring that retains the fiber head in the body of the hammer. I made the hammer shown to overcome any such objection to its use.

It consists of a brass body *A*, bored at each end to receive the two fiber plugs *B*, which are held in by taper pins. When the fiber becomes worn, it is an easy matter to knock the taper pins out and put in new fiber. These pieces are drilled and taper-reamed in place and then pinned. There are no projections, as the fiber plugs are of the same diameter as the brass body of the hammer. A hammer made to the dimensions shown will be found far superior to small lead or babbitt hammers and will last almost indefinitely.



FIBER HAMMER

White Surface for Layout

By L. A. Ott

For general layout work on both rough and finished surfaces, difficulty is usually experienced in getting a surface that will show a line plainly and not rub off too easily.

I have hit on the plan of mixing a little shellac with wood alcohol to make the chalk stick. Keep the alcohol in a can or bottle tightly corked, as it absorbs moisture from the atmosphere, and when so diluted will not dry so quickly. Put a handful of dry shellac in a gallon of wood alcohol. Take a small quantity of powdered chalk or whitening and mix as needed to the desired consistency, with the thin shellac solution. The result is a surface as easy to work on as drawing paper.

Organization for Munitions Manufacture

THE following extracts have been taken from a paper read at the spring meeting of the American Society of Mechanical Engineers, Cincinnati, Ohio, May 21 to 24, 1917, by Harry L. Coe.

I have approached the subject from the viewpoint of a manufacturer already engaged in a metal-working business, and have tried to suggest some of the factors which he should consider if he expects to produce projectiles. Assuming that the manufacturer has ample financial resources, adequate equipment, a satisfactory source of raw materials, etc., what type of an organization is essential to the successful production of munitions; and among the various kinds of munitions, what articles can the particular plant produce economically?

Much time and effort will be wasted if this double process of selection is not given attention. The characteristic optimism and confidence of the American manufacturer, coupled with the strong desire to be of service to his country, or to make money, lead many firms into making persistent efforts to get munitions contracts which should, logically, go to firms of an entirely different character and facilities.

SELF-ANALYSIS IMPORTANT

Before looking for a munition contract, there should be an honest self-analysis. It isn't a question of "Can my shop produce this piece?" but "Can it make this piece as well and as economically as anyone else?"

Many firms having a good manufacturing organization will feel that they require only a little additional equipment. To these people I say, "Beware!" Three years ago they might have had as good a chance of success as anyone, but today they will have to compete with the firms which have not only the organization but the proper equipment as well.

On the other hand, they may have a general equipment which can be adapted to munitions, but their shop and executive organization may not be trained to think and act along the lines of specialized mass production. And here again I say, "Beware!" Difficult, slow and expensive though it may seem to start from nothing and equip a complete munitions plant, it is much more difficult, slow and expensive to develop and get into effective operation the organization which will make this kind of a business successful.

CHARACTERISTICS WHICH MUNITIONS PLANTS LACK

We turn with pride to our great industries—the steel corporation, our railroads, etc.—and feel that certainly the American genius and ability which have made them possible can turn out unlimited quantities of shells. And so they can, *if they have time.* Unfortunately for the manufacturer, this element of time is of the greatest importance to the fighting units. The advantage lies with the side which first gets the necessary supplies.

The big, centralized organizations are the result of a slow process of evolution, and while their working force may be constantly changing, one finds that the habits and traditions of the work are maintained, and it is this force—habit and tradition—which is entirely lacking in the munitions business. To produce shells economically, this force must be generated in and by the organization, which means embodying in that organization a certain proportion of picked men, chosen because they possess these habits, or who, because of their versatility and training, can quickly acquire them. Such men are not easy to find and the time it would take to get *enough* of them together in one place to make a large organization successful is almost a fatal handicap.

SMALL UNITS PROBABLY BEST

It would seem, therefore, that the greatest success would be obtained by comparatively small units specializing in one type of munitions. One may say, "Why not have a big shop departmentalized, with a case shop here, a shell shop there, time fuses or primers in another section, etc.?" Theoretically, this would be all right, but if one studies the organizations which have tried this in the past few years, he will find a tremendous amount of lost time, effort and money. In other industries where this principle has been successfully developed, I believe there will be found quite a percentage of men in each division who have grown gray-haired with years of service along that line.

This condition does not obtain today with respect to the munitions business. Before the present year the firms manufacturing projectiles in the United States were very few. The orders placed by our Government outside of its own arsenals were so small that even at the high figures paid they offered no attractions to anyone to develop a business along these lines. As a rule, the training in the arsenals has not fitted men to produce the best results under our existing industrial conditions. At the present time the arsenals are not letting any of these good men get away. In general the attitude of the War Department has not encouraged the development of this industry except in the cases of a few manufacturers, as mentioned above. The result is that there is a very limited field from which to draw either workmen or executives "skilled in the art."

It would seem, therefore, that the manufacturer must build an organization around such of his men as possess the proper habits and training, and they in turn will have to see to the development of the manufacturing units. Here, again, large and complicated units do not develop rapidly, and in them mistakes are tremendously expensive and slow to correct.

The manufacturer should therefore take stock of his organization carefully. If it does not contain men whose habits of thought and training are consistent with specialization of processes and mass production, it lacks one of the prime factors in successful munition manufacture.

ADAPTABILITY OF PLANT TO PRODUCT

If, on the other hand, the organization *is* of this type, he should look carefully over the wide range of articles classified as munitions and select something which is as similar as possible to his regular product in size, material and general nature.

We hear of gray-iron foundries making strenuous efforts to get contracts for producing cartridge cases, when the nearest thing they have to a press is a plate-molding machine, and they never had an opportunity of running to capacity on a single pattern for more than a few days at a time. Needless to say, if such people are so unfortunate as to get a contract, it is almost certain to prove an expensive failure for them and may result in a serious shortage of supplies for the fighting line.

Assuming now that there is an organization which is accustomed to specialization and that a type of munitions adapted to the available equipment has been selected, what subdivision should be made in the organization and what functions should be performed by each?

In the first place it is futile to try to handle a projectile department as an appendage to some other part of the business. It is a business in itself, and its success or failure will probably depend on the completeness with which every detail is worked out.

This is a product in which duplication inside exceedingly small limits is essential. Moreover, if one agrees with the theory of specialization mentioned above, the type of munitions manufactured will be limited to a few pieces, or even to a single piece, of the same nature. The size of the order should be large enough so that even the smallest working unit —man or machine—can be employed constantly on the same operation. Under such conditions no detail is so small but it pays to give it careful attention. Every motion will be repeated many times an hour, and the expense due to trivial losses will soon reach large proportions. Realizing this and knowing that this is a temporary business, many firms have gone outside of their regular force and employed special managers to look after their projectile manufacture. This has been their sole function, and the arrangement was terminated when the order was completed.

The Internal Organization

The internal mechanism of the organization, then, might be classified somewhat as follows: (1) General Service Department; (2) Diplomatic Staff; (3) Production Department; (4) Inspection Department.

1. General Service Department—Under this department, we find: (a) Records and accounting (with special prominence given to control of manufacture rather than to details of cost finding); (b) purchasing and stores organization; (c) designing, drafting and experimental development; (d) protection and safety (with special reference to destruction by representatives of the enemy's government and to the safeguarding of unskilled workers).

With reference to these general departments, it may be safe to modify our general principle of entirely separate organizations. Whether or not these departments are combined with the existing departments employed in similar work will depend somewhat on the volume of the work both in the normal business and in the munition contract, as well as on the physical layout of the plant. In most cases it is possible so to plan that this work will follow the practice developed for the regular business and can be absorbed by the departments already doing this kind of work.

With reference to the purchases and stores of the department, there are no special features which differ to any radical degree from ordinary practice.

2. Diplomatic Staff—While this organization will be small, it is none the less important. If the munitions are for a foreign government there will undoubtedly be foreign representatives stationed at the plant as receivers. These men are not accustomed to our methods. Their temperament is entirely different from the people we are ordinarily meeting. Possibly they do not speak our language. If sufficient attention is given to them, and their points of contact with the organization limited as far as possible to a few chosen men, it will be much easier to reach a practical working basis and to prevent expensive and often unnecessary misunderstandings and delays.

This department is responsible for seeing that these receivers are provided with the information they desire and that it is presented to them in such a way that they get a correct impression of the conditions. If they appreciate the difficulties which may be arising and the action the organization is taking to eliminate causes of trouble, it naturally affects their attitude toward the plant.

The diplomatic staff sees to it that any instructions issued by the receivers are transmitted to the proper department so that they go into effect.

Through this department, the shop can approach the receivers for information or rulings on conditions which may not be clear.

Even in the cases of work for our own Government, I believe such a department is advisable. The fewer people who have official relations with these receivers, the less the chance of contradictory instructions or of false or unnecessary information or misunderstanding.

3. Production Department—Under this department come: (a) Maintenance of equipment; (b) operation of equipment; (c) selection and training of workmen; (d) tool and gage production; (e) establishment and operation of the various wage payment and penalties systems.

This department is responsible for maintaining production and developing economy, and has full control of all agencies which bear directly on the operation of equipment.

Maintenance of Equipment

Maintenance of equipment has been included under this department for two reasons: First, it brings the time element of repairs largely under its control. Much loss of production can be avoided by a careful and frequent inspection of machines and transmission. A few hours in adjusting may save days of shutdown later. And second, because the men who make up the maintenance crew are usually the general group of millwrights who see to the location and moving of equipment, which again is a direct corollary of production. When breakdowns occur, operations have to be readjusted and it is often more economical to take an idle machine out of a battery and replace with a spare than to interrupt the flow of product. Such work is obviously up to the repair gang assigned to the work.

In this connection I am inclined to think that twenty hours per day is about the economical limit to run machines under the conditions of forced production usual on this work. The remaining four hours for repairs is most excellent insurance.

Having given the production chief the means of supplying his working force with equipment to use, we must turn to a study of the workers.

Because of the difficulty of getting skilled mechanics, it has been necessary to develop that type of an organization which can produce results with the average workman in the shortest possible time. This is one of the reasons why it is well to subdivide the operations into simple elements and eliminate complex machines. Because of the very nature of the class of workmen available, it is necessary to make the most out of a continually changing force. This has been done successfully by selecting from the better grade of men a class which might be called *tool setters* or *machine starters*, and giving them charge of a battery of machines. This builds up a secondary line of defense, as it were, and it is possible to develop a fairly permanent organization of this kind of men. Behind these machine starters come the group foremen, assistant superintendents, etc.

For somewhat the same reasons the tool and gage manufacturing department is made a part of the production chief's organization. I say tool and gage *manufacturing* department instead of toolroom advisedly, for it has to be a real manufacturing department with the demand for flat cutters, boring bars and heavy supplies of special tools which immediately occurs when one starts to reach maximum output on single-operation machines. The good toolmaker is not as a rule a production man, and it is a difficult thing to get a toolroom into the spirit of manufacturing.

THE MATTER OF WAGES

The method of wage payment for all these men is immaterial provided a maximum incentive is given to each man. Personally, I am in favor of a thorough piecework system, as it is simple for the workmen to understand and not expensive to operate. However, premium or bonus plans are all right if the rewards are immediate. The setting of standards is an important part of the wage basis and the opportunities for the competent operation and time-study man are wonderful. He, too, is part of the production chief's organization.

In this connection, while in general the theory of penalties is not desirable, it has been found that it is a good balance wheel to the continuous insistence put on production, especially where the workmen are not trained in the true spirit of machine-shop existence and often are only transients with very little interest in the quality of their work.

4. Inspection Department—The work of this department comprises: (a) Inspection of operations; (b) intermediate inspection; (c) final inspection.

To some it may seem that at least part of the inspection organization should be directly under the chief of production—for example, the first or operation inspection which occurs between each operation. I believe, however, that better results and a more consistent and thorough inspection will ensue by creating a staff of inspectors responsible to their own chief to handle all inspections wherever they occur. It is easier to train men for these jobs and instill into them the necessary standards of work and habits of thought and action if they are included in a branch of the organization which is all their own.

Assuming that the complete inspection is organized into a department of its own, it may well develop according to the following scheme:

If the work has been subdivided so that operations occurring on individual machines are simple, it is possible to station back of each group of machines an inspector or inspectors and gage every piece for the controlling dimensions. We might class these inspectors as *operation inspectors*. It is their duty to see that each piece produced falls inside the tolerances which are allowed.

As the work progresses and a series of operations are performed upon a piece, it is often found desirable to have an *intermediate inspection*, as in many cases the later operations materially change the form of the piece so that it is impossible to check the work previously done. It is usually found desirable to set aside a certain part of the shop for this purpose and have all the product delivered to the inspection room.

This intermediate inspection is a general overall check on the production reported by the operation inspectors. The advantages are obvious when considered from the payroll point of view.

When a piece is finally finished and ready for presentation to the receivers, of our own or of a foreign government, there should be organized a thorough *final* inspection. Under this final inspection, all dimensions possible are checked and in general the same procedure as may be instituted by the receivers is followed out. In case the product does not come up to the standard it is either sent back for repairs or else set aside and presented as a special batch with full explanations to the receivers. In this way the shop establishes a very desirable basis of fair play with the receivers and, as a usual thing, the policy results in the granting of special limits to cover slight deviations from specifications, which, if sent through with the other work, might arouse suspicion and work to the detriment of the shop.

In connection with the inspection organization it is very necessary that an ample gage-checking force be organized. All working gages should be checked at least once a day and, in case of some of the finer type of gages, it may be necessary to check oftener if the standards are very exacting.

Plain Carbon Steel for Threading Tools

By Harry P. Simmons

The impression somehow seems to linger that high-speed steel is the proper thing for a threading tool. For the accurate cutting of taps and thread gages in such material as Ketos or other high-grade tool steels, it can easily be proved that a piece of ordinary drill rod, properly hardened and drawn, will hold its point and cutting edge much better than a cutter of high speed.

The point to be remembered is that, with the very slow cutting speed used in cutting threads on the tool steels, the advantages of high-speed steel are laid aside and a distinct disadvantage appears. One would not expect to get satisfactory results with a high-speed drill with the cutting speed reduced in the same proportion as in tap and gage threading.

IDEAS FROM PRACTICAL MEN

Simple Device for Cutting Oil Grooves in the Lathe

By William T. Slider

Appreciating as I do the many novel kinks published in the columns of the *American Machinist*, I think perhaps some of your readers will be interested in knowing how we handle the oil-grooving proposition.

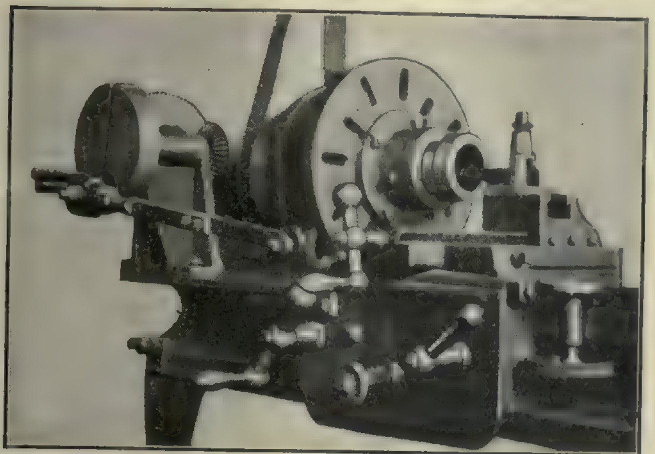


FIG. 1. LATHE ARRANGED FOR CUTTING OIL GROOVES

We cut internal and external grooves with equal ease with a machine that, in its working, is equal to anything for the purpose. In many respects it is far superior to many with which I have come in contact, yet the cost was practically nothing.

In the first place we took a worn-out lathe that had been abandoned and consigned to the scrap heap. First, we removed the lead screw, to avoid any possibility of the nut becoming accidentally engaged; then we made a cast-iron bracket that, upon referring to Fig. 1, will be seen attached to the bed by means of capscrews. It is also fastened to the headstock in the same manner; but the capscrews come behind the web, so they cannot be seen in the photograph. We replaced the spindle gear that drives the feed and screw-cutting mechanism, putting in its place a 40-tooth 8-pitch gear that in turn runs into an 80-tooth spur gear. This alteration gives the machines somewhat the appearance of a lathe with a back gear in front of the headstock. The large, or 80-tooth, gear is carried by a short shaft on the opposite end of which is a bevel gear of 30 teeth. This gear in turn engages another bevel gear of 30 teeth driving across the shaft, on the opposite end of which is seen the crank disk, with connecting-rod attached. On the upper left corner of the apron is a small forged bracket to which the reach rod is fastened.

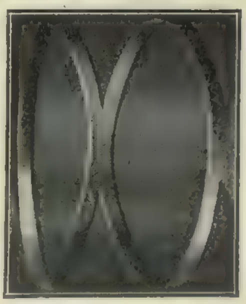


FIG. 2. OIL GROOVES CUT IN THE LATHE

One edge of the slot in the crank disk is graduated in inches and fractions to facilitate setting for the length of stroke required, which obviously is also the length of the oil groove to be cut. Near the middle of the reach rod will be seen two bolt heads. The rod is made in two sections. The front section has only two bolt holes, while the back section has a series of holes, the two sections overlapping. Thus, adjustment is possible for any desired length and also for any required position. Any other needed adjustment in the location of the tool point is easily obtained by adjusting the tool in the toolpost.

The machine, geared as here described, will cut a groove in one complete revolution of the work, from end to end, according to the set stroke, entirely regardless of the length of the groove, as shown in Fig. 2. Thus, the tool, starting at a given point, will return to the same point in one revolution. The cutting tool is fed into the work gradually to the desired depth of cut, without any danger of crossing the lead or making a miscut, as the tool will always travel in the same path. By changing the relation of the 80-tooth and 40-tooth gears, any desired lead of groove may be obtained.

The idea for this machine was picked up by one of our engineers in another city, with permission to adopt it, as it is neither patented nor patentable, having been in use too long. With what our engineer saw and with his own improvements, the arrangement is an up-to-date one with which I am much impressed, for it certainly does the work.

Does a Grinding Wheel Peen?

By O. D. Carter

The article by C. A. Macready, on page 125, and the one by J. B. Murphy, page 389, Vol. 46, were interesting.

A grinding wheel, because of its construction is not an ideal cutting instrument, since it is impossible to give each grain a point with the correct rake and clearance. Hence, if the wheel be held in a sufficiently rigid bearing, the particles that are not cutting points must tear their way through the work; or, if unable to do so, they must compress the metal in order to pass over. Otherwise, the grain would be torn from the bond, which finally occurs when forced by too much feed, resulting in wheel destruction.

The grinding wheel may be likened to high-speed steel, in that the grain, while hard and fast cutting, is too brittle to resist severe shock. The cutting points, when subjected to the shock of vibration or stressed with heavy feeds, are chipped back rather than melted; and if the bond holds, the dulled points force their way through and over the surface, causing the burnished effect often seen after a wheel "loads."

That this tearing and burnishing displaces the metal at the surface can not be doubted if the burr thrown over the edge of the work is examined under a glass.

If ring stock be turned and bored and rings parted from the stock, on slitting they have a tendency to expand the slot; but if the outer surface of the remaining stock be finished by grinding, a tendency to contract will be observed on slitting the ring, showing a compressed condition of the surface of the ground work.

Possibly Mr. Macready may be able to control the curvature of the thin steel stock at will. If a piece of thin steel or hard brass be peened on one side or otherwise stretched or pressed until concave, it becomes in effect a spring, which will return if pressed in an opposite direction. However, if this peening action goes beyond a certain limit, the piece may be concaved either way, with little tendency to spring back.

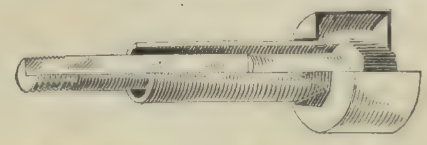
The position on the magnetic chuck may govern this spring according to which is released first, the center or the edges.

From the foregoing it can be assumed that this action, which may be likened to processing with a hammer in such a manner as to compress or displace the surface of metal from its original position, surely does exist.

Method of Installing Foundation Bolts

By W. A. Lailer

While installing a lot of new machinery, we experienced considerable difficulty because the holding bolts, as embedded in our concrete foundations, did not always line up with the holes provided in the base of the machines. We therefore looked about for a method whereby we could overcome this difficulty by providing for a slight movement of adjustment to meet the baseplate holes even after the concrete had set.



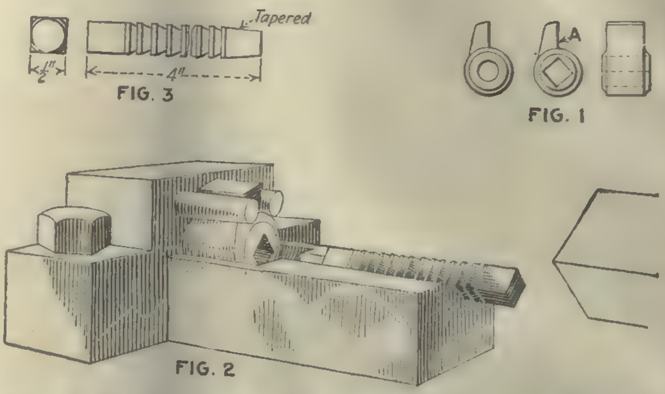
FOUNDATION BOLTS IN POSITION

To do this we devised the arrangement shown. Instead of embedding the bolt itself in the concrete, a pipe about 1 in. larger in diameter than the bolt, though smaller than the bolt head, was placed between the bolt and the concrete, the lower end of the pipe being fitted with a tin or wooden box large enough to contain the bolt and the head. When the concrete had set around the pipe, the bolt could still be moved ½ in. in any direction to accommodate it to the position of the baseplate hole. After the machines had been set, lead or babbitt or grouting was poured in between the pipe and the bolt to hold the latter firmly in place. A few holes were drilled at the bottom edge of the pipe to permit the lead or grouting to flow down and completely surround the bolt head.

Broaching on a Planer

By Charles H. McCarter

The illustration shows a broaching operation on igniter stops for gas engines, which may be applicable to pieces of a like nature in shops not equipped with a broaching machine, or where the quantity of work turned out does not warrant the expense of installing one.



FIGS. 1 TO 3. IGNITER STOP, FIXTURE AND BROACH

In Fig. 1 is shown the drop-forged igniter stop before broaching. It is first drilled and turned true on the sides preparatory to broaching. The work is then placed in the fixture shown in Fig. 2 and located in its proper position by the two pins. A V-block, set directly in front of the fixture, furnishes the seat for the stop and also acts as the guide for the broaches.

The first broach is placed in position in the V-block, and the stroke of the planer is adjusted. Then the planer is started, forcing the broach through the work by means of a hardened block of tool steel fastened on the front of the head.

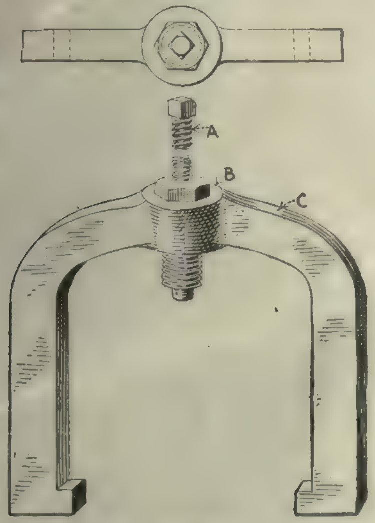
Three broaches are used to bring the hole to size. They are made with a pilot on the end with about 0.002-in. clearance in the work. Each broach is made with a radius on the edges, the radius getting smaller toward the rear end. The final broach is made with a small radius gradually decreasing toward the back until about 1 in. from the end; the rest of the cutting part of the broach is left with perfectly sharp edges. The broaches are made slightly taper on the rear end, as the blows received tend to upset them a little. The speed of the planer is made considerably slower than usual, in order not to break the tools and to give them time to cut.

This operation is entirely satisfactory, and the pieces are done at a fair rate of speed. After the broaching operation the pieces are put on a square mandrel, five at a time, and a milling cut is taken at *A*, Fig. 1, bringing this face correct with relation to the square hole. This is of course an ordinary miller operation, and a description of the set-up is necessary.

Improved Gear Puller

By J. F. S.

Recently I was watching a machinist while he was engaged in removing a gear from the end of a shaft. I noticed that he was being put to considerable trouble and annoyance. In the first place, the gear was on the shaft quite some distance from the end, and was very tight. In order to start the gear, it was necessary to remove the long screw from the gear puller, owing to the tendency of the screw to twist off when it was forced against the end of the shaft. After putting a short screw in the gear puller, and starting the gear, the man was obliged to put the long screw back in the gear puller. The machinist also had the annoying job of holding the gear puller straight and central with the shaft while turning up the screw against the end of the shaft, a job that makes a man wish he had three hands. To overcome this trouble a gear puller was built as illustrated in the sketch. To use this puller the large screw *B* is turned so that the end projects through *C* a short distance. The screw *A* in turn projects somewhat through *B*. The gear puller is hooked to the gear to be removed, and the large screw *B* is turned to loosen and start the gear. When started, the long screw *A* is utilized to remove the gear the rest of the distance.



IMPROVED GEAR PULLER

Some question might come up as to why a large screw, long enough to remove the gear and heavy enough to start the gear without distorting the screw, could not be used. In answer to this I would say that my main reason is that it was desired to make the gear puller as light as possible. As is generally known, the greatest difficulty in removing a gear or anything else of that nature is to get it started. Once started, it is a simple matter to remove it the rest of the way. It is extremely annoying when the piece is almost off to find that the screw is in as far as it can go. This means the doubtful pleasure of backing the screw out and setting up all over again. With this gear puller the smaller screw can be made a good length, and the piece removed the first time.

Hollow Setscrew as an "Adapter"

By R. W. Dicley

Trouble was experienced in tightening the screw that holds the rolls in the holder of the roller back rests on our Gridley automatic screw machines. It is necessary for this screw to be placed in the curved portion of the tool slide. This makes it almost impossible to use a wrench on the screw, which must be securely tightened.

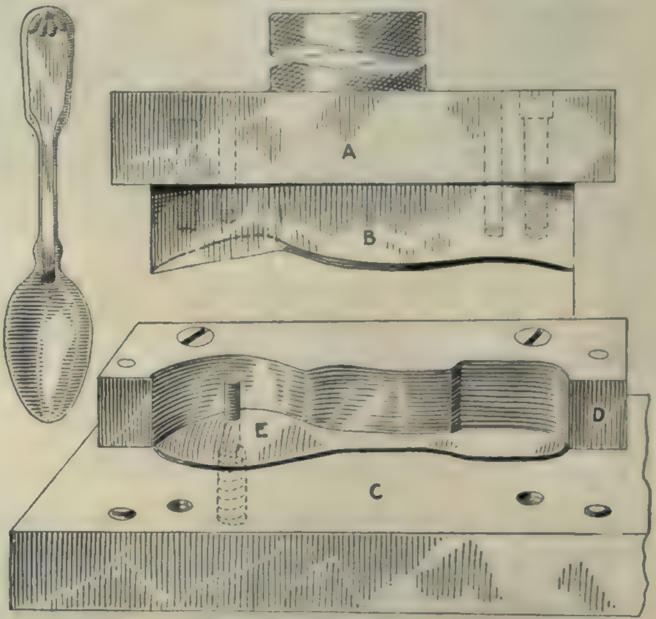
I took an ordinary blank hollow setscrew, drilled one end, and tapped it according to the size of the screw. I then inserted the regular bent, or ell, hollow-setscrew wrench. In this manner the screw was tightened without any inconvenience.

This scheme is equally useful in any place where it is difficult to use an ordinary wrench. It is a device that can easily be secured in any machine shop, as all that is required is a piece of round steel of the proper length to allow for the necessary depth of the tapped hole and the insertion of the wrench at the opposite end.

Combination Iron and Steel Die

By G. B. Olson

The illustration shows a blanking and forming die with one of the forming members made of cast iron. The punch holder *A* is cast iron and carries the tool-steel grinding and forming punch *B*. The die shoe *C* carries the tool-steel blanking die *D*. The lower former *E* is a part of the cast-iron die shoe *C*. The die shoe and form being cast in one piece makes this a simple and cheap construction. Two sizes of these dies were made, one for teaspoons and the other for tablespoons. Both sizes of spoons were made from No. 24 gage thin sheet iron. The production from the cast-iron die is practically the same as it would be from one made of tool steel.



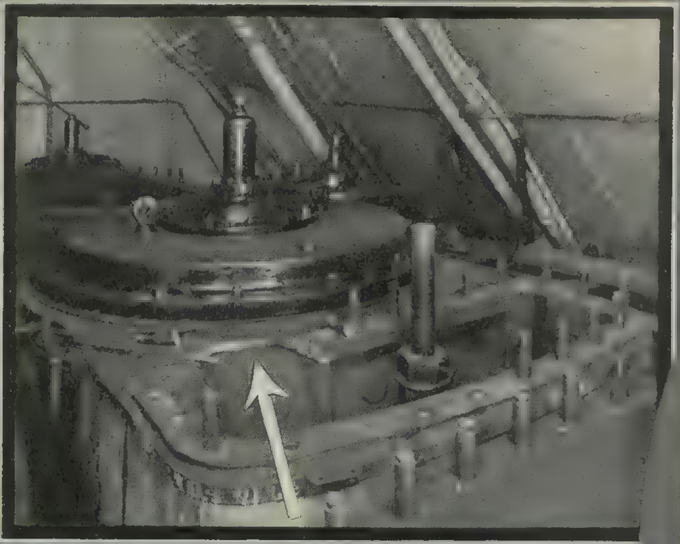
THE COMPOSITE DIES

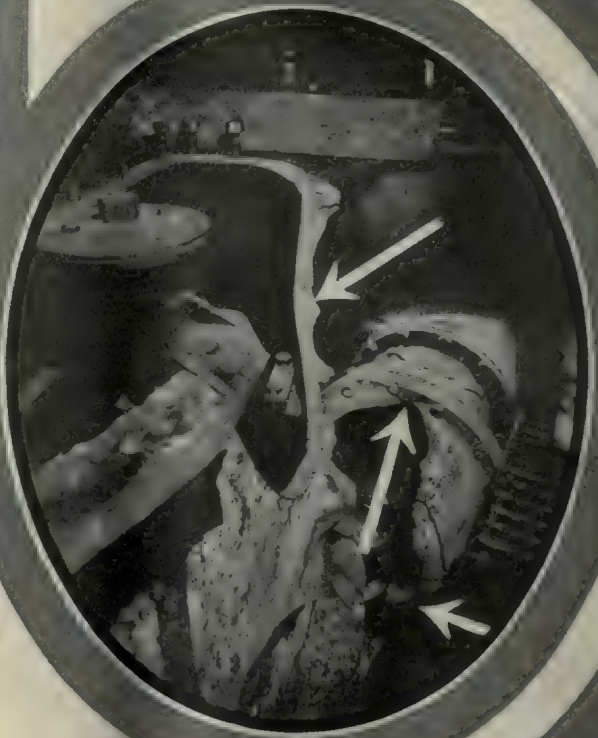
Bolts Stuck in Socket Wrench in Bolt-Cutter

By Edwin Chapman

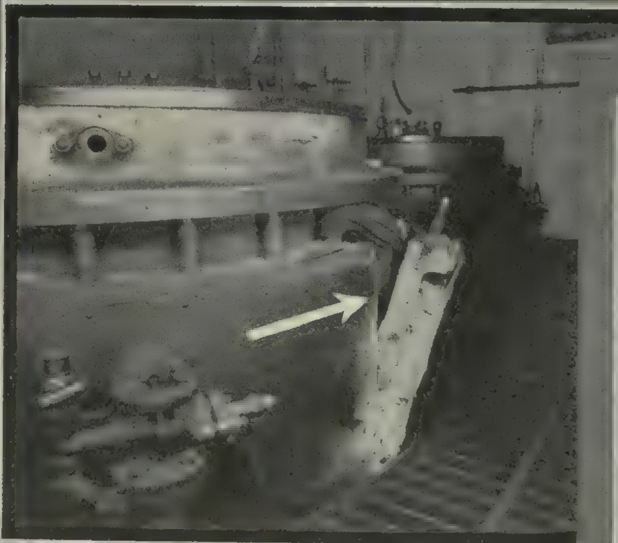
While threading short bolts, holding them with a socket wrench clamped in the cutter jaws, I found that the bolt heads jammed in the socket after the thread was cut. This I overcame by drilling a hole entirely through the socket wrench and using a rod to drive the bolt out when it stuck in the socket.

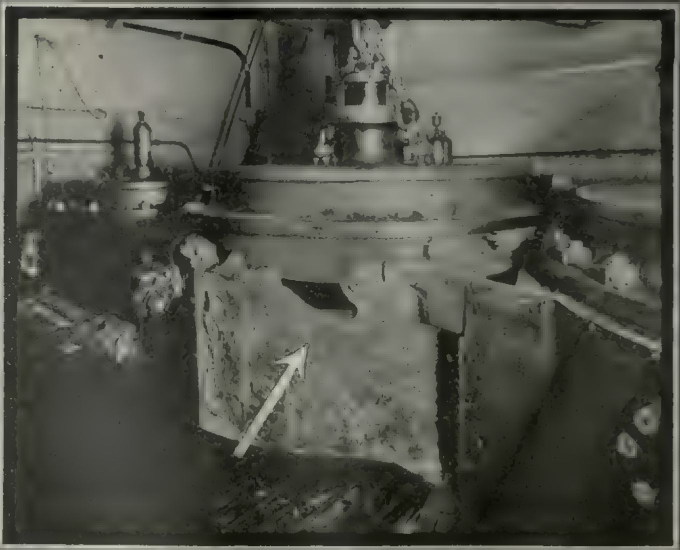
“Schrecklichkeit” did this to



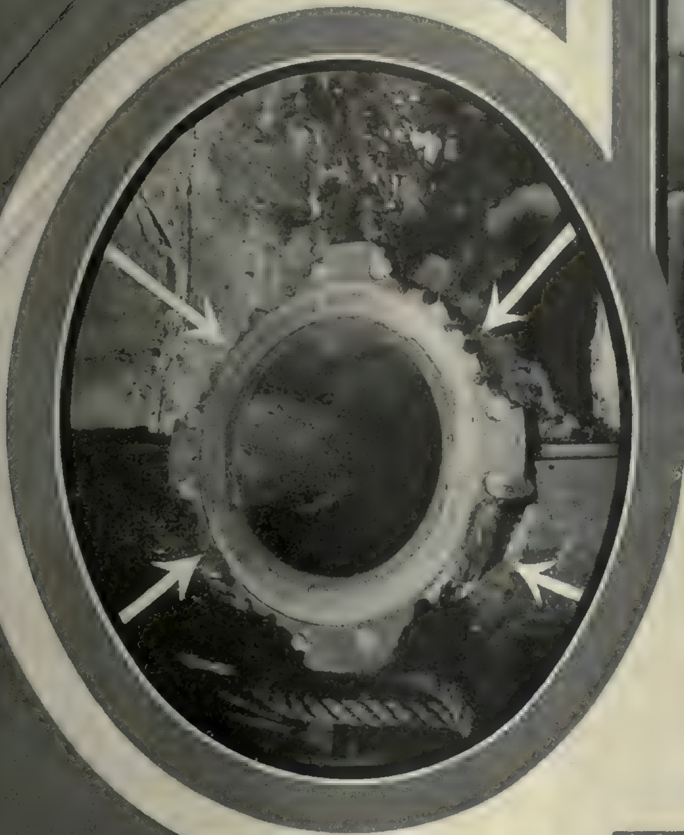


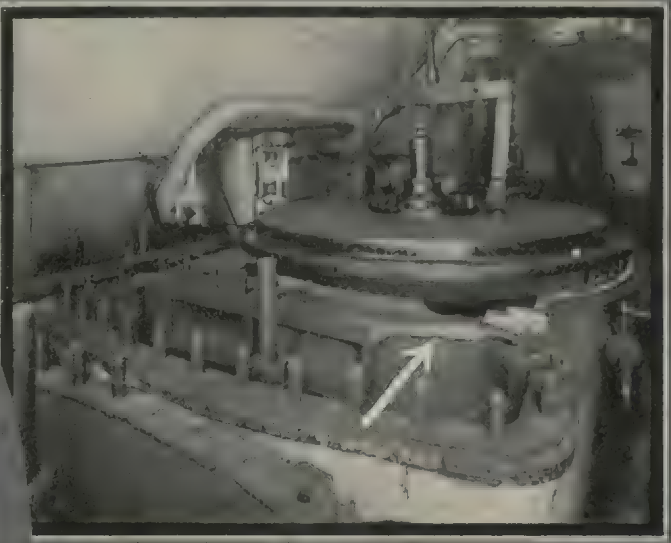
This is the first authentic publication anywhere, by permission of the United States Government, of the way in which German ships in American ports were damaged prior to the declaration of war.



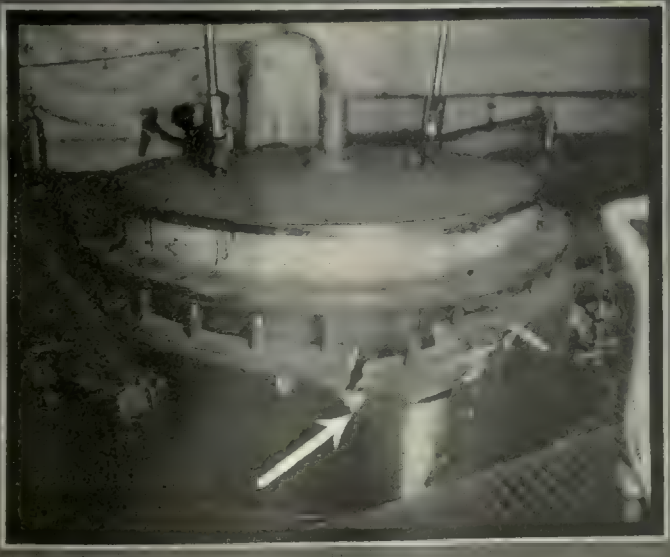


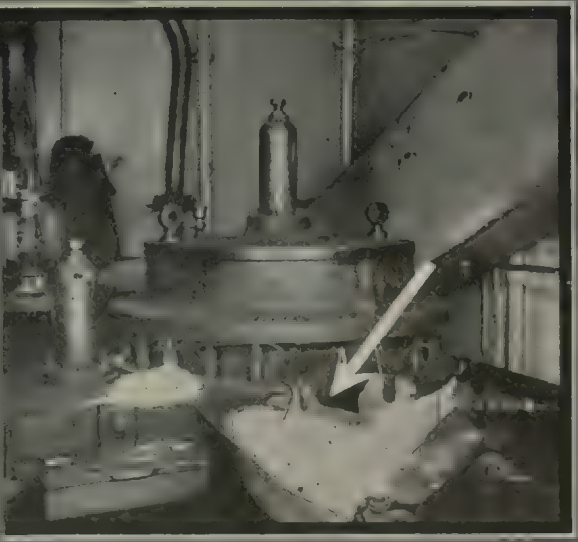
German Ships before their Seizure





Cylinders were loaded with scrap iron and then steam turned on, smashed heads and flanges. Rags and carpets stuffed into working parts helped out the hurried sabotage of *Schrecklichkeit*.





We have the SPIRIT
We have the MEANS
—Act and WIN!
Don't delay the Eagle's Flight

OUR SPIRIT cannot be questioned — the means we have, as all the world knows. If we act as real Americans should, we can win, but action must come quickly.

Great military authorities are urging the immediate appropriation of a huge sum of money for the building and manning of an enormous air fleet. With an overwhelming air fleet we can carry the war to the enemy with the least loss of our men's lives. We can go over our enemy's great intrenchments instead of through, and take advantage of every opportunity to destroy whatever is of military value to them. Let us act at once, and by means of our millions and skill transform the Spirit of the Eagle into the reality of the Airplane and through it *win.*

Editorials

Giving the Engineer His Due

NO ONE who is not directly in contact with the work of expanding our army of 65,000 men into a half-million as the first section of the two million we shall probably have to raise can appreciate the magnitude of this task. The direct problems of securing the men and of training them to be efficient in modern methods call for army officers of the highest type and give them every opportunity to show their capacity.

But modern warfare demands far more than men. It is a struggle of machine and manufacturing capacity, a matching of the best engineering intellects to provide the men with the very best mechanical methods of offense and defense. Rifles, guns, shells, airplanes and the like must be furnished in enormous quantities to the men in the field, to say nothing of the foodstuffs, clothing and other supplies. The utilizing of these various necessities of equipment and sustenance is clearly a military matter; but their production is just as clearly the natural function of the engineer, the mechanic, the weaver and the farmer, and the supplying of these articles to the army should be done by those most familiar with them.

Rational efficiency demands that each particular job be done by those best fitted for the work to be done. A graduate engineer would not be kept at clerical work, nor detailed to select horses or to buy socks, but would be put at the particular work for which his training had best fitted him. But the mere fact that he is a graduate would not automatically put him in charge of men who know the work in hand much better than he can possibly know it, due to their long experience and contact with it. This method savors too much of the divine right of kings and kaisers and has no place in a real democracy, besides being extremely inefficient in every way.

Now that war is so largely an emergency proposition, is it not an opportune time for the engineer to come into his own, instead of being merely an appendage to the military? At present his only recognition is as a major, when he is assigned a title so as to secure recognition. Even then he is not recognized as an engineer, but as an army officer, and this classification savors too much of the military régime we are opposing and not enough of the world democracy for which we are striving.

We recognize and appreciate fully the merits of the military officer in conducting military operations, and we would be the last to detract in any way from his glory, his bravery or his devotion to duty. But the engineer is equally necessary, and his ability should be recognized as an engineer and not as an army officer, which he is not, except by courtesy. He should have authority over engineering work by his right as an engineer, and he should not be subject to the orders of a less skilled man who happens to wear a uniform.

Let the civilian engineer be enlisted in the Government service if necessary, let him be held responsible for his work in every particular, but let him also receive due credit as an engineer both for the sake of the profession and to emphasize our belief in a democracy where the civilian must always play his part or the structure falls.

Admitting that the engineer is a very necessary part of the modern structure of civilization—and none deny it—is it not clear that he should also play a much more important rôle in the conduct of public affairs? Here again, not for his own glorification, but for the benefit of the community and the country, just as his work is a necessity to the army. Take, for example, the benefit that would have resulted if there had been a few engineers in the United States Senate when the appropriations for the Bureau of Standards were under consideration. Then we would have been spared the spectacle and the delay of having the money for gage inspection thrown out on the ground that gages had no part in the conduct of war. A few engineers of known repute could have easily shown the nontechnical senators the necessity for gages and thus avoided the delay in making provision for properly testing these essential instruments.

Schrecklichkeit and the Eagle

THE *American Machinist* is gratified to be able to give its readers the first published illustrations showing the actual damage done to German ships in American ports before they were seized by the United States Government. The illustrations on pages 34 and 35 of this issue conveys a remarkable picture of *Schrecklichkeit* as applied to the works of man.

Every man who has devoted his life to mechanical pursuits will feel shocked at the wanton display of savagery exhibited by those who abused the courtesy and restraint of our liberal Government. Up to the moment of the declaration of war these ships, which had sought the hospitality and refuge of our harbors, were free to leave whenever they desired. They were welcome to stay, but there was no restraint upon their going.

Incidents of this kind merely emphasize the unapproachable difference in the point of view of *Kultur* and Americanism, and perhaps it is as well that this striking difference has been emphasized as an object lesson to us of what *Kultur* does to forbearance.

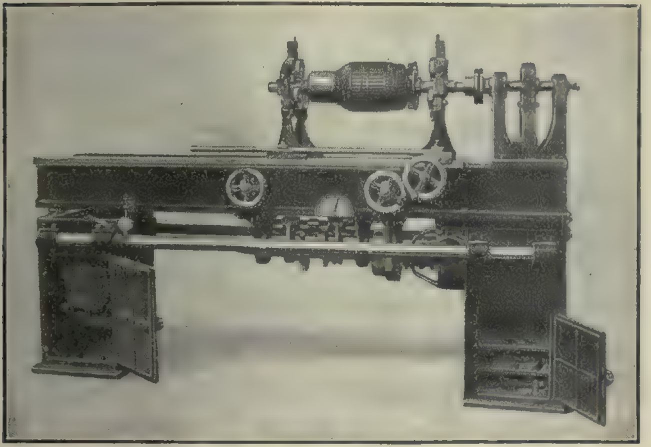
The American eagle does not stoop to the pettiness of the vulture, and the American eagle can bestow full and sufficient punishment for these atrocities in its own way. Examine carefully the two pages immediately following those in this issue showing the damage to German ships. Here is the remedy which we have at hand for the disease of *Schrecklichkeit*. Let the American eagle go forth on its flight to punish not only the wanton destruction of machinery, but also the uncivilized barbarism that depleted a large part of France of its fruit trees.

Shop Equipment News

Carwen Dynamic-Balancing Machine for Rotating Parts

The Carlson-Wenstrom Co., Richmond St. at Erie Ave., Philadelphia, Penn., is now marketing the Carwen dynamic-balancing machine illustrated. The machine is based on the Akimoff patents, but all adjustments have been brought out to handwheels at the front of the machine, thus allowing them to be made while the machine is running.

The part to be balanced runs at the same speed and in the same direction as the dummy shaft carrying the adjusting weights. When the machine is in operation, any unbalance in the part being tested will cause the hinged bed to vibrate. When this occurs, the adjusting weights are moved until they form a couple which is equal and opposite to that in the unbalanced part. This condition is indicated by the cessation of the vibration. The positions of the weights are then determined, and from this information the operations necessary to balance the part are calculated.



CARWEN DYNAMIC-BALANCING MACHINE

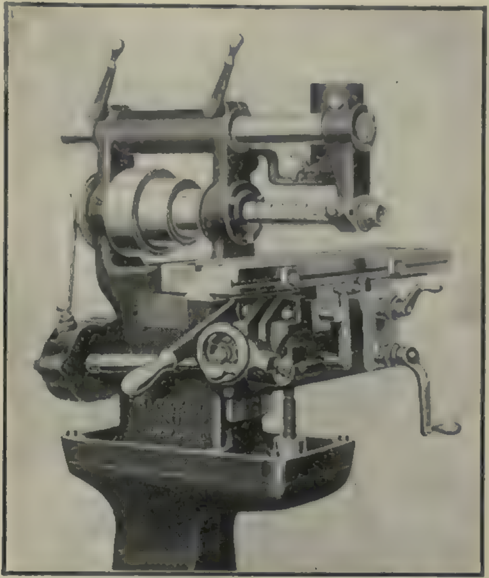
A micrometer indicator is connected between the hinged bed and the pedestal to indicate small vibrations. The machine is driven by an electric motor through a train of gears and a loose coupling. Parts to be dynamically balanced must be put in static balance before being placed in the machine.

Bickett Hand- or Power-Feed Horizontal Bench Miller

The horizontal bench miller shown in the illustration is arranged for both power and hand speed. It is one of the latest products of the Bickett Machine and Manufacturing Co., Cincinnati, Ohio.

The spindle is of crucible steel ground to size and is mounted on Gurney ball bearings that may be adjusted for wear. Six speeds are provided for, it being possible to operate the machine at speeds as great as 2500 r.p.m. The arbor is of tool steel ground all over and has a diameter of 1 in. It is fitted with a set of cast-iron spacing collars, both the arbor and the collars being keyseated. The arbor support bracket is supplied with both a bushed center bearing and with the ordinary pointed center, either of which may be used for supporting the end of the cutter arbor when heavy cuts are being made.

Oil grooves and pockets and a ½-in. T-slot, running lengthwise, are incorporated in the table. A reversible power feed is provided for the longitudinal movement of the table and will give three different speeds. It is driven by a 1-in. leather belt running on three-step cones and is transmitted through a set of tumbler gears and a universal-drive shaft to a worm and gear underneath the table. An automatic trip is used to release the worm at the end of the cut in order to reverse the table travel. The power feed may be quickly changed to hand feed, which is operated either by means of a geared lever or by handwheel.



BICKETT NO. 1 HORIZONTAL BENCH MILLER

Longitudinal feed, 18 in.; traverse, 5 in.; vertical feed, 5 in.; hole through spindle, ⅞ in.; arbor, 9 in. long, 1 in. diameter; arbor support arm, 1$\frac{13}{16}$ in. in diameter; maximum distance, face of column to arbor support bracket, 11½ in.; table, 24 x 5½ in.; power feeds, 0.003, 0.006 and 0.009 in. per revolution of spindle; height of machine without pedestal, 25 in.; dimension of base, 9½ x 18 inches

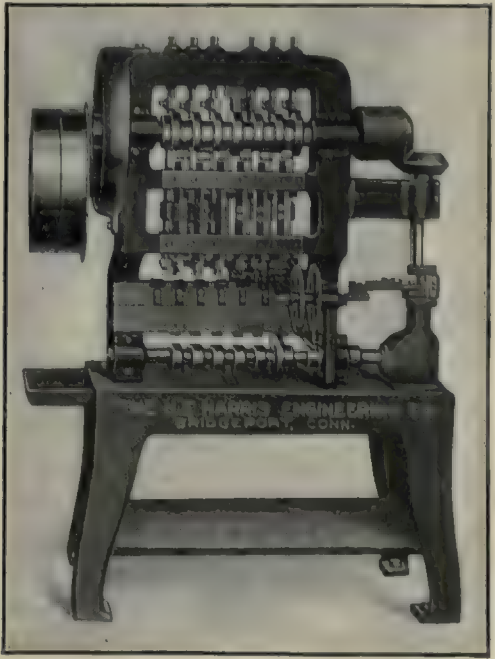
The knee is of the box type with adjustable gibs and is raised and lowered by an elevating screw with an Acme thread. Both the transverse and the vertical feed are provided with dials graduated to read in thousandths of an inch. The regular equipment includes countershaft, arbor, lever for hand feed, necessary wrenches and an oil pot. Special equipment includes a plain vise, swivel vise, draw-in attachment, draw-in collar, pedestal and lubrication system with pump, piping, etc.

Harris Automatic Multiple-Plunger Press

The automatic multiple-plunger press illustrated is the product of the H. E. Harris Engineering Co., Bridgeport, Conn., having been placed on the market to meet the demand for a press for manufacturing eyelets, snap fasteners, pencil tips, primers, buttons, ferrules and other similar types of sheet-metal work.

The machines are built in sizes of from 3 to 12 plungers and may be run at speeds of from 65 to 150 strokes per minute. All operations are automatic, and no handling is necessary between the various operations. The left side of the frame is offset in such a manner that a double punch may be carried on the last plunger, thus making it possible to perform one more operation than the press has plungers. All plungers are operated simultaneously by cams, the throw of which is governed by the nature of the work. The dies and transfer slide are carried by a bolster fitted to the main frame.

After completing an operation, the plungers are returned to their upper position by a second set of cams carried on the same shaft. A vertical crankshaft, geared to the camshaft, serves to operate the transfer slide, which takes the blank cut from the strip of metal, on the reel at the front of the machine, and feeds it through the various operations. An intermittent ratchet is used to operate the feed-roll mechanism. After each operation the work is returned from the die to the transfer slide by vertical ejector plungers operated by the lower camshaft, which is driven from the upper one through miter gears. All cams are of hardened tool steel and operate against adjustable bumpers on the ends of the plungers. Hardened tool steel is also used for the plunger bodies, which are ground to correct size.



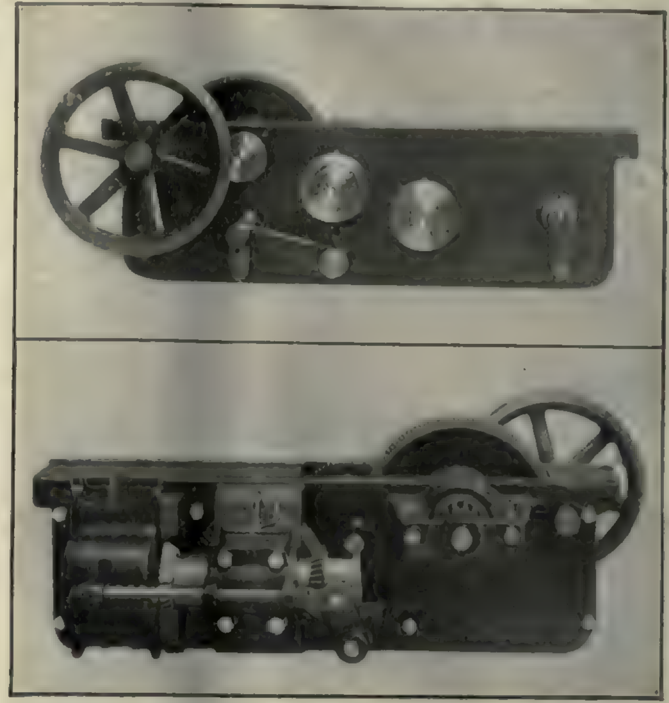
AUTOMATIC MULTIPLE-PLUNGER PRESS

Movement of plungers, $1\frac{7}{8}$ in.; distance between plungers, $2\frac{1}{4}$ in.; maximum diameter of work, $1\frac{1}{4}$ in.; maximum depth of draw, $\frac{5}{16}$ in.; weight, 6-plunger type, 2215 pounds

Houston-Stanwood Lathe Apron

The Houston, Stanwood & Gamble Co., Cincinnati, Ohio, has built the lathe apron illustrated, which will hereafter be used on its lathes in sizes of from 30 to 60 in. Front and back views are given in the illustration.

All gears are of steel, and a toothed clutch is used. A shearing pin is incorporated in the mechanism for safety purposes. The pinion may be withdrawn from the rack when cutting threads. The customary methods are followed for connecting the nut and the lead screw and for engaging the carriage reverse gears. A gear reduction is incorporated in the handwheel movement of the carriage in order to insure easy operation. The rack pinion is provided with an outer bearing. A wick oiling system is used.



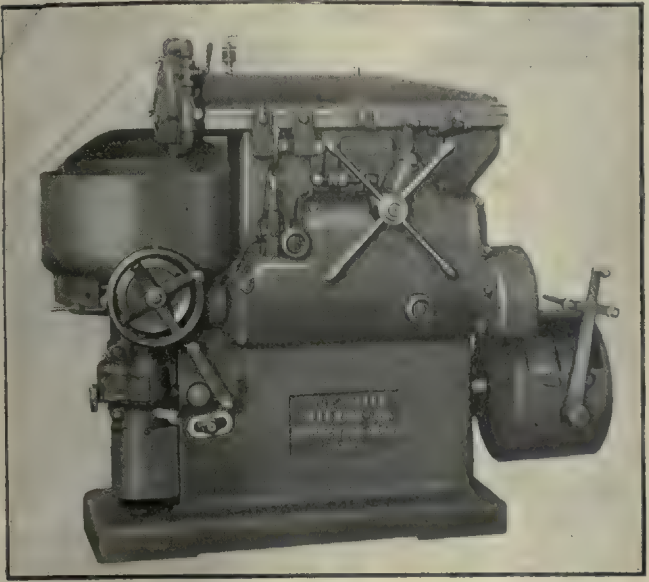
FRONT AND REAR VIEWS OF LATHE APRON

Heald Rotary Surface Grinder

The illustration shows one of the latest rotary surface grinders to make its appearance on the market. It is the product of the Heald Machine Co., Worcester, Mass., and has been designed especially to grind surfaces up to 12 in. in diameter or any number of small parts arranged in the same area. The machine is entirely self-contained, being driven from the lineshaft by a single belt or from a motor attached to the base. The feed box is located at the front of the machine and provides four speeds for the chuck and four rates of travel for the wheel slide. The wheel slide may also be fed by means of the spider wheel.

Lubrication of the 13 bearings used on the machine is taken care of by a central oil supply located at the front of the box near the top. An idler pulley at the rear serves to keep the proper tension on the spindle-driving belt. The spindle runs in a fixed taper bushing at the wheel end and in a ball bearing, held in an adjustable sleeve at the rear end. The spindle slide has two flatways and a gib at the rear for taking up wear. Cone-shaped and ball bearings are used respectively on the upper and lower ends of the vertical chuck spindle, and the drive is by spiral gears. The upper bearing may be adjusted in case of wear. The gears are so arranged that the spindle may be tipped in case concave or convex work is being handled.

Vertical movement of the chuck is secured by means of the handwheel shown at the left, or by power feed. The chuck is held between the walls of the base, the upper end being pivoted on two trunnions while the lower end is clamped by a bolt passing through the base and the bracket. This bolt allows the chuck to be tilted, and a dial is provided to indicate the angle. The slide has four dogs, two used to govern the length of stroke and two to govern the feed. Regular equipment includes pump, tank, water guards and all other attachments necessary for wet grinding.

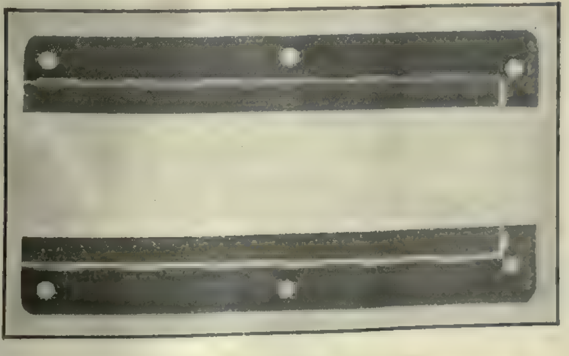


HEALD ROTARY SURFACE GRINDER

Diameter of chuck, 8, 10 or 12 in., as desired; grinding wheel, 12 x 1 in. with 5-in. hole; maximum distance top of chuck to center of spindle, 9½ in.; minimum diameter grinding wheel, 7½ in.; vertical adjustment of chuck, 5 in.; maximum swing inside water pan, 15 in.; floor space, belt drive, 41 x 66 in.; motor drive, 41 x 85 inches

Universal Card Holder

The Detroit Stamping Co., 955 West Fort St., Detroit, Mich., has recently placed on the market the universal card holders shown in the illustration. A set of card holders consists of two metal stampings, which may be tacked in place to fit the size of the card.



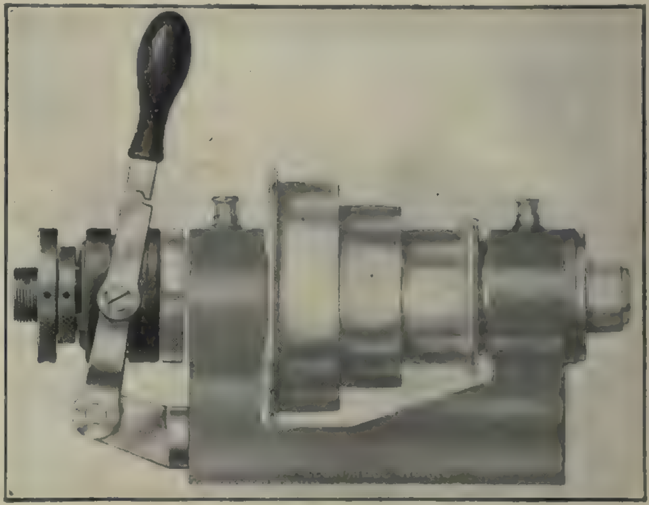
UNIVERSAL CARD HOLDER

The advantage of these holders is that cards of varying sizes may be used and may be placed in either a vertical or a horizontal position. Cards may be easily put in or taken out, and nearly the entire card is available for the necessary writing.

Elgin Automatic Chuck Closer

The Elgin Tool Works, Elgin, Ill., have recently placed on the market the automatic chuck closer illustrated, which may be fitted to any of their lathe heads in a few moments. The attachment consists of a draw spindle, two sleeves, dogs, a yoke and a bracket and allows work to be inserted in or removed from the spindle without stopping the machine.

The draw spindle is threaded at the rear end and fitted with two checknuts, which provide suitable adjustment for the required collar tension. The inner sleeve, which carries the dog operated by the sleeve and yoke, slips directly over the lathe spindle and is held in place by a setscrew. The device is so designed that it requires no extra fitting, the tapped holes used for fastening indexing, dividing and other attachments serving to secure it in place. The ordinary use of the draw spindle is not interfered with in any way.



ELGIN AUTOMATIC CHUCK CLOSER

Heat-Treatment of Cutters

By R. C. Wilson

Recent articles regarding the heat-treatment of high-speed steel prompt me to tell a little experience I had with some milling cutters that were used to cut a steel forging with a high percentage of manganese. These cutters were as near glass hard as the heat-treating department could get them, but they would stand up only a very short time. I had cutters drawn to 700 deg. F., and they gave us about 200 per cent. more service than before.

They had been previously hardened according to the treatment given by Mr. Hartley on page 624. This treatment had been used for some time, except that the quenching heat was somewhat higher than 1800 deg. We are still experimenting with these cutters.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Hotel Powhatan, Washington, D. C., June 30, 1917—Some things are beginning to move in the matter of the orders for motor trucks and other supplies, and contracts should be placed in a number of lines in a very short time. Some idea of the work that lies ahead of us may be had from the facts that there were 35,000 trucks called for in the bids and that three different concerns offered to supply the whole lot. This experience gives some notion of the truck-making capacity of the country. With such an example, it is not boasting to suggest that none of us realize how great a manufacturing capacity we really have when it is once properly organized and directed by some central head that can prevent needless duplication and overlapping. A far greater problem than making the trucks is to provide ships for taking them to France, which promises to be the place where the war is to be decided. But this too can be solved when we really get down to business and put our manufacturing capacity and, more than that, our manufacturing capability to a real test. We must not forget that Commodore Perry built his ships on Lake Erie from trees that he felled for the purpose. They were not seasoned in the least, yet made a fairly successful job of it at that.

Readers of these columns are asked to pardon their diminution or cessation during the coming few weeks as our Washington editor has been selected by the Council of National Defense to perform a special foreign mission of great importance. We will, however, during Mr. Colvin's absence from Washington, attempt to keep our readers posted on all of the most important developments of interest to machinery building plants.

The hopeful sign, or one such at least, is that contracts are being let to plants which have not counted much in our recent shipbuilding program and which consequently can be called new.

These ships involve another problem that must be looked after promptly. This is the matter of instruments with which they are to be equipped, such as chronometers, sextants, compasses and the like, not forgetting the compasses and dividers that are used in measuring and checking up the charts.

It is difficult to understand just why no chronometers are made in this country, but this seems to be the case, except for those which are assembled from Swiss movements. The instruments on the interned German ships will all be needed for those vessels, and even some of them are missing, the officers taking them off in some cases and either selling or destroying them. Most of them have been rounded up, however, and will be in commission as soon as needed. We do not like to admit that we cannot make chronometers at least as well as our neighbors across the ocean, and it seems as if it is up to our watch and clock shops of the better grade to get busy and show what they can do. The failure to make these instruments must surely be due to commercial reasons, and not to a real lack of skill on the part of the men in the shops.

The same thing is true in a measure of other instruments, even the plain compass and dividers. Only a few firms in this country make them, mostly on account of commercial reasons. But there is a ready market for at least a thousand sets at this moment, and probably five times this number as soon as it is known that they can be secured with certainty. Those who have shop capacity and experience that can be turned in this direction should get into communication with the Shipping Board, Munsey Building, or the Compass Division at the Naval Observatory, both in Washton. "The best-laid plans of mice and metric men go aft astray," to misquote our old friend Burns, the occasion being the latest report of the Standards Committee of the S. A. E., which now means the Society of Automotive Engineers and included in its meeting of June 25 and 26 all makers of things which "automote," from Simon Lake, of submarine fame, to Charles Manley and others in the airplane game, with a host of automobile and motor-boat men in between. The society now includes all that "motes"—in the air, on land or sea, and under the sea.

As I wrote some time ago, the airplane makers decided to use metric measurements to conform with French and British practice. But when they came to think it over carefully and calmly at home, they began to see some of the practical difficulties that presented themselves when it came to manufacturing in large quantities, and decided that this was no time to make any such changes. The words of the committee are interesting:

"In view of the fact that the Army and Navy Departments are not both in favor of adopting the metric system, and further in view of the necessity of arriving at standards that will mean the least possible delay in the production of airplane parts, this Division (the Division of Standards Committee) recommends definitely to use the English system of measurements except in isolated cases such as spark-plug threads, where the metric system is desirable in order to effect interchangeability with some well-established standard."

Nor is this all. They have worked out tables for ball bearings in inch measurements and recommend the use of the inch instead of the millimeter, which has heretofore held sway in almost every ball-bearing list. They give carefully worked-out tables and also formulas, which naturally involve the use of constants. A very commendable feature is the elimination of all decimal places over two and the use of common fractions in most cases. After the formula for each dimension are definite instructions such as "to nearest $\frac{1}{16}$ in."; "to nearest $\frac{1}{32}$ in. greater" or "to nearest $^1/_{100}$ in." This gives definite instructions and at the same time allows the use of rational dimensions in all cases.

The society also recommends the elimination of gage numbers for rods, wires, tubing, sheet metals and similar materials, the use of decimals for wall thickness of tubes, for sheets, etc., and inch and fractions for the outside measurements of tubes. Altogether the friends of metric measurement seem to be up against it at present; and the desire of Dr. Kunz to use this emergency to put over the adoption of the metric system seems to be a fading dream, or was it a nightmare?

Personals

R. E. Uptegraff has accepted a position as designing engineer in the transformer department of the Packard Electric Co., Warren, Ohio.

Cornelius S. Vosburgh and **Dwight S. Goodwin,** of Waterbury, Conn., have gone to Chambery, Savoie, France, for the purpose of erecting a large rolling mill.

H. L. Paulus, R. G. Ferguson and **F. L. Graf,** formerly connected with the Baird Machinery Co., Pittsburgh, Penn., have become connected with the J. S. Miller Co., also of Pittsburgh.

Robert R. Keith, formerly in charge of the Sheffield plant of the Fairbanks-Morse Co., of Three Rivers, Mich., has taken a position as plant manager of the Holt Manufacturing Co., Peoria, Illinois.

M. M. Moore has severed his connection with the machine-tool department of Gaston, Williams & Wigmore, Inc., New York, and become associated with the sales department of John W. Thorne & Co., Inc., of 165 Broadway, New York City.

Albert P. Weigel has severed his connection with the Superior Machine Tool Co. as superintendent and general manager and organized the Weigel Machine Tool Co., Peru, Ind. The new company will engage in the manufacture of high-grade tools.

George W. Dover has disposed of his interest in the Dover-McDevitt Co., Providence, R. I., and has started a new shop at Baker and Eddy Sts. All kind of toolwork and light machinery building will be handled, the company being known as George W. Dover, Inc. The officers are George W. Dover, president and general manager; Benjamin Peckshaw, vice president; Fred H. Bratesman, secretary and treasurer.

James H. Herron, who was inaugurated president of the Cleveland Engineering Society at the 37th annual banquet, held June 12, was born in 1875 in Girard, Penn. Receiving his early education at the Girard Academy, he served as apprentice at the Stearns Manufacturing Co., Erie, Penn., from 1890 to 1894, and then served in the drafting department and as chief draftsman for the Erie City Iron Works, Erie, Penn., from 1894 to 1897. From 1897 to 1899 he studied at the University of Michigan, at this later date taking the position of draftsman with the Cambria Steel Co., Johnstown, Penn., where he remained until 1902, becoming chief engineer at that time of the Bury Compressor Co., Erie, Penn., of which concern he became commercial manager in 1905. In 1907 Mr. Herron became metallurgical engineer for the Detroit Steel Products Co. He became a member of the American Institute of Mining Engineers in 1914, at which time he was a consulting metallurgical engineer. Mr. Herron is a member of the American Society of Mechanical Engineers, the American Chemical Society and the American Society of Automotive Engineers.

Business Items

The Cooper-Hewitt Electric Co. has moved its Philadelphia office from 124 South Eighth St. to the Drexel Building.

The Phœnix Manufacturing Co., manufacturer of machine tools, with works at Eau Claire, Wis., has moved its Cleveland office from 1430 West Sixth St., to 913 Engineers Building.

The Manufacturers Equipment Co., Chicago, Ill., has opened a New York office at 30 Church St., with E. W. Chamberlain in charge. The company manufactures air chucks, air cylinders and other similar devices.

Homer Strong will carry on the business formerly conducted under the name of Strong & Hery Co., Inc. The office has been moved from 301 State St., Rochester, N. Y., to 818 University Block, Syracuse, New York.

Wheelock, Lovejoy & Co., Cambridge, Mass., and New York City, have opened a warehouse and office at 1800 Columbus Road, Cleveland, Ohio, where a complete stock of their special Hy-Ten machinery steel will be carried.

The Lincoln Machine Co., Pawtucket, R. I., has been formed and incorporated to take over the business of the Dover-McDevitt Co., of Providence. The former equipment has been removed to a new building at Main and Carver Sts., Pawtucket, and additional machinery that will greatly increase facilities is being added. The new company will act as mechanical engineers and manufacturers, doing all kinds of special-tool work, making interchangeable machine parts and high-grade machinery. J. Frederick McCloskey, formerly superintendent of the Taft-Pierce Manufacturing Co. and later with the United Shoe Machinery Co. and the Remington Arms Co., of Bridgeport, is president, treasurer and manager. Other officers of the company are John N. McDevitt, vice president and assistant treasurer; and James F. Pullan, superintendent; E. J. Peirce, Jr., of 253 Broadway, is the New York representative.

The Westinghouse Electric and Manufacturing Co. held its regular meeting of the board of directors in New York on June 20. An extra dividend of one-half of 1 per cent. was declared on both the common and the preferred stock for the benefit of the Red Cross fund. The following officers were elected: Chairman of the board, G. E. Tripp; president, E. M. Herr; vice presidents, L. A. Osborne, C. A. Terry and H. P. Davis; acting vice president, T. P. Gaylord; comptroller and secretary, J. C. Bennett; assistant secretary, W. H. Jones; assistant treasurer and secretary, S. H. Anderson; auditor, F. E. Craig; assistant auditor, W. B. Covil. Three new vice presidential offices were created, and the following were elected to fill them: H. B. Shute, H. T. Herr and W. Cary. H. F. Baetz was elected to succeed Mr. Shute as treasurer, while L. W. Lyons succeeds Mr. Baetz. W. J. Patterson was elected to the new position of assistant auditor.

Trade Catalogs

"The Ideal Drive for Textile Machinery." Link-Belt Co., Chicago, Ill. Book No. 258. Pp. 30; 6 x 9 in.; illustrated. This describes the application of the Link-Belt silent chain to textile machinery.

"Hess-Bright Ball Bearings—How To Apply Them." The Hess-Bright Manufacturing Co., Philadelphia, Penn. Pamphlet containing article by H. Wickland of the engineering department of this company. Pp. 12; 4 x 9 in.; illustrated.

"The Application of Ball Bearings to the Airplane." The Hess-Bright Manufacturing Co., Philadelphia, Penn. This is the title of a pamphlet containing article by W. L. Batt M. E., and should be useful to those interested. Pp. 10; 4 x 9 in.; illustrated.

Drills, Reamers, Sockets, Counterbores, etc. The Cleveland Twist Drill Co., Cleveland, Ohio. Catalog No. 39. Pp. 238; 5 x 7½ in.; illustrated. This is very conveniently arranged with thumb index enabling anyone to quickly locate particular tool wanted.

Grinding and Polishing Machinery. Gardner Machine Co., Beloit, Wis. Catalog. Pp. 122; 7 x 10 in.; illustrated. This very fully describes the line of disk grinders and other polishing machinery made by this company, giving specifications, also views of grinders in operation.

Forthcoming Meetings

The twelfth annual exhibit of foundry and machine-shop equipment and supplies will be held under the auspices of the American Foundrymen's Association in the Mechanics Building, Boston, Mass., from Sept. 25 to 28, 1917. The officers of the exhibit committee are: President, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; vice president, Benjamin D. Fuller, Westinghouse Electric and Manufacturing Co., Cleveland, Ohio; secretary and treasurer, A. O. Backert, 12th and Chestnut Sts., Cleveland, Ohio; manager of the department of exhibits, C. E. Hoyt, 123 West Madison St., Chicago, Illinois.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

The American and Canadian engineers and architects of Norwegian birth and descent will hold an informal congress and reunion at the Chicago Norske Klub, Logan Square, Chicago, Ill., Sept. 27 to 29, 1917.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Qutations were current as follows at the points and dates indicated:

	June 29, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$45.00	$40.00	$14.50
No. 2X Northern Foundry, New York..	50.25	46.00	19.75
No. 2 Northern Foundry, Chicago......	55.00	47.00	19.00
Bessemer, Pittsburgh	55.95	50.95	21.95
Basic, Pittsburgh	50.00	45.00	18.95
No. 2X, Philadelphia................	50.75	45.50	19.75
No. 2, Valley........................	53.00	45.00	18.50
No. 2, Southern Cincinnati............	47.90	42.90	17.40
Basic, Eastern Pennsylvania..........	50.00	42.50	19.50
Gray forge, Pittsburgh...............	47.95	43.95	18.70

STEEL SHAPES—The following base prices in cents per pound are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	June 29, 1917	One Month Ago	One Year Ago	June 29, 1917	One Year Ago	June 29, 1917	One Year Ago
Structural shapes ...	5.25	5.00	3.50	5.00	3.25	5.00	3.10
Soft steel bars.....	5.00	4.75	3.55	4.50	3.25	4.50	3.10
Soft steel bar shapes	5.00	4.75	3.50	4.50	3.25	4.50	3.10
Plates	9.00	8.00	4.00	8.00	3.65	8.00	3.50

BAR IRON—Prices in cents per pound at the places named are as follows:

	June 29, 1917	One Year Ago
Pittsburgh, mill	4.25	2.60
Warehouse, New York....................	4.60	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

		New York			Cleveland		Chicago	
	Pittsburgh, Mill, in Carloads	June 29, 1917	One Month Ago	One Year Ago	June 29, 1917	One Year Ago	June 29, 1917	One Year Ago
*No. 28 black......	8.25	10.00	9.50	3.65	9.00	3.20	9.50	3.20
*No. 26 black......	8.15	9.90	9.40	3.55	8.90	3.10	9.40	3.10
*Nos. 22 and 24 black	8.10	9.85	9.35	3.50	8.85	3.05	9.35	3.05
Nos. 18 and 20 black	8.05	9.80	9.30	3.45	8.80	3.00	9.30	3.00
No. 16 blue annealed.	3.60	9.70	9.20	4.70	8.45	3.70	9.70	3.60
No. 14 blue annealed.	8.35	9.60	9.10	4.60	8.35	3.60	9.60	3.50
No. 12 blue annealed.	8.10	9.55	9.05	4.50	8.30	3.50	9.55	3.45
No. 10 blue annealed.	7.85	9.50	9.05	4.55	8.25	3.55	9.50	3.50
*No. 28 galvanized..	10.25	13.00	12.00	5.65	10.50	5.50	11.00	5.50
*No. 26 galvanized..	9.95	12.70	11.70	5.35	10.20	5.10	10.70	5.20
*No. 24 galvanized..	9.80	12.55	11.55	5.20	10.55	5.05	10.55	5.05

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring fair-sized lots, the following quotations hold:

	June 29, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	40%	45%
Cleveland	40%	45%
Chicago	45%	50%

SWEDISH (NORWAY) IRON—This material per 100 lb. sells as follows:

	June 29, 1917	One Year Ago
New York	$20.00@26.00	$6.00
Cleveland	12.30	6.30
Chicago	12.00	5.25

In coils an advance of 50c. usually is charged.
Note—Stock scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire*	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16 ..	
No. 18	
No. 20	

*Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York June 29, 1917	Cleveland June 29, 1917	Chicago June 29, 1917
Tire	5.00	5.00	4.50
Toe calk	5.00	5.50	4.75
Openhearth spring steel...	7.00	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Carbon tool steel, base price	10.00	13.00	....
Special best cast steel....	14.00@18.00	20.00	....

*In bars.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh basing card in effect May 1, 1917:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜..	42%	15½%	¾ to 1½.....	38%	22%
½	46%	31½%			

LAP WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
2	42%	27½%	1¼	23%	8%
2½ to 6......	45%	35½%	1½	30%	16%
			2	31%	17%
			2½ to 4......	33%	20%
			4½ to 6......	33%	20%

BUTT WELD, EXTRA STRONG PLAIN ENDS

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜..	38%	20½%	¾ to 1½.....	38%	23%
½	43%	30½%			
¾ to 1½.....	47%	34½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
2	40%	28½%	1¼	24%	8%
2½ to 4......	43%	31½%	1½	30%	16%
4½ to 6......	42%	30½%	2	32%	19%
			2¼ to 4......	34%	22%
			4½ to 6......	33%	21%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	43%	28%
3½ to 6 in. steel lap welded	28%	10%	39%	25%	39%	25%

Malleable fittings, Class B and C, from New York stock sell at 5% from list price. Cast iron, standard sizes, 27 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound:

	June 29, 1917	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)*....	30.00	31.00	28.00
Tin	62.50	61.00	40.00
Lead	11.75	12.00	7.00
Spelter	9.25	9.50	12.25

*Third-quarter copper; for spot copper the market price is 33c.

ST. LOUIS

	June 29, 1917	One Month Ago	One Year Ago
Lead	11.50	10.75	6.85
Spelter	9.25	9.25	12.25

At the places named, the following prices in cents per pound prevail:

	New York			Cleveland		Chicago	
	June 29, 1917	One Month Ago	One Year Ago	June 29, 1917	One Year Ago	June 29, 1917	One Year Ago
Copper sheets, base.	42.00	42.00	37.50	42.00	37.50	42.00	37.50
Copper wire (carload lots)	39.50	39.50	37.50	39.00	33.00	39.50	38.00
Brass pipe, base...	47.50	47.50	46.50	46.00	45.00	47.50	46.00
Brass sheets	45.00	45.00	44.50	38.00	42.00	43.50	38.00
Solder ½ and ½ (case lots)	39.125	41.25	30.62½	39.50	28.75	39.50	27.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	June 29, 1917	One Month Ago	Six Months Ago
Mill	$42.00	$42.00	....
New York	45.50	45.50	$44.50
Cleveland	38.00	38.00	38.00
Chicago	42.50	42.50	40.00

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.................................. 19.00

	In Casks		Broken Lots	
	June 29, 1917	One Year Ago	June 29, 1917	One Year Ago
New York	21.00	21.50	21.50	22.00
Cleveland	23.00	22.75	23.25	23.25
Chicago	22.50	20.00	23.50	21.00

ANTIMONY—Chinese and Japanese brands in cents per pound for spot delivery, duty paid:

	June 29, 1917	One Year Ago
New York	19.00	18.00
Cleveland	21.00	24.00
Chicago	19.75	23.00

Mechanical Equipment of a Hawaiian Sugar Plantation

THE chief industry of the Hawaiian Islands, as has been pointed out in other articles, is the production of cane sugar, the total value of this commodity for last year approximating closely $60,000,000.

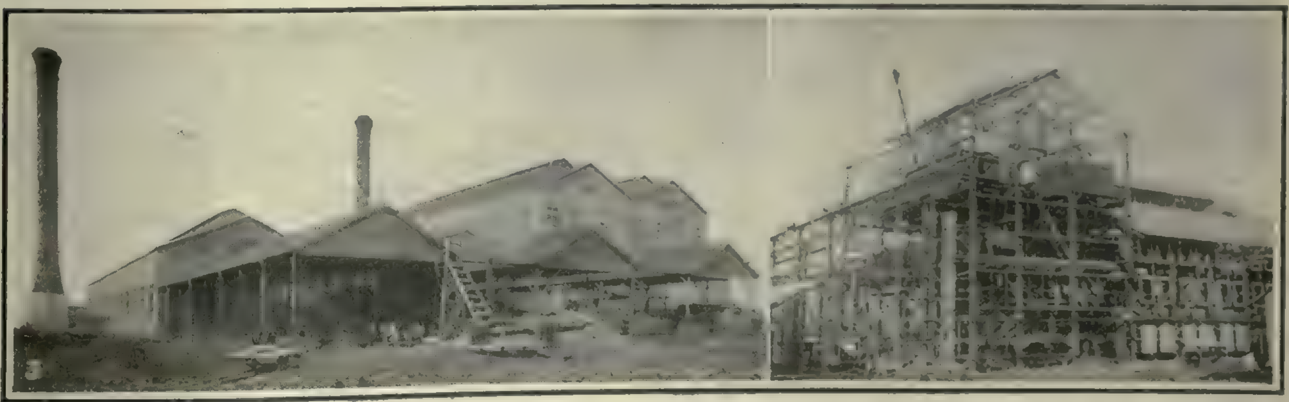
There are on the Islands of Hawaii, Maui, Oahu and Kauai some 50 or more sugar plantations, all of them, with two or three exceptions, operating their own mills. These plantations range in area up to over 30,000 acres, with, in some instances, 10,000 to 15,000 acres under cultivation, and employ as many as 3000 workmen.

The variety of work and the extent of the operations conducted on some of the plantations and in their mills can hardly be appreciated without a personal visit to the district. It is believed, however that an article dealing with important features of some of these plantations and mills may arouse the interest of engineers and be of real service to machinery builders in pointing out the extensive application of mechanical equipment in a field so little known to manufacturers in general.

Some of these plantations and mills are within a few miles of the City of Honolulu, and one, the Ewa plantation, about 18 miles out, has one of the largest sugar mills in the world. This mill is equipped with up-to-date machinery in every department. As in the cases of various other establishments on the island, there is much auxiliary apparatus in the way of irrigating pumps, plantation locomotives, cars and other equipment essential to the satisfactory operation of big sugar factories.

In this connection it is of interest to mention that on the Ewa plantation the irrigation system alone is valued at $850,000 and consists of eight pumping stations, in which are installed 12 pumping engines that supply 91 million gallons of water daily to the cane fields. The immensity of these figures can best be appreciated by comparison with the water-supply of some great city like New York, which consumes daily 500 million gallons. These figures show that the one plantation at Ewa uses in irrigation practically one-fifth as much water as is required by the 5,000,000 residents of New York City.

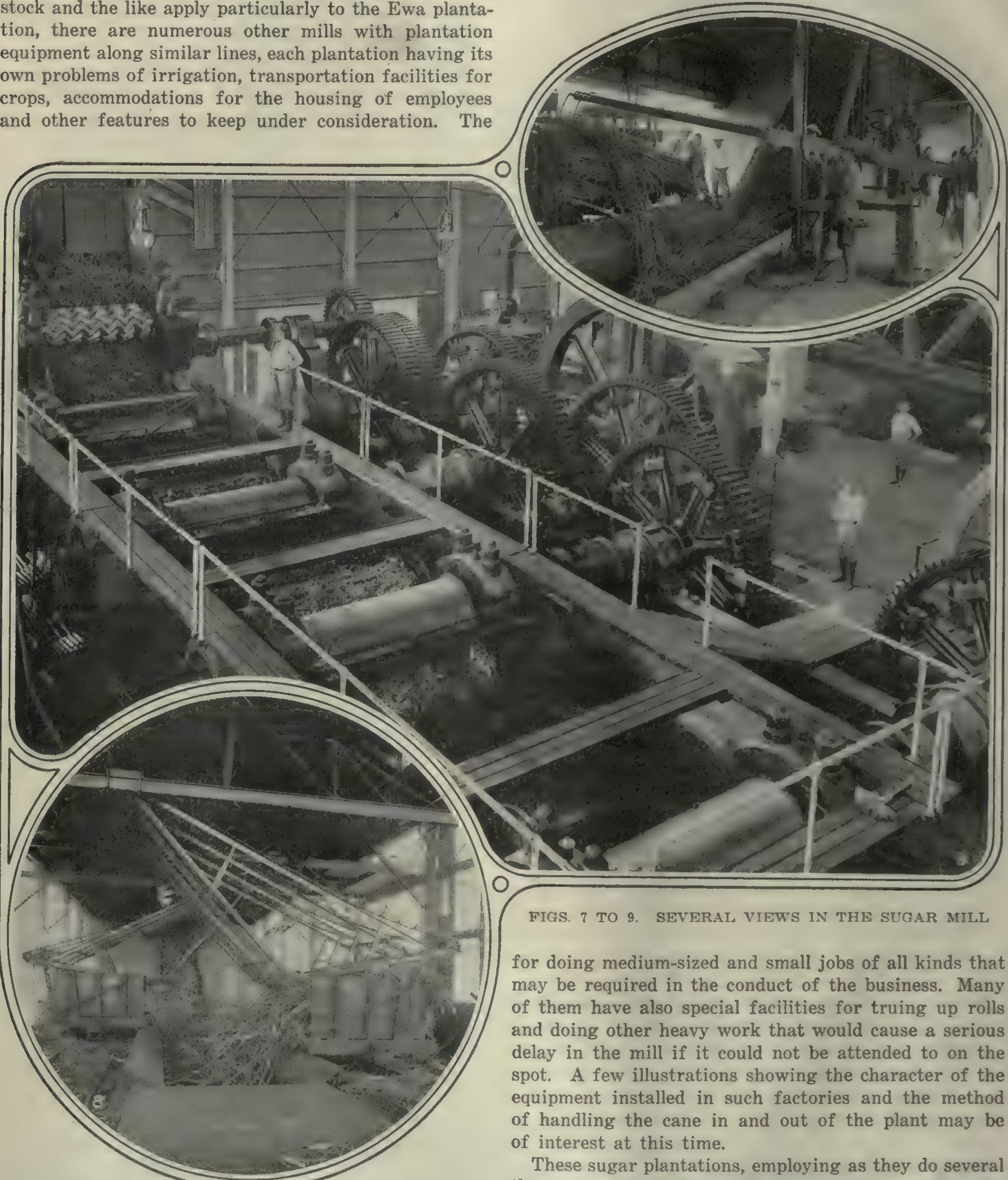
There are 30 miles of permanent track about the plantation and 8 miles of portable track. In the line of rolling stock for handling cane between plantation and mills there are six Baldwin locomotives and 600 cane cars of five tons' capacity, besides a number of



FIGS. 3 AND 4. A MODERN SUGAR-MILL PLANT REQUIRES TONS OF STRUCTURAL STEEL

regular flat-cars. In addition to the railroad equipment, nearly 150 horses and mules are used about the plantation. The Ewa plantation has nearly 8000 acres of growing cane, and the crop for 1914 amounted to 31,500 tons.

While the above data relating to irrigation, rolling stock and the like apply particularly to the Ewa plantation, there are numerous other mills with plantation equipment along similar lines, each plantation having its own problems of irrigation, transportation facilities for crops, accommodations for the housing of employees and other features to keep under consideration. The equipment in the line of implements for preparing soil, planting and harvesting is always of great importance; and as will be understood, the managers have to supervise not only the production of the raw material—that is, the growing of the cane—but also the manufacture of the commodity, raw sugar, in the mills. It is difficult at the moment to recall other industries where raw material and the manufactured product are turned out.



FIGS. 7 TO 9. SEVERAL VIEWS IN THE SUGAR MILL

Most of the mills about the islands have their own machine shops for making repairs to the equipment and for doing medium-sized and small jobs of all kinds that may be required in the conduct of the business. Many of them have also special facilities for truing up rolls and doing other heavy work that would cause a serious delay in the mill if it could not be attended to on the spot. A few illustrations showing the character of the equipment installed in such factories and the method of handling the cane in and out of the plant may be of interest at this time.

These sugar plantations, employing as they do several thousands of people, constitute industrial communities of themselves and are often located directly on the main railroad line with a station on the premises, as shown by Fig. 1.

A typical sugar mill of modern design is illustrated in Fig. 2, this view showing a great number of cane cars in front of the building and a large quantity of cane alongside the plantation tracks. Ordinarily, these buildings are constructed with a steel skeleton and covered in with corrugated metal. There are big monitors running the full length of the roofs, with many skylights, windows and doors in the walls of the building. The adjoining sheds, in which are installed the repair shops, power plant, stock racks, etc., provide ample storage facilities for more or less of the equipment and are so constructed as to have liberal doorways and openings on all sides. Frequently, they are covered principally with a roof only, as in Fig. 3, to give the freest possible circulation of air.

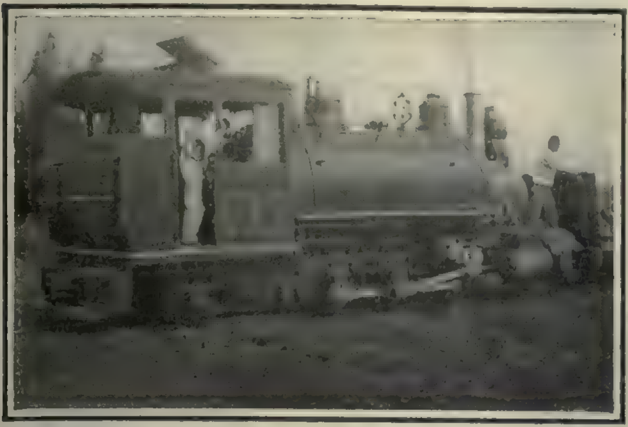


FIG. 6. PLANTATION LOCOMOTIVE AND SUGAR-CANE CAR

A big sugar mill under process of erection is shown in Fig. 4, which illustrates clearly the type of construction and shows the method of installing much of the heavier equipment before the steelwork is closed in at sides and ends. In this view, on the second floor of the structure will be noticed a battery of large cylindrical tanks, which are known as crystallizers. These receptacles often range up to 8 ft. or more in diameter by 20 ft. in length. They are provided in each instance with a long horizontal shaft, carrying blades or vanes that are revolved by worm gearing at the end of the shaft and keep the syrup in motion to hasten the process of evaporation and the crystallization of the sugar. A characteristic growth of cane is illustrated in Fig. 5. In the Hawaiian Islands, sugar cane frequently reaches the height of fully 12 ft., and some of the stalks in this view easily measure that height. The cane, after cutting and stripping, is loaded on the plantation cars and hauled into the mills, as in Fig. 2. One of the usual types of locomotive and a car are shown in Fig. 6. The appearance of the loaded cars as they are pushed into the factory is shown in Figs. 7 and 8, where are also represented two kinds of cane unloader.

The first of these, a Wicks machine, consists of an outrigger or arm pivoted and balanced at one end, while the projecting, or working, end extends out over the loaded cars. A vertical fork is operated by power-driven mechanism at the rear end to pull the bundles of cane from the car on a sloping platform in front, from which surface the cane slides onto a traveling conveyor that carries it upward into the mill proper, where it shoots down into the crushing rolls.

The other type of unloader, illustrated in Fig. 8, is suspended from the roof chords and carries a series of traveling chain belts with forks spaced about a foot and a half apart. As they travel toward the center of the building and over the conveying belt, they drag the cane from the cars and drop it onto the conveyor. This view shows two of these unloaders at work at opposite sides of the building, there being two tracks for the cars as drawn in from the plantation.

CANE-CRUSHING MILL

Fig. 9 shows the cane coming down an inclined chute and into the sugar mill proper. The cane passes through the corrugated rolls at the head of the machine, at which point the material is broken up preparatory to feeding through the sets of grooved rolls mounted horizontally along the frame of the machine. Between these rolls the juice is squeezed from the cane. The crushed cane coming from the machine is called "bagasse." While still in the moist condition in which it comes through the final set of rolls, it is shot down into the boiler room and used to feed the furnace fires.

Another view of the mill in operation is seen in Fig. 10, which shows the crushing rolls from the ends and also clearly represents the bagasse on the inclined chutes from which it feeds between the sets of rolls. Both illustrations, Figs. 9 and 10, give an excellent idea of the massive construction of the mill equipment, from the big Corliss engine that furnishes the power to the great broadfaced driving gears and the heavy crushing rolls.

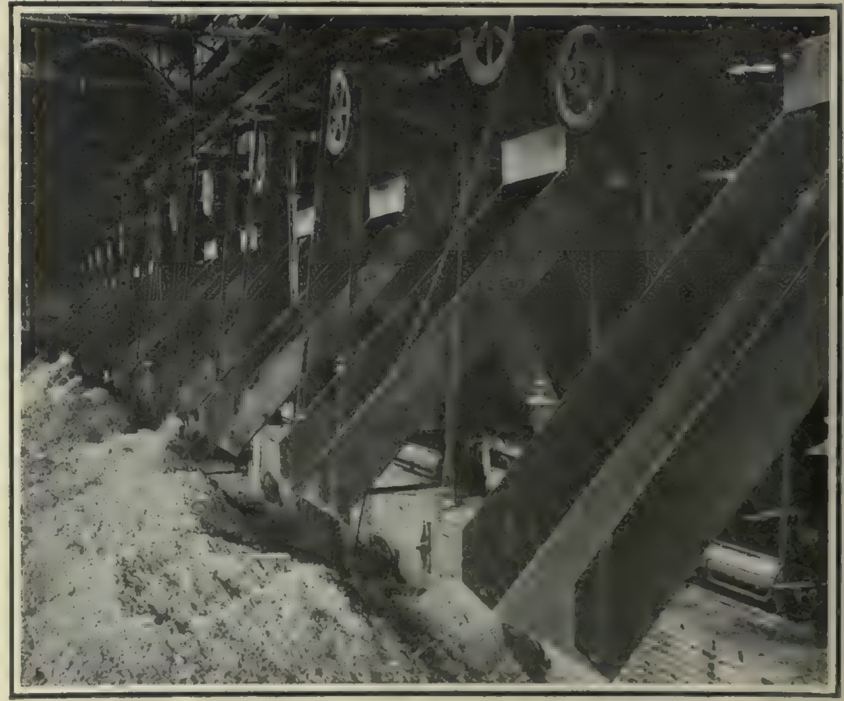


FIG. 11. "BAGASSE" PROVIDES EXCELLENT FUEL AT LOW COST

A general view of the boiler room is given in Fig. 11, which shows a series of sharply inclined steel chutes down which the bagasse slides to the floor plate in front of the furnaces. From this point it is shoveled into the fires.

Reference has already been made to the big crystallizing tanks on the upper floor of the sugar factory. A battery of such equipment is seen in Fig. 12. In this view are shown clearly the worm gearing and driving shaft by which the blades inside of the crystallizer shells are kept continually in motion. As the juice comes from the roller mill, it passes through the processes of purification, which separates the clear liquor, and then through an evaporation process, which concentrates it into a syrup. In the crystallizers shown the process of evaporation is continued during the forming of the sugar crystals. From these crystallizers it goes to the centrifugals and through several more processes of purification preliminary to being sacked for shipment.

FIG. 10. HYDRAULIC JACKS FOR THE ROLLS

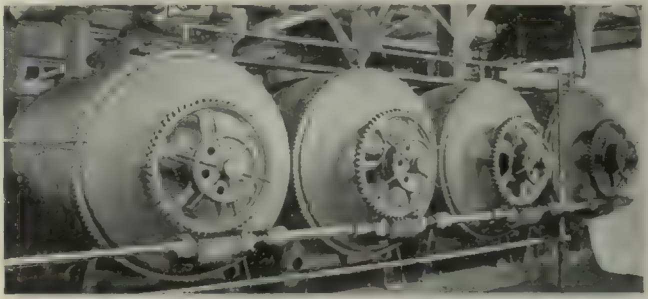


FIG. 12. BATTERY OF REVOLVING SUGAR CRYSTALLIZERS

To keep the entire equipment of the sugar mill in proper running order requires a broad experience upon the part of the engineer in charge. The repair work alone in connection with the operations of a good-sized factory makes necessary the employment of a considerable number of skilled men.

Organizing for Munitions Manufacture

The following extracts are taken from a paper read at the spring meeting of the American Society of Mechanical Engineers by Arthur L. Humphrey:

The task of organizing a plant to undertake the manufacture of munitions is one of many factors. In fact organizing involves all of the items in the general list: Specifications, materials, designing, limits, gages, inspecting, etc. The general success of the undertaking is dependent upon the perfection of the working organization, upon the selection and installation of adequate machines and other tools, and upon the careful planning of the work, which is not limited to that within the shop alone, but involves a consideration of the market, the purchase and delivery of supplies.

The financing accomplished, the task of organizing comes next in order. Their work done, the financial backers of the undertaking become impatient to see deliveries made because of their failure to understand the mechanical and human problems in the task of organizing, and a net loss is the result of insufficient time being allowed for perfecting the working organization, equipping for and planning the work. Haste makes waste in most affairs and it is not the exception here. A premature beginning may result in an encounter with conditions which will mean an entire revamping of the whole scheme—conditions which would have been determined and provided for had sufficient time been given for careful planning and making schedules complete in every detail from start to finish.

It is quite essential that an organization for the manufacture of munitions be built around a nucleus of men who have had experience either in munition making or in work of an allied character. With such a group as a basis, it is comparatively easy to place new men and ramify the organization into the various departments and divisions, each properly correlated.

The work to be accomplished is first revealed by the specifications submitted. Conferences between the engineers and shop foremen should be held at frequent intervals as the planning and scheduling progress in accordance with the results demanded by the specifications, and the whole problem should in this way be thoroughly "threshed over."

This problem of organizing is closely bound up with that of equipment. The condition of the machinery market and the urgency of the contract will determine largely the type of machines installed. In every case, where possible, automatic or semi-automatic machines should be given preference in order to get maximum accuracy with a minimum skill requirement on the part of the operators. This reduces materially the losses due to error of the individual.

Great emphasis must be placed on the necessity for a well-organized and well-equipped toolroom. It is of paramount importance to have an unstinted supply of gages, jigs, machine fixtures and other special tools, for these are needed in great number in the manufacture of munitions. They are, in fact, indispensable to the successful quantity production of accurate work.

Also, upon the inspection department will depend the proper utilization of the gages supplied by the toolroom—in other words, the inspection department and the toolroom are links in the same highly important chain of accuracy. A carefully organized inspection force must check the product not only at the end, but at each successive stage of manufacture. The product must be checked not only for variations in dimensions but for chemical and physical properties as well. The personnel of the inspection force is of the utmost importance, for it is quite unwise to give the power of rejection to a group of uniformed inspectors who are lacking in judgment. And if power to reject be withheld, the inspection force might well be entirely dispensed with.

Effect of Countershaft Speed Ratio on Power and Torque

By A. LEWIS JENKINS
Associate Professor of Mechanical Engineering, University of Cincinnati

SYNOPSIS—*A study of two different combinations of countershaft speeds, back-gear ratios and cone-pulley ratios for a cone-driven machine. An example is worked out for each combination, showing the belt speeds, horsepowers and spindle torques.*

IN THE operation of cone-driven machines the consecutive spindle speeds may be obtained in a number of different ways by effecting various combinations of countershaft speeds, back-gear ratios and cone-pulley ratios. Of the many possible ways there are two in use which require different cone-pulley ratios and ratios of countershaft speeds, and these are as follows:

Case I—The consecutive spindle speeds are obtained by first using the slow countershaft speed, the largest back gear and the belt on the largest step of the head cone, which gives the first cone-pulley ratio. The change from the first (slowest) to the second spindle speed is accomplished by merely changing the countershaft speed from the slow to the fast. In changing from the second to the third speed it is necessary to change the belt from the first to the second step on the head cone and change the countershaft speed from fast to slow. The fourth speed is then obtained by merely changing the countershaft speed from slow to fast. This alternate employment of the countershaft speeds is followed throughout the cone-pulley ratios for each set of back gears. On going from the lowest to the highest spindle speed on the machine it is only necessary to throw in each back gear once, as all the speeds obtainable through any back-gear ratio are consecutive.

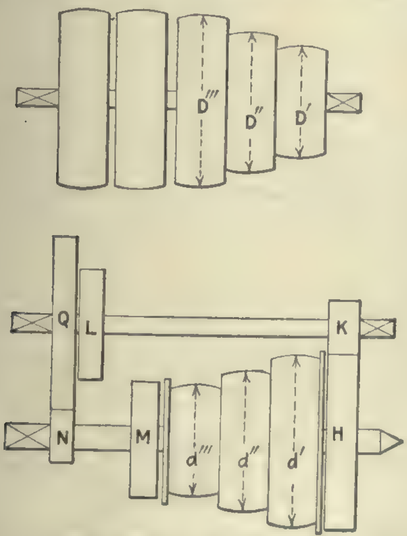


FIG. 1. LAYOUT OF COUNTERSHAFT AND HEAD

It is necessary to change the countershaft speed to change from any spindle speed to the next higher or next lower, and it is an even chance that the belt will have to be shifted also.

Case II—In this case the back-gear ratios are used in the same way as in Case I; but the countershaft speeds and steps on the cones are not. The slowest, or first, spindle speed is obtained by using the slowest countershaft speed and the largest step on the head cone. In changing from the first to the second spindle speed and from the second to the third it is only necessary to shift the belt from one step to the next. If there are only three steps on the cone, the fourth speed is obtained by using the fast countershaft speed with the belt on the largest step of the head cone. The fifth and sixth spindle speeds are obtained by using the second and third cone-pulley ratios with the fast countershaft speed. It is seen that this necessitates less changing of the countershaft speed and the same number of changes of the belt in producing all the consecutive spindle speeds.

The first three spindle speeds are obtained with the slow countershaft speed and the second three with the fast countershaft speed, and for each countershaft speed there are always three consecutive spindle speeds available.

NOMENCLATURE OF SPEEDS AND RATIOS

In Tables I and II and in Fig. 1 the following nomenclature is used:

a, b, c, d = Consecutive spindle speeds in revolutions per minute, a being the first, or slowest, speed;

= Constant multiplier in the geometric series of spindle speeds;

A = Second gear reduction, or the reciprocal of the second back-gear ratio $\frac{N}{Q} \times \frac{K}{H}$, when H, K, Q and N denote numbers of teeth or diameters of gears;

B = First gear reduction, or reciprocal of the back-gear ratio $\frac{M}{L} \times \frac{K}{H}$;

F = Fast countershaft speed in revolutions per minute;

S = Slow countershaft speed in revolutions per minute;

(1), (2), (3) = Cone-pulley ratios $\frac{D_1}{d_1}$, $\frac{D_2}{d_2}$ and $\frac{D_3}{d_3}$

The slowest speed, with the second back gear in, is g or *1BS*. The symbol *1BS* signifies that this speed is obtained through the use of the first cone-pulley ratio $\frac{D_1}{d_1}$, the first back-gear reduction $\frac{M}{L} \times \frac{K}{H}$ and the slow countershaft speed; or

$$1BS = \frac{D_1}{d_1} \times \frac{M}{L} \times \frac{K}{H} \times S$$

This system of designating speeds is due to Carl G. Barth and has been adopted to some extent. Although the use of numbers (1), (2) and (3) for the ratios may be somewhat confusing at first on account of their numerical significance, their advantage over letters is readily appreciated. This system uses the numerals (1), (2), (3) . . . to designate the position of the belt on the cones; the letters A, B, C . . . represent the gear reductions, including the back gears and any other gears, such as the bevel gears on a vertical drilling machine; and F and S are the fast and slow countershaft speeds.

Back-Gear Ratios

For either case the first back-gear ratio is found by dividing any value of the second column by the corresponding value in the third column in either Table I or Table II, such as $\frac{1BF}{1F} = \frac{ar_7}{ar_{13}}$, from which $B = \frac{1}{r_6}$. Similarly, $\frac{1AF}{1F} = \frac{ar}{ar^{13}}$ *and* $A = \frac{1}{r^{12}}$.

Cone-Pulley Ratios for Duplicate Cones

Case I—The cone-pulley ratio (1) $= \frac{D'}{d'}$ is the reciprocal of the cone-pulley ratio (3) $= \frac{D'''}{d'''}$ and for duplicate cones $d' = D'''$ and $d''' = D'$; hence, the ratio of these ratios is

$$\frac{(3)}{(1)} = \frac{\frac{D'''}{d'''}}{\frac{D'}{d'}} = \left(\frac{D'''}{d'''}\right)^2 = (3)^2$$

also

$$\frac{q}{m} = \frac{3S}{1S} = \frac{ar^{16}}{ar^{12}}$$

and

$$\frac{(3)}{(1)} = r^4 = (3)^2$$

or

$$(3) = r^2; \qquad (1) = \frac{1}{(3)} = \frac{1}{r^2}$$

Hence, the cone-pulley ratios for this cone are (1) $= \frac{1}{r^2}$, (2) $= 1$, and (3) $= r^2$.

Case II—In this case

$$\frac{O}{m} = \frac{3s}{1s} = \frac{ar^{14}}{ar^{12}}$$

and

$$\frac{(3)}{(1)} = r^2 = (3)^2$$

and for duplicate cones (3) $= r$. Hence, for this case the cone-pulley ratios are (1) $= \frac{1}{r}$, (2) $= 1$, and (3) $= r$.

From this it is seen that in a given range of spindle speeds the value of r is the same for both cases, but the cone-pulley ratios in Case I are greater than those in Case II.

Countershaft Speeds

The ratio of countershaft speeds in Case I is r, and in Case II it is r^3. Changing from the slow to the fast countershaft speed in Case II increases the cutting speed an amount equal to r^3; and when $r = \sqrt[4]{2}$, then $r^3 = \sqrt[4]{8} = 1.68$, or an increase in cutting speed of 68 per cent. If a roughing cut is taken with the slow countershaft speed, this enables the operator to change from the roughing to the finishing speed by merely changing the countershaft speed.

The solution of a numerical example follows: What should be the back-gear, cone-pulley and countershaft-speed ratios for a machine having three steps on the cone pulley and two back-gear reductions? The diameter of the largest step is 12 in. The range of speeds is 13.5 to 256. The value of the constant multiplier in the geometric series is

$$r = \left(\frac{256}{13.5}\right)^{\frac{1}{17}} = (19)^{\frac{1}{17}} = 1.1892 = 2^{\frac{1}{4}}$$

Case I—For Case I the cone-pulley ratios for duplicate cones are (1) $= \frac{1}{r^2} = \frac{1}{2^{\frac{1}{2}}} = \frac{1}{1.41}$, (2) $= 1$, and (3) $= 1.41$. For duplicate cones $\frac{D'}{d'} = \frac{1}{1.41}$, $D''' = d' = 12$ in., $D' = \frac{12}{1.41} = 8.5$ in., and $d'' = \frac{d' + d'''}{2} = \frac{12 + 8.5}{2} = 10.25$ in.

Hence, the diameters of steps on both cone pulleys are 12 in., 10.25 in. and 8.5 in. The back-gear ratios are

$$A = \frac{1}{r^{12}} = \frac{1}{(2^{\frac{1}{4}})^{12}} = \frac{1}{2^3} = \frac{1}{8}$$

$$B = \frac{1}{r^6} = \frac{1}{2^{1.5}} = \frac{1}{2.83}$$

The slowest countershaft speed is

$$S = \frac{13.5}{(1)A} = \frac{13.5}{\frac{1}{1.41} \times \frac{1}{8}} = 13.5 \times 1.41 \times 8 = 152$$

The fastest countershaft speed is

$$F = \frac{256}{(3)} = \frac{256}{1.41} = 181$$

Case II—In Case II the cone-pulley ratios for duplicate cones are (1) $= \frac{1}{r} = \frac{1}{1.189}$, (2) $= 1$, (3) $= 1.189$. Hence, $\frac{D'}{d'} = \frac{1}{1.189}$, $D''' = d' = 12$ in., and $D' = \frac{12}{1.189} = 10.1$; $d'' = \frac{d' + d'''}{2} = \frac{12 + 10.1}{2} = 11.05''$, or the diameters of the steps on the cones are 12 in., 11.05 in. and 10.1 in. The back-gear ratios are the same as for Case I, $A = \frac{1}{8}$ and $B = \frac{1}{2.83}$.

The slow countershaft speed is

$$S = \frac{13.5}{\frac{1}{1.189} \times \frac{1}{8}} = 128$$

The fastest countershaft speed is

$$F = \frac{256}{1.189} = 215$$

If it should be desirable to have $S = 152$ for this case also, then $F = \frac{152}{128} \times 215 = 1.189 \times 215 = 255$, and the cone-pulley ratios become $\frac{1}{1.41}$, $\frac{1}{1.189}$ and 1. If the large step on the head cone remains unchanged, the diameters of steps on the countershaft cone are 10.25 in., 9.375 in. and 8.5 in.; and the diameters of the steps on the head cone are 12 in., 11.125 in and 10.25 in. The countershaft cone may be made larger instead of smaller than the head cone, if it is desirable to have slower countershaft speeds.

Table III shows the belt speed in feet per minute, horsepower and torques available for each speed for both cases. The friction of the back gears was neglected in computing the power and torques. It is seen that the speed of the belt on the cones in Case II is greater for spindle speeds obtained by the fast countershaft speed and less for those obtained by the slow countershaft speed, except when the belt is on the largest step of the head cone. At first glance, Case II seems to give greater powers and torques for all speeds except three, but the fact that this is not true is shown by the graphs in Figs. 2 and 3. For the spindle speeds of 13.5, 38 and 108 r.p.m. the torques and also the powers are the same for both cases, but for spindle speeds 16, 19, 45.3, 53.8, 128 and 152 r.p.m. the powers and torques are less for Case II than for Case I. Hence, the effect of using the countershaft speeds as in Case II is to decrease the small and increase the large powers and torques.

TABLE I. SPEEDS ARRANGED FOR CASE I*

a = 1 AS = a
b = 1 AF = ar
c = 2 AS = ar^2
d = 2 AF = ar^3
e = 3 AS = ar^4
f = 3 AF = ar^5
g = 1 BS = ar^6
h = 1 BF = ar^7
i = 2 BS = ar^8
j = 2 BF = ar^9
k = 3 BS = ar^{10}
l = 3 BF = ar^{11}
m = 1 S = ar^{12}
n = 1 F = ar^{13}
o = 2 S = ar^{14}
p = 2 F = ar^{15}
q = 3 S = ar^{16}
s = 3 F = ar^{17}

* The consecutive speeds are obtained by alternating the countershaft speeds. The back-gear ratios are $A = 1/r^{12}$ and $B = 1/r^6$. When duplicate cones are used, the cone-pulley ratios are (1) = $1/r^2$, (2) = 1/1 and (3) = r^2; and the ratio of countershaft speeds is F/S = r.

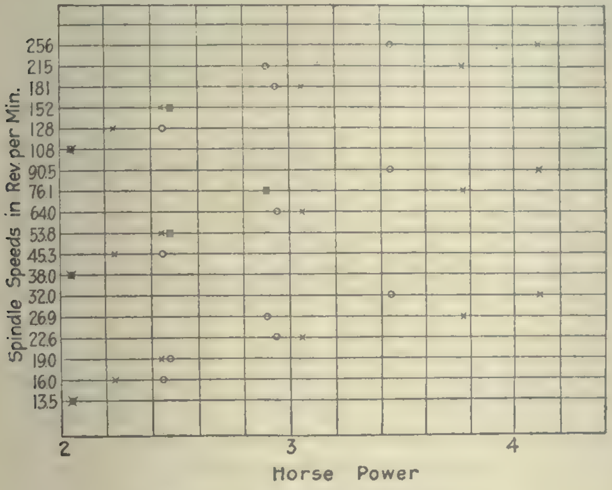


FIG. 2. HORSEPOWER GRAPH
O indicates Case I, X indicates Case II

TABLE II. SPEEDS ARRANGED FOR CASE II*

a = 1 AS = a
b = 2 AS = ar
c = 3 AS = ar^2
d = 1 AF = ar^3
e = 2 AF = ar^4
f = 3 AF = ar^5
g = 1 BS = ar^6
h = 2 BS = ar^7
i = 3 BS = ar^8
j = 1 BF = ar^9
k = 2 BF = ar^{10}
l = 3 BF = ar^{11}
m = 1 S = ar^{12}
n = 2 S = ar^{13}
o = 3 S = ar^{14}
p = 1 F = ar^{15}
q = 2 F = ar^{16}
s = 3 F = ar^{17}

* The consecutive speeds are obtained by using all the cone-pulley ratios with the slow and then with the fast countershaft speeds. The back-gear ratios are $A = 1/r^{12}$ and $B = 1/r^6$. For duplicate cones the cone-pulley ratios are (1) = 1/r, (2) = 1/1 and (3) = r. The ratio of countershaft speeds is $F/S = r^3$.

TABLE III. COMPARISONS OF POWERS AND TORQUES IN CASES I AND II FOR DUPLICATE CONES

Spindle Speeds, R.P.M.	Belt Speeds, Ft. per Min.		Hp. with 200-lb. Belt Pull		Spindle Torques	
	Case I	Case II	Case I	Case II	Case I	Case II
13.5	338	338	2.05	2.05	800.0	800.0
16.0	403	370	2.44	2.24	800.0	736.0
19.0	408	402	2.47	2.44	684.0	673.0
22.6	485	568	2.94	3.44	684.0	800.0
26.9	477	622	2.89	3.77	566.0	736.0
32.0	568	676	3.44	4.10	566.0	673.0
38.0	338	338	2.05	2.05	283.0	283.0
45.3	403	370	2.44	2.24	283.[illegible]	261.0
53.8	408	402	2.47	2.44	242.0	238.0
64.0	485	568	2.94	3.44	242.0	283.0
76.1	477	622	2.89	3.77	200.0	261.0
90.5	568	676	3.44	4.10	200.0	238.0
108.0	338	338	2.05	2.05	100.0	100.0
128.0	403	370	2.44	2.24	100.0	92.0
152.0	408	402	2.47	2.44	85.5	84.2
181.0	485	568	2.94	3.44	85.5	100.0
215.0	477	622	2.89	3.77	70.8	92.0
256.0	568	676	3.44	4.10	70.8	84.2

Since the steps on the cones are more nearly the same diameters, it might appear that the powers are more nearly equal, and Case II more nearly approximates a single-pulley drive than Case I; but owing to the difference in countershaft speeds the reverse is actually true. There is a greater variation in power, and the increase is at the speeds that usually have an excess of power in Case I. The increases in powers and torques are needed for the slower speeds. It is true that the increase in power on the high speeds might be utilized in some instances; but as a general proposition it is apparently inadvisable to increase the powers and torques for the higher speeds at the expense of the powers and torques for the lower speeds.

The greatest objection to the use of Case II occurs when only one of the countershaft speeds is used or when one is used for reverse. If the higher countershaft speed is reversed, then the forward spindle speeds obtainable through the use of the slow countershaft speed are only those involving *S* in Table II. This divides the speeds into three groups of three speeds each; the speeds in each group are in geometrical series with a constant multiplier equal to *r*, and the ratio of the highest speed in one group to the lowest speed in the next group is r^3, thus making two large gaps in the series of spindle speeds and omitting the three highest. Instead of covering the range of 13.5 to 256 it covers only 13.5 to 152. In Case I the use of a single countershaft speed only decreases the range by one spindle speed, and the speeds are in a geometric series having a constant multiplier equal to r^2 instead of *r*.

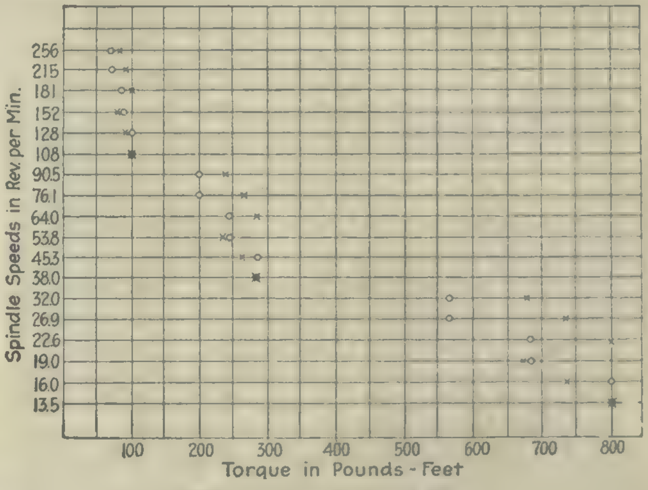


FIG. 3. TORQUE GRAPH
O indicates Case I, X indicates Case II

Gages and Small Tools

The following abstracts are from a paper read at the spring meeting of the American Society of Mechanical Engineers, by Frank O. Wells:

Of first importance in the manufacture of rifles, guns and munitions of war are gages. There are many types of gages, but the one used in the manufacture of munitions is the dimension or limit gage. Whatever instrument is used must be able to measure accurately and rapidly, and must also be durable, as very slight wear will destroy the accuracy.

It has been well said that if we can measure an article we can make it. The difficulty lies not in the making, but in the measuring; and our greatest obstacle in exact measurement is the human element.

In olden times the human element was the controlling factor in all operations. Work was done in very small quantities and was not interchangeable. Some work was good and some was poor, all depending on the man who did it. To meet the demand of the present day, we must have progressive manufacturing, where each man has only a small part of the work, and that part must be done by an ordinary workman. All this calls for a method of measurement different from that formerly used. Then we wanted one piece, now we want thousands of pieces, all alike and each one an exact duplicate of the other. This is easily accomplished by our printed instructions and gages, and with these we can start a large number of factories making war materials that will be 100 per cent. good, and also standardize the cost of production.

QUESTION OF GAGES IMPORTANT

Improperly designed gages cause poor work and a lack of interchangeability, making the cost of production and the cost of assembling greater. Our Government should take advantage of the knowledge of this fact, obtained at such great cost in the present war, and should standardize all its operations, gages and measuring tools, so as to avoid a repetition of mistakes of this kind.

The Government should have, first of all, its blueprints prepared indicating the proper tolerances perfected by tests and careful practice. The sequence of operations and the time taken to do the work should also be perfected and put in printed form with the necessary illustrations showing the set-up, as well as the best way to handle the work, both in the operation and gaging. This would enable all factories to standardize their productions.

The importance of the best methods of measuring is illustrated in a report from the U. S. Ordnance Department, in which the statement is made that the cost of inspection is from 10 to 12 per cent. of the total cost of manufacturing. These are startling figures and indicate that the proper gaging methods had not been used.

OUTPUT OF GOVERNMENT ARSENALS

The output of the U. S. Government arsenals for the year 1915 was $11,284,113.95; for the year 1916, $9,471,300. It has been estimated on good authority that this could have been increased at least 50 per cent. without increasing the size of the plants, by having a larger supply of gages and tools. The cost of such tools and gages is estimated at 20 per cent. of the total cost of the plant, which shows conclusively the need of gages and small tools.

Few people realize that our Springfield rifle has more than one hundred parts and requires 1400 distinct factory operations. To produce 1,000,000 rifles requires $360,000 worth of gages for the original equipment, while renewals cost $400,000, making a total of $760,000. Each 1000 rifles made require 4800 gages. The renewal of the gages costs about 50c. per gun. To make 10,000,000 rifles in 200 days requires at least sixty more arsenals than we now have. The war material most talked about is ammunition, of which our Government uses about 17 sizes at present. The cost, including the upkeep of gages, used in the making of 1000 rounds of ammunition per day, with a steady production for 200 days, is at least $2,225,000. These figures have been carefully worked out by makers well versed in the manufacture of gages for ammunition. It has been estimated by good authority that we should be able to make at least 200,000 rounds per day. The vast importance of the whole gage question can be realized.

Of course, some sizes of ammunition have to be made in much larger quantities than others. Careful estimates show the special jigs and fixtures would cost nearly double what the gages would. So far, the paper has only touched on ammunitions and rifles. To have everything on hand necessary, the figures given have to be multiplied many times.

There are today some 3,500,000 people in Great Britain engaged in making munitions of war in over 4500 factories. In doing this work to advantage, each workman should at least have $25 worth of gages, tools and fixtures.

The majority of contracts taken for ammunition in this country were taken by manufacturing organizations without experience on war material, and the gages first designed were not the best possible to insure economical assembling of the parts, with the result that a great many rejections were inevitable during the first months after production was attempted.

GAGES THE FIRST NECESSITY

Our Government should provide itself with all the gages, tools, jigs and fixtures far in advance of any possible expectation of requirement; the cost is small compared with the results obtained. This is a very simple business proposition—what every efficient manufacturing company would do.

It is a very poor policy to cut down on the number of gages and small tools. It is far better to use every labor-saving device possible. All this means a saving in high-priced labor, and this is very important in time of need when we cannot get the necessary skilled labor.

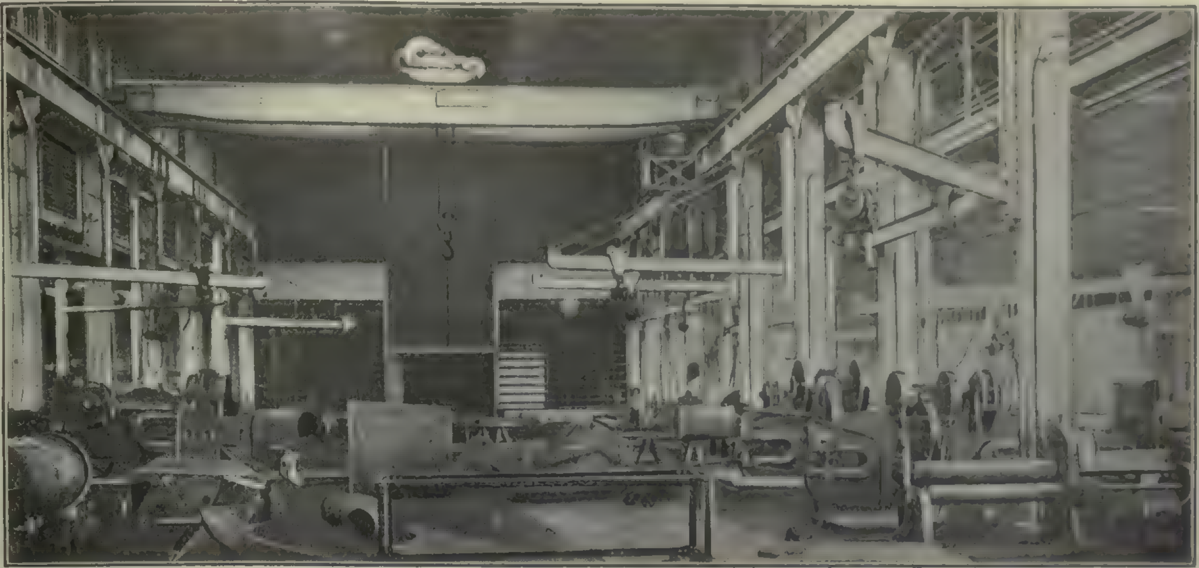
It is considered the best practice in manufacturing to put the thought and money not so much in the large machinery as in the small tools. The most important of all are the gages, and these must be so designed as not to have any guesswork about it. We must know that every part is machined right. We must be able to say, "We know this is right," and not say, "I guess we are right."

To most people gages seem of small importance, but this paper endeavors to show that they are quite the reverse of this.

Graduations on Feed Dials

BY WILLIAM S. ROWELL

Replying to your question on page 378, Vol. 46, regarding graduations on feed dials, let me say that probably the graduated feed collars are made so that one line of the graduated circle indicates 0.002 in. advance of the cutting tool. This arrangement was adopted because the collars are usually so small in diameter as to preclude anything finer—when there is plenty of room for larger collars.



Panama Canal Boiler Shops at Balboa

By Frank A. Stanley

SYNOPSIS—*Boiler and structural work in the Canal Zone are important items cared for in the shop described in this article. A special machine for tumbling and cleaning boiler flues, a swager for welding on new flue ends, and a home-made flue trimmer are among the machines presented herewith.*

ONE of the largest of the structures forming the permanent group of shops at the Pacific entrance to the Panama Canal is that containing the boiler and shipfitters' shops at Balboa.

A general view of the interior of this shop is illustrated in the headpiece. This shows the south end of the main aisle, which has a total length of 358 ft. 8 in. The high section of the shop is 61 ft. in width, and the lean-tos on the east and west sides are 29 and 40 ft. wide respectively. The overhead traveling crane shown in the illustration is one of two that serve this section of the shop, these having capacities of 60 and 20 tons respectively. It will be noticed that the various punching and shearing machines are located near the south end of the structure and that north of them are the pneumatic riveters, plate-bending rolls, etc. The punches, shears and rolls have individual motor drives. The toolroom is located near the center of the shop in the east lean-to, and at the northern end of this same section are the plate and angle furnaces, flange fires, flanging clamps and the like. In the south end of the same aisle is installed the flue-repairing equipment. It will be seen that individual jib cranes are placed on the columns, for serving all the heavy machines, each of these cranes having a pneumatic hoist carried on a trolley on the arm.

In addition to boiler work, repairing and overhauling structural work of all kinds are handled in this shop; also plate work and various parts such as dredge dippers and buckets. Steel pontoons and other units from the dredging fleet are built and overhauled here when required. For welding, which is carried on extensively, there is an adequate electric welding equipment of the portable type, and this is moved to any place where required, either inside or outside the plant. There is also an oxy-acetylene welding and cutting ap-

FIG. 1. FOUNDATION FOR 100-TON HYDRAULIC BENDING MACHINE

paratus, gas for which is generated in a special building located immediately adjacent to the boiler shops.

As may be supposed, there is a great deal of acetylene cutting and welding to be done, not only in the shops, but also along the Canal Zone, and the generating plant supplies the oxygen and acetylene in cylinders, which are carried to any point where operations are necessary.

FIGS. 2 AND 3. DREDGE DIPPERS ARE REPAIRED IN THE BOILER SHOP—AN IMPORTANT ITEM OF MAINTENANCE

The structural features of the boiler shop are quite similar to those already described in connection with other buildings in the group. The leading illustration shows distinctly the movable metal louvers, the rolling steel doors, the heavy column and craneway construction, the arrangement of jib cranes and other matters of importance.

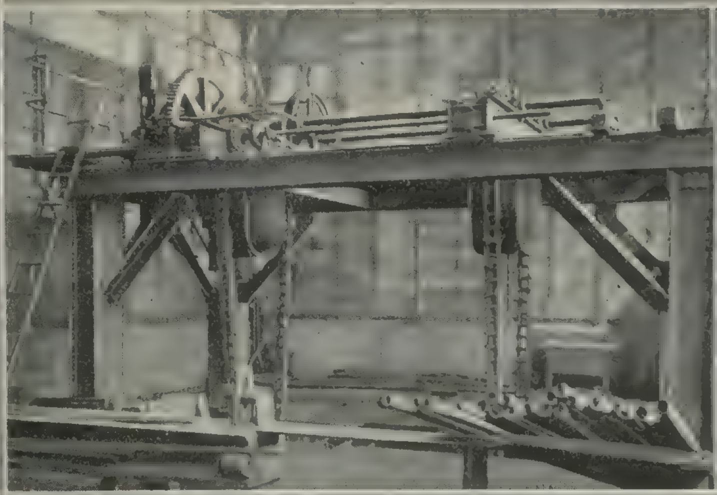


FIG. 4. THIS APPARATUS TUMBLES THE BOILER FLUES AND CLEANS THEM

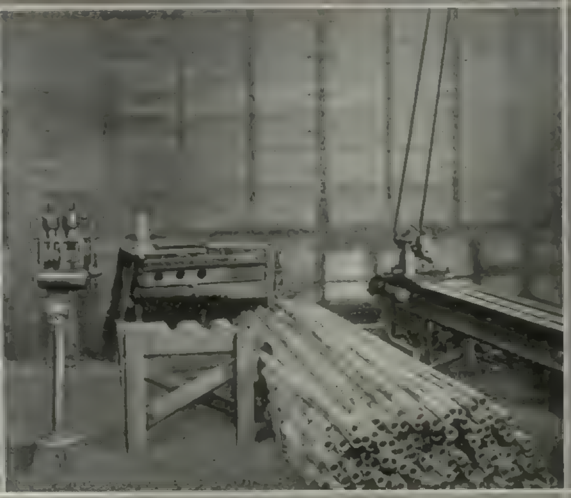


FIG. 5. FLUE-WELDING MACHINE (LEFT) AND FLUE TRIMMER (RIGHT)

A number of the machines require substantial foundations, and an interesting illustration of a concrete pier which is typical of the foundations for machinery in the east aisle of the boiler shop is shown in Fig. 1. The photograph represents the foundation for a 100-ton hydraulic bending machine, which is carried down about 4 ft. below the surface to earth sufficiently firm to support the machine. The bottom slab of this foundation is strongly reinforced with steel rails placed at intervals of about 18 in., and the outside and central piers are poured in heavy section. In certain other cases the foundations for heavy equipment in this department consist of concrete piers carried down to bedrock, while others rest on piles.

As already indicated, boiler work constitutes only a part of the overhauling done in this shop. There is perhaps more of interest to be seen here in connection with the upkeep of dredging and other equipment. Fig. 2, for example, shows a big dredge bucket which has just been repaired and put in condition for service by the replacement of the shell plates constituting the bucket proper. A fair idea of the size of this part can be gathered from a comparison of the bucket with the shop equipment alongside.

A dredge dipper repaired for service can be seen in the center of the view, Fig. 3, and to the right is shown the new shell for another dipper of similar size, ready to be riveted for receiving the steel supporting members, trunnions, etc.

Flue work is an important part of the repairs made in the boiler shop, and Fig. 4 shows a special machine for tumbling and cleaning flues. These are placed in bundles in the sprocket chains, which are shown dropping into the cleaning pit, and when the machine is set in motion the flues are kept rolling over and over in the bight of the chains until the power drive is thrown off. This machine was built at the shops and is operated by motor drive, power being carried through suitable gearing to the two main shafts across the top of the structure, to which shafts are secured the two sets of sprockets over which the flue-tumbling chains are carried.

Other home-made apparatus in this department is illustrated in Fig. 5. In this view the vertical machine to the left is a swager for welding on new ends, the dies for the operation showing clearly in the photograph. The oil heating forge for the work is shown in the center of the group. This forge has three openings at the front to receive as many tubes for the heating process. The horizontal machine at the right is a flue trimmer built up on an old lathe bed, with machining apparatus at the left end of the ways, while a suitable outboard support, not shown, is provided at the extreme right of the bed.

Two More Thread-Measuring Instruments

By Fred H. Colvin

The illustrations show two more forms of thread-measuring gages that have been suggested by persons interested in this line of work and have been brought out after an examination of the gages illustrated on pages 1001 and 1002, Vol. 46, of the *American Machinist.* They are numbered Figs. 10 and 11 so as to be continuous with the ones already illustrated.

The instrument shown in Fig. 10 was designed and suggested by E. A. Darling, Hopedale, Mass., after becoming acquainted with the plan of the A. S. M. E. committee to show a triangular safety zone of tolerances which should include variations of both diameter and lead. There is a fixed measuring point *A*, an adjustable support *B*, which is locked by the knurled thumb-screw *C*. A movable point *D* multiplies the variation in lead and shows it by the graduations at the other end of the needle.

The roll *E*, which bears in the thread on the other side of the screw being measured, shows the diameter. This is mounted in a bell crank, the other end *F* bearing on and actuating the segment *G*, which carries a triangle on its upper surface. This is shown enlarged in the section below. By graduating this triangle in accordance with predetermined tolerances, it is easy to see when the screw being measured falls outside of the amounts allowed. Too great a variation in diameter would move the triangle on *G* beyond the measuring edge, while too great variation in lead would throw the pointer of *D* outside of the triangle and reject the piece.

The second instrument is suggested by the Test Department of the Pennsylvania R.R. and holds the piece to be tested on centers *A* and *B* instead of supporting it from beneath. This plan is followed in some of the instruments used by the National Physical Laboratory of England. The measuring is done by the four dial gages: *C*, showing the root diameter; *D*, the outside diameter; *E*, the pitch diameter; and *F*, the lead, in connection with the fixed point *G*. These gages are all mounted on slides for adjustment.

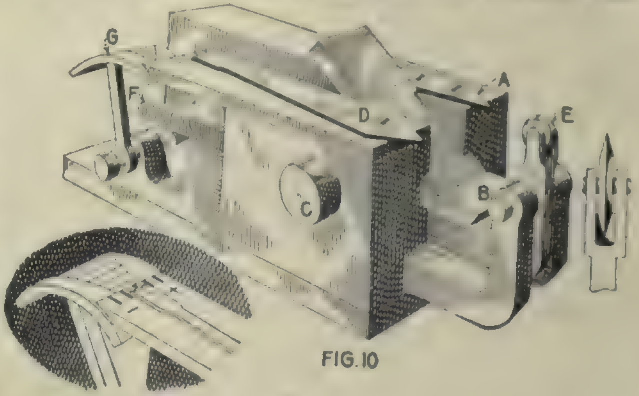


FIG. 10

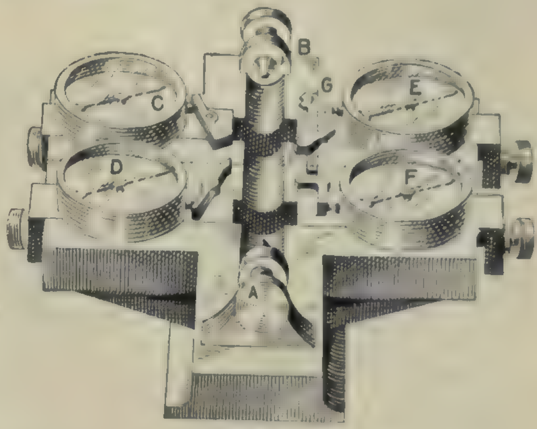


FIG. 11

FIGS. 10 AND 11. TWO MORE THREAD-MEASURING INSTRUMENTS

Demagnetizing High-Speed Steel

By C. J. Converse

An article on the subject of demagnetizing high-speed steel, on page 470, Vol. 46, has interested me.

It speaks of the trouble in getting magnetism from high-speed tools that have been ground on a grinder with a magnetic bed. Outside of using a demagnetizer the method employed is not mentioned.

If the high-speed piece contains much magnetism, and it is only placed upon the demagnetizer, I doubt very much if all the magnetism will be drawn from it.

A common method is to shift the piece back and forth across the holes. This will usually free the piece from magnetism, but I have known this to fail also.

Another method is to take a piece of tissue paper and place it between the piece and the poles of the magnetizer. Shift the piece back and forth across the holes and thus draw the magnetism through the paper. This will take every trace of magnetism from the piece. I am speaking of high-speed steel and hope that this will be of benefit to some reader.

Reorganization of Industrial Processes After the War*

BY ROCKWOOD CONOVER
General Electric Co., Schenectady Works

AMONG the important world-wide changes that are bound to take place during the period of reconstruction after the war is over and peace finally reëstablished, a readjustment of industrial methods and practices, wider in its scope than anything that has yet been conceived, is likely to occur. This readjustment, which will include nearly all phases of industrial undertaking from organization and plant construction down to the simplest mechanical process, will doubtless be as unique and revolutionary in some of its aspects as has been the great advancement in many things pertaining to engineering and manufacturing that has taken place during the two or three decades just passed.

Among the more important phases of this readjustment that are worthy of our attention, several features stand out clearly as being of immediate and pressing value to both producer and consumer, and as meriting chief consideration among the developmental processes affecting the manufacturing side of industrial life that the new conditions will bring about. Briefly these are: Organization for more definite and specific purposes; building construction providing for unlimited expansion; greater concentration and segregation of manufacture; elimination of the function of human labor and increase of mechanical performance; Government aid in the process of readjustment to the country's needs.

At the present time the human mind cannot clearly conceive the magnitude of the work of reconstruction, the new activity of human endeavor and the amazing stride at which the rehabiliment of the world must go forward. These things will come upon us with a suddenness and magnitude that will require the maximum of ingenuity and power to meet.

ORGANIZATION FOR MORE DEFINITE AND SPECIFIC PURPOSES

It has been the custom to some extent in past years to build up factories and industries for the production of certain kinds of classes of apparatus as a finished product, without clearly defined plans of procedure in reference to the many and varied integral parts of which the completed unit is composed. The production of automobiles, farm machinery, machine tools and many other kinds of product is illustrative of this. The plan in the mind of the owner or manager heretofore has chiefly been to provide buildings sufficiently large in which to manufacture his product without careful preliminary analysis as to what portions or details might be purchased in the open market or from other factories at a less cost than he could produce them. Even at the present time the manufacturer quite generally seeks to make all parts of apparatus, both large and small, within his own factory. He does this with the conviction that the labor and material cost in his own shop will be less than the outside purchase price for the various elements required, and that an economy in production will be effected. Not infrequently he overlooks the item of overhead expense, which he should add to his own labor and material in arriving at this conclusion, and that what he chiefly saves is the producer's profit, other things being equal.

The manufacturer can sometimes produce the separate elements of a piece of apparatus for less than he can buy them in the open market. This is an often demonstrated platitude of business. But it is not always so, and in many instances is proved otherwise. Equipment and facilities for the production of small parts in quantities often enable the company engaged in this class of manufacture to offer its product at lower prices than the individual manufacturer, not so equipped, can produce them. Overhead expense involved in the exclusive production of this class of product is normally much lower than in the production complete of apparatus of uniformly greater bulk and weight, resulting in a distinct gain to the producer of the former class and, ultimately, to the buyer as well.

ANALYSIS OF CONDITIONS NECESSARY

It is evident that during the new period of reconstruction it will become increasingly desirable for the individual manufacturer or corporation contemplating the founding of an industry to analyze carefully these most important phases of organization and to proceed with fully defined plans as to the specific purposes for which buildings can be erected and equipment purchased to secure the greatest economic advantage in production. The new problem before the industrial world is likely to be that of the establishment of factories devoted to the assembly and sale of finished product and the establishment of other factories and foundries whose function is to feed these great assembly plants with the supply of castings and various details incident to the production of the finished unit.

And here the question may naturally be asked, Why should the manufacturer of the greater product undertake the production of the smaller details on a limited number of automatics, lathes or other machine tools (located in segregated sections or departments of his shop and often operated interruptedly and expensively), any more than he would engage in the production of the thousand and one small items of shop supplies that he normally uses and which he is accustomed to purchase in the open market? The concentration of production of small product in one or a limited number of factories offers the distinct advantage of large orders, continuous operation and other features not possible under the old plan. Under the new period of reconstruction it will be necessary to give consideration to a greater degree of diversification in industrial processes than we have been accustomed to contemplate in the past, in order to secure the largest economic advantage that the world-wide commercial readjustment will make both desirable and imperative.

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It is evident that in building new industrial plants we must provide for a far greater expansion than ever before in the history of industrial undertaking. Not only must the layout of the buildings provide for a large expansion of assembly floors and greatly increased space for machine tools and preliminary productive processes, but the areas between buildings must also be larger than ever before. Where 50, 75, or 100 ft. was considered ample space between shops, doubtless 200 ft. and even more will be required. Sudden expansions of business will require the erection of one- or two-story additions and lean-tos to provide additional assembly space, or space for more machine tools with which to get out greater products sold on limited delivery dates of shipment. Larger areas for storage sheds and platforms between shops will be required, and there must also be provision between the buildings for expansion of tracks and sidings, overhead cranes, scales and facilities for rapid unloading of every description.

In the larger type of industries now existing, and in those that will be organized in increasing numbers during the new period, it will doubtless be necessary to set aside a considerable definite area for the receiving and storage of castings and metal stocks and such materials as may be kept in open and covered spaces. These receiving and storage yards will need to provide for big expansions through ample equipment of sheds, platforms, narrow- and broad-gage trackage, gantry cranes, railroad scales, conveyors, etc. More materials will be received and handled than ever before, and the railroads will demand and need our coöperation and assistance. Every provision must be made to relieve congestion and save demurrage and minimize the tying up of cars.

The removal of chips, turnings, metal sheet trimmings and scrap and refuse of every nature will have to be provided for with improved methods. With the great increase in productive output it will become desirable to handle these materials more expeditiously and economically, either by means of conveyors operating below shop floors in close proximity to the lines of machine tools or by other means not interfering with or detrimental to the operation of the regular shop equipment, or detracting from space required for the movement and handling of castings and other materials in process of manufacture.

CONCENTRATION AND SEGREGATION OF PROCESSES

The new industrial conditions will force corporations and managers more and more to give attention to concentration and segregation of all manufacturing operations, and to concentration of supervision in order to establish such coöperative routine of directive effort as will result in the greatest economy in manufacturing methods in the shop and influence all functions of the factory's organization in efficient and profitable channels. The small manufacturer will need to more carefully analyze his practices, to segregate more definite assembly processes from preliminary processes, in order to secure a speeding up of all operations and prepare for a more intensive production of product. In the small shop where specialization has only partly superseded the old methods much can be done along this line. Instead of the all-round machinist making apparatus complete, as in the past, the owners or managers of the smaller sized factories will find it desirable and necessary to concentrate assembly work as far as possible and segregate from this the machine operations and manufacture of small details, in order that through this grouping of similar processes all tools may be kept in constant operation and the greatest speed and efficiency in productive activities secured. Only in this way can the small shop hope to exist with the bigger factories in the driving competition that is bound to come.

During the next two decades the grouping of industrial enterprise and the building of big assembly plants will receive greater attention than has ever been given the subject heretofore. The world-wide demand for products, for rapid fulfillment of big contracts, and the increasing competition of purchasing power, will all contribute to direct the trend of the world's industrial development and progress. The making and supplying of small parts is, comparatively speaking, one of the simpler phases of production. It is chiefly a question of capacity for quantity, for precision and for reduced cost of output. It is the big business, the assembly of completed apparatus of medium, large and still larger proportions that makes imperative the adoption of new methods of production on a scale more gigantic than anything we have yet conceived. Assembling and shipping, it is possible to conceive, may become the chief function of the big industry of the future, the thousand and one smaller details being fed into these big assembly plants automatically through other channels—the foundries and factories erected for their manufacture, either apart from or in combination with the big home unit.

SEGREGATION WILL BE ESSENTIAL

The segregation of production of small parts from assembly processes is diametrically opposed to decentralization of manufacture, which involves the grouping of all equipment required for the production of a given class of product as far as possible within the limits of the factory in which the product is made. There are advantages in favor of both methods of procedure, but it is doubtless true that under the new conditions that the manufacturer will have to face, a more diversified application of both manual and machine performance will be essential to keep pace with the demands of consumption. Specialization will be carried far beyond its present bounds and will be limited only by the specific conditions of manufacture involved and the kind of product for which the industry is organized.

The evident results of this growing change will be greater refinement and precision in all manufacturing operations. Constant repetition of effort, whether directive, manual or mechanical, must invariably result in greater uniformity of action and in a more perfect accomplishment of the thing desired. The decades to come will be marked with a tendency toward a condition of more intensive progressiveness and a greater insistence in demands on the part of the buyer and consumer, all of which will make for the reorganization and establishment of industrial enterprise on the basis of the highest refinement and economy of effort and procedure.

Coincident with the new era in industrialism will come the elimination in an increasing degree of the factor of manual labor in productive processes. More and more the purely manual task will be superseded by machine-tool performance. Greater demands will be made upon the tool builders. The skill of scientific men will more and more be required to design tools for new and untried mechanical processes. The new and world-wide development in all commercial undertaking will bring about a condition of productive activity greatly emphasized in its intensiveness.

This does not mean that the all-round tradesman machinist will no more be needed. It means that the evolution of shop practice toward specialization and machine performance is rendering his skill less a factor of necessity in manufacturing operations and placing this class of highly educated labor in the minority. There is always room, however, for the skilled tradesman higher up, doing the tasks of laying out, lining up and assembling, which the handy man or purely mechanical performance cannot always do. With the increasing intensity of production and constantly growing demand for product there must obviously arise a condition in which there will be work for all classes and kinds of men. The substitution of mechanical performance for manual tasks will in no wise be able to keep pace with the new and growing needs of the industrial world. Should the processes of transformation under the new era develop an excess of manual labor of certain grades, which with the rapid organization and building of new industries is not likely to occur, there is always open to the individual the field of agriculture, which, now more than at any other period in recent history, is in need of reëstablishment on a profitable and enduring basis.

GOVERNMENT AID IN THE READJUSTMENT OF INDUSTRY

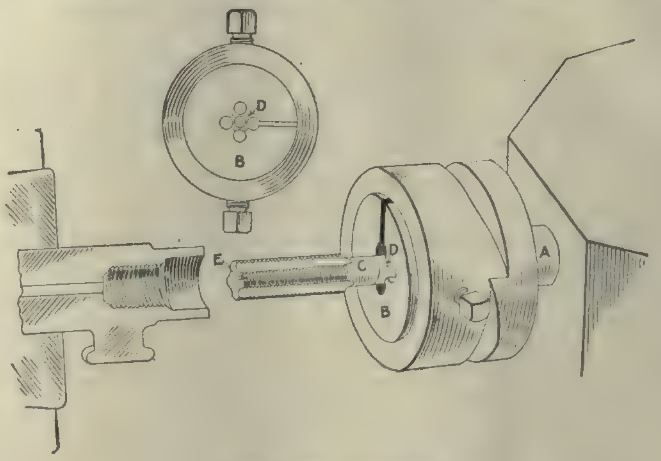
Government aid may be rendered the manufacturer through bureaus or commissions already appointed for the study of industrial conditions by giving counsel and direction in the establishment of new manufacturing projects, and by furnishing him with such data as may be of assistance in the grouping of assembly plants in localities where the natural resources of power and facilities for transportation by rail or water to and from the world's markets and sources of supply are economical and advantageous. Near these greater assembly plants, or in conjunction with them, it will doubtless be desirable to group the segregated shops and factories for the manufacture of small parts in order that the greatest economy in cost and transportation may be secured. In the founding of industrial enterprise under the new conditions the manufacturer will require more than his own knowledge and experience to guide him in the more important considerations of the project. He will need the expert knowledge and information which may be obtained through the coöperation and service of a friendly Government commission.

Tap Driver Made from an Old Die

By H. H. M.

The accompanying illustration shows a tap holder that has proved successful in actual practice. It was used for tapping steel cranks ⅜ in. U.S.S. by ⅞ in. deep. A run of 490 pieces was completed without breaking a tap or causing trouble.

It consists of an ordinary die holder *A* and a worn out die *B*. By removing the taper adjusting screw in the die, the tap shank is clamped by compressing the die. It is obvious, however, that the latter should be selected according to the size of the tap shank. In larger work, if necessary for positive driving, the flutes *E* of the tap *C* can be meshed with the die flutes *D*.



THE TAP DRIVER

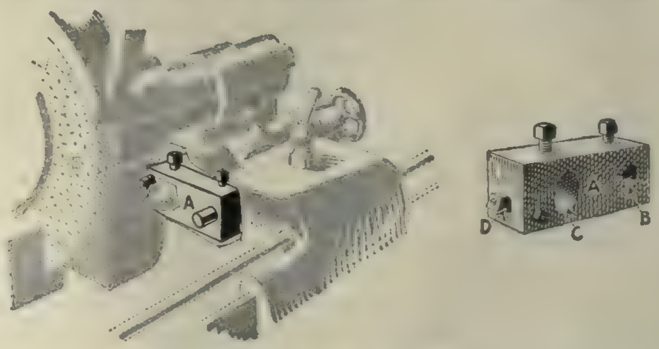
The two principal features are that the screw or wrench fit on the tap is never mutilated and that old dies can be made useful. The idea should be credited to E. Bolinger, screw-machine operator with the Sheffield Car Co., Three Rivers, Mich.

Diamond Holder for Norton Grinder

By R. C. Fetch

The illustration shows a diamond holder used for truing an 18-in. wheel on a Norton 10 x 72-in. grinder.

The holder, as shown in the illustration, is made from a piece of cold-rolled steel *A* 1½ x 2½ x 6 in. long, with a hole bored at *C* to fit the center spindle and one at *B* to fit the projecting post. The post was designed to hold a diamond holder and was furnished with the machine, but it had been broken.



A DIAMOND HOLDER

A ½-in. hole was bored on the end to take a stud *D* in which was set the diamond, setscrews holding the small stud in place, so that it could be moved around and get even wear of the diamond point.

This construction is more solid than the regular device furnished and does not chatter at all, while the old one did. The saving of time taken to put the new holder on and take it off fully compensates for the change.

Series for Draftsmen and Designers

Value of an "Eye" in Designing

BY CHARLES M. HORTON

ONCE upon a time, in the drafting room of a large manufacturing company in western Pennsylvania—an organization putting out, among other things, a line of engines—there was a young man with a pair of spectacles on his nose and a quiet but dignified manner concealed underneath his vest. He was a designer. He was the real thing, too. He worked on two boards at one time—if you get me. He would lay out a whole engine on a great board some 7 ft. long; and as he worked, he would draw up in larger scale on a smaller board, about 3 x 4 ft., detailed sections of the engine as he required these sections in his work of running up the general design. He was rapid and accurate. But above all else he was rapid. He was the "white-haired boy" in that drafting room, a room carrying over a hundred draftsmen, and he deserved all the secret admiration and unstinted adulation, whenever an opportunity came to bestow this upon him, that he got.

But there was something queer about his method of working. Nobody ever saw him bent over the calculating book with which all the draftsmen were supplied when they came with the company, and nobody ever saw him make a calculation. Yet his designs always passed the board of censors, as represented by the staff of engineers; and what was better, his designs always stood up under the rigorous test given them on the testing floor, once his drawings were converted into actual cast iron and brass and steel units. To me, a comparative newcomer at the time, as well as to those who had been on the payroll a good many months, Jones, in his method of working, was a mystery. I decided one day to look into the thing and to submit a long report to me in person on the results I found. I sure wanted to know.

I horned in one afternoon, shortly after lunchtime. Jones was seated on the rounds of an upturned chair, preparing to dig into his afternoon's work. He had one of those tilting drafting boards, and he always kept it well down—the lower edge—toward the floor. Most of the time we just saw the top of his head above the surrounding tables of other men. In this, as in other things, Jones showed that he had an original mind and that he was not afraid to exercise initiative against well-established rules of the drawing room in which we worked. Quite a capable gazabo, was this *hombre.*

"Jones," I began, a little timidly I confess, yet nevertheless bulging at once to the point. "Tell me how you do it." Jones looked up quizzically and then crawled, as it were, behind his spectacles. He used to do exactly that. I would look into Jones' gray-blue eyes and sometimes see the soul of Jones and sometimes not, as he would withdraw or would not withdraw behind his spectacles—see only the round glasses in their frame. At such times, unquestionably, he was thinking. He was thinking now.

"I don't quite understand," he rejoined. "How do I do what?" "Design engines without making calculations," I explained bluntly. "You do it, I've observed, and I'm looking to steal the trick. If you don't mind telling me, I'd consider it a great favor—" "Oh!" interrupted Jones, a great light dawning evidently, and he smiled. "I see." But he was silent.

I waited patiently. Perhaps I had been a little cheeky in trying to grab his stuff, as the saying goes among the writing fraternity—so ran my troubled thoughts—but now that I had launched my shaft, I was determined to stand my ground until I either got the secret or got the gate. I continued to wait—patiently. Jones at last laid down his pencil. "Son," he began—I was somewhat of a kid at the time, "it's a gift." He was modest, then, I saw, although he was still smiling. "At least, it is with me, though I don't take any particular credit for it. I had a dad who could guess the diameter of a tree on the farm as far as he could see it. He used to do it for the pleasure it gave him. And I never caught him more than an inch or so out of the way in all his tests—and then, whenever he fell down, the tree was pretty far away and he had the wrong pair of glasses with him.

"But it can be developed, too," went on Jones, evidently enjoying my look of surprise. "Try it—you—now." He turned to his drawing. "I haven't marked down the scale of this drawing yet. What is the diameter of that shaft, for instance?" I bent over the board. The drawing was a design of a double-acting horizontal gas engine, and it was a beautiful piece of work, in so far as the drawing was concerned. I was hardly capable at the time to criticize the design itself. But I took a broad squint at the shaft and made a guess, grinning as I did so. Jones nodded approvingly.

"Pretty close," he said. "You'll come in time. Anybody will, if they go at it. At college I used to beat out the class on examinations by some four hours by just taking stabs at sizes and rushing through the design. It gave me a lot of fun, besides giving me more time out in the sunshine. But anybody can do it after a little practice."

Still I was not convinced. "But how do you do it here—on the job? You take some big chances, don't you? Suppose you miss a couple of times and something lets go on the testing floor?"

"It hasn't so far," said Jones, calmly. "As to something letting go sometime, I don't take the chances you seem to think I do. Whenever I'm struck with a doubt, I do make a calculation, in order to guard against trouble. But I don't make calculations very often, because I'm not often struck with doubt. And I'll tell you why."

He went on to tell me. And the more he talked the more I thought of Kipling's Kim, who, as everyone will remember who has read the story, was coached by the old East Indian priest to use his eyes in strange and amazing ways. Jones had been using his eyes ever since he could remember. Indeed, it was a habit with him, one that required no especial effort on his part. He did it subconsciously. He saw things, and his mind instantly absorbed them, to come to him again whenever he saw the same thing again, or something similar to that thing. And he spent a good deal of time in the shop. He told me that, too.

Hanging around the testing floor; and knowing the different sizes of engines on the block, he would see and retain in his mind the relative sizes of these engines; and whenever an order came to him to design a type of like size of cylinder and consequent horsepower, without his going to the work of making calculations he would draw up the design and have it approximately the same—close enough to pass criticism of the engineers. Also, he remembered what he saw in the drafting room on the boards of other men. So it was easy for him to establish thickness of cylinder walls, size of ports, diameter of shaft, diameter of flywheel, all from what he had seen and remembered in shop and in the work of those around him. A kind of remarkable skate, was Jones.

In New York harbor today there are plying towboats and ferryboats whose engines were designed by the rule of thumb methods years ago. Fletcher built a good many of these engines. The Fletchers were rule o' thumb boys. They would hold up a two-foot rule before their eyes, close one eye thoughtfully at the rule and announce to the foreman of the shop what the size of a shaft ought to be. And that they rarely went far wrong is proved by the fact that these engines are in operation today, engines that were built, some of them, 50 years ago. Of course, these old engines are much heavier than need be, and the engines coming along nowadays are considerably lighter in design—the work of accurate mathematicians in drafting rooms. But that these old engines were strong enough shows that the older men in the game were not far from having the right idea either.

The machine designer with a keen eye saves himself and his company much time and money. He need not take risks where such risks will endanger the lives of men. But very often in designing a machine the careful workman will spend considerable time making calculations in matters of little actual value, in so far as endangering the lives of men who will eventually operate the machine is concerned. Frames of tools, levers and arms of working parts, thickness of walls, and the like—the man with a good eye will establish these things almost without thought and will receive never a word of criticism afterward. If it looks all right, as someone has said about machine design, then it is all right. And it is.

One can see every day about him in the works of nature enough of value in an instructive way to carry him far in his work of designing machinery. Trees—their diameter and height and spread—are instructive. There is a positive and accurate relation between the diameter of the base of a tree and its height and spread of limb. Given the proper root in concrete in the ground, any tower or chimney may be given for its taper or slope of side the same degree of line found in the works of nature, and be safe. Likewise, the taper of an arm or a leg among humans or animals may be accepted—and is, unconsciously, by designers—as an accurate pattern to follow in working out the taper of arms or legs in machine design. It is all a matter of the eye and the training of the eye through persistent observation.

Indeed, though I am not prepared to say that it is so, all calculations in these matters must have had as their initial base evidence of the fixed and established strength in things to be found among the works of God. Take the average lamp post or electric-light pole or flagstaff. Look at them. Every one resembles as to general line a sapling or a tree you have seen somewhere a thousand times in your strolling about in the country or in some near-by park. It is infall-*i*-ble.

Jones one day got a big promotion, and I was given his job. There is a story there, too, and I shall tell you about it some day. I had been with the company some four years, though, before this long-delayed recognition of true merit was bestowed upon me. But, as I say, one day I was given his job. And I had hardly donned Jones' mantle when there came a rush job for an engine, not more than an outline, though it had to be sufficiently correct in design so that, if they decided later to build the type, it could be erected; that is, I was not to give them something it would be impracticable to build. It was an idea of the Old Man's—the Big Gun. He had such ideas, at the rate of about two a minute, and one of the big requirements for the job I now was holding was the ability to get them out at about the same rate—two a minute.

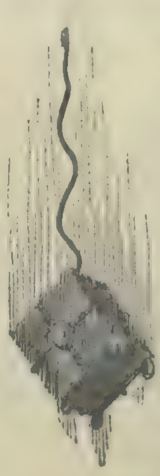
The particular rush about this job was that the Old Man wanted to catch a steamer in New York for Europe two days later, and he wanted to take the design along with him to consult some eminent specialist abroad as to its theoretical value. The Old Man was like that. He walked to and fro over the earth and up and down in it with the same *élan* with which a kid sets out for school in the morning.

I made a swift mental calculation and perceived that I had to do the job in 24 hours. The thought of it kind of made me sick to my stomach. The idea itself was revolutionary—the Old Man wanted to explode a volume of gas directly against a volume of water inclosed in cylinders, with the idea in view of cutting out the ordinary method of cooling the engines with a circulation of water. You know what I mean—economy, and such. I tacked down a fresh piece of drawing paper and went to it. I had been given a sketch, such as it was—two dots, representing crankshafts; two vertical lines, representing cylinders; two slanting horizontal lines, these being the connecting-rods connecting the cranks of the two cylinders with the main driving shaft, eventually to be hooked up to a generator, I suppose. It never got that far, however.

But I went bravely to it. I slashed up center lines, established the size of the two cylinders, drew on my previous knowledge for the thickness of the cylinder walls, made a generous guess at the diameter of the shafts and began to work in the details, such as—the more difficult and critical—the method of machining and putting this damned thing together if they should ever want to build it. Taken it from me, I sweat blood, and then some.

There was not a machine in the wide world, to my knowledge, that even remotely resembled this idea, and so I had no precedent to follow in working out these details. It was all sheer creative work, but I nevertheless gloried in the job. I was on my toes every minute of the day and long into the night. My pencil began to smoke, I pushed it so hard; and then and there I decided that some manufacturer ought to devise a kind of water-cooled pencil. But the good work was not permitted to falter for this. I schemed out something that looked practicable from the shop point of view, and some time during the night I laid down my pencil with a sigh of relief. The job was done.

And it passed muster. The Old Man was pleased with the work, next morning; and after rolling it up, he took his umbrella and disappeared, to be gone for another protracted period in Europe. And I myself had won my spurs.



But the point is this: I did not make a single calculation on that job, and knew that if I had I should not have finished it on time. I had learned my lesson from Jones. This lesson had taken shape, among other things, in a combination of virtues as viewed from the standpoint of the designer. These virtues, summed up, were courage and more courage, and then more courage. I had an "eye," and the fact was known to me—was made known to me by my friend Jones—and I had the nerve to use it when the situation demanded it. Calculations, on that one job at any rate, would have delayed me beyond the required time set by the Old Man, and I should have been everlastingly disgraced and humiliated. But I took a chance and won. There was an element of chance in it, to be sure. But so is there an element of chance in anything we undertake that is worth while. Life itself is one big and continuous chance. Who knows but what, as he turns a corner, someone will drop a safe upon his head? The bone in his head may successfully ward off serious concussion, even as it may throw off the safe itself. But the element of chance is there. You take a chance with your daily food — ptomaine poisoning is not impossible to any of us. But who thinks of it in that light? Nobody. Just so, nobody in the game of designing machinery ought to let himself be buffaloed out of making a name for himself if, by taking a chance, given proper reason for confidence in his ability, he can carve a niche for himself in the designer's Hall of Fame. There is such a Hall—only, instead of calling the occupants of it designers, they are called scientists. But these scientists for the most part were designers just the same. Bell and Edison and Morse and Holland and Wright and Marconi are all slated for immortality, and not one of them but could rightly be called a designer—a man who gives commercial shape to ideas, even though, as in a good many cases among these men, the ideas are their own.

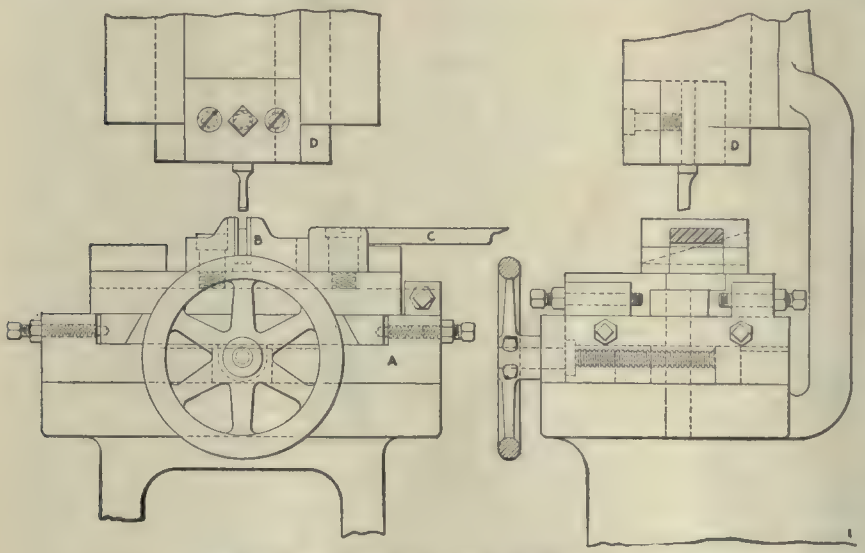
And not one of them, I do bravely state, but what possesses an "eye." Ask them and see. Observers, every last man of them, and proud of it. It is a gift, if you have it. If you haven't it, it is not impossible to attain it. And to attain it, all one has to do is to see objectively everything around and about him as he walks through this life of laughter and tears—60 per cent. laughter, if you will cultivate the power of objective observation; 60 per cent. tears, if you don't. As to the length of time necessary to cultivate powers of observation, it all depends on the mental acuteness and alertness of the man. Two weeks of persistent observing on the part of a man mentally slow normally will bring about as quick and surprising results as two weeks of persistent exercise in a gymnasium will bring out quick and surprising results in your physical well-being. Try it some time—try both—and see.

Slotting Attachment for the Punch Press

By J. J. Eyre

The accompanying illustration and description of a slotting attachment for a punch press may be of interest to the small shop without a slotter, or to the large one desiring to increase production.

A base *A* is cast and machined to receive the cross-slide and gibs for the vise table. The base is bored, and a lug under the cross-slide is threaded for the screw that actuates the table across the base. A wheel is attached to the front end of the screw to operate it. A work vise *B* of machine steel, pack hardened, is fitted to the top of the table. The cam lever *C* operates one vise jaw; the other is adjustable.



SLOTTING FIXTURE FOR PUNCH PRESS

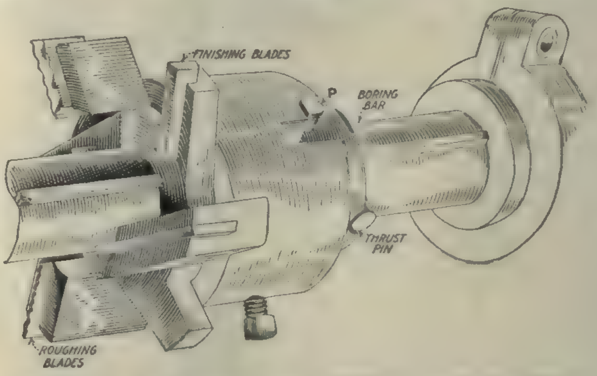
The press ram *D* is fitted with a slotting tool of the desired width; and when the fixture is secured to the bed of the press with the vise under the slotting tool, an efficient slotter is ready for use. Adjustable stop screws are secured to the base at each end of the cross-slide for controlling the length of travel.

Combination Roughing and Finishing Facing Head

By H. E. McCray

Our production on tractors, not long ago, was becoming seriously handicapped by the length of time consumed in boring and facing transmission-case bearings.

There were three pairs of bearings to be rough and finish bored, reamed and faced. The limits on the holes were $4.750^{+0.002}_{-0.000}$ and $6.000^{+0.002}_{-0.000}$, there being only 0.0005 in. eccentricity allowed and 0.012 in. over all on the faces. There were two small holes and one large one, on a common center line, the maximum variation on centers being only 0.005 in., and misalignment 0.003 in. in 12 in. The flanges on the small holes were 6½ in., diameter, the large one 10½ in., to be sweep faced.



COMBINATION ROUGH AND FINISH FACING HEAD

The job was set up on a Barrett cylinder boring machine, a single-spindle horizontal with an end support on the outer end of the boring bar. The case was held in an indexing fixture, moved back and forth with a crossfeed screw and handwheel. Production was raised somewhat by putting right- and left-hand facers, rough and finish boring cutters and reamers on the bar, feeding straight through with the three cutters, and then facing each side. The principal trouble was to get a straight facing cut on the flanges, without first rough facing and then withdrawing the bar to put on finishing facers. This difficulty was finally overcome by the use of a combination roughing and finishing facer, shown herewith. Each facing head is three-bladed, with a 7-deg. front rake (not shown), and a 20-deg. shearing angle to prevent chatter. The roughing blades are held in bosses projecting from the face of a flanged outer collar, fitting over the body of the finishing head. In the illustration the tool is shown with the roughing head advanced to working position. The thrust of cut and driving torque is taken by two pins *P*, flatted and hardened, secured in the body of the finishing head. These fit into notches milled in the back of the roughing head, which is shoved ahead and rotated slightly, then locked with the setscrew. Rotating it in the direction of cut permits it to be slid back out of the way for finishing. This change can be made quickly and with little trouble.

The finishing blades are serrated in order to get under the scale easily and wear longer. The roughing blades can be set out and worn down within $\frac{1}{16}$ in. of the casting, even with a new set of finishing blades, as the bosses on the flange project enough to allow it.

We found it advisable to use the inner head for finish facing, as it had no chance for misalignment, it being a nice sliding fit on the bar. The thrust was taken by dropping a pin through a hole in the bar, the back being recessed to keep it from dropping out. The whole arrangement is driven by a key and keyway in the bar.

As might be expected, a considerable amount of time was saved by this method, and the head seems to be standing up well in service.

Spoked Handwheels for Machine Tools

By W. Burr Bennett

Some time back, Prof. John Sweet made the suggestion that there are certain "best ways of doing things" in the mechanical field. Among the multitude of things in the field of design that need attention in accordance with his suggestion, is the method of spoking a solid-hub handwheel. This matter seems to have received little thought from designers.

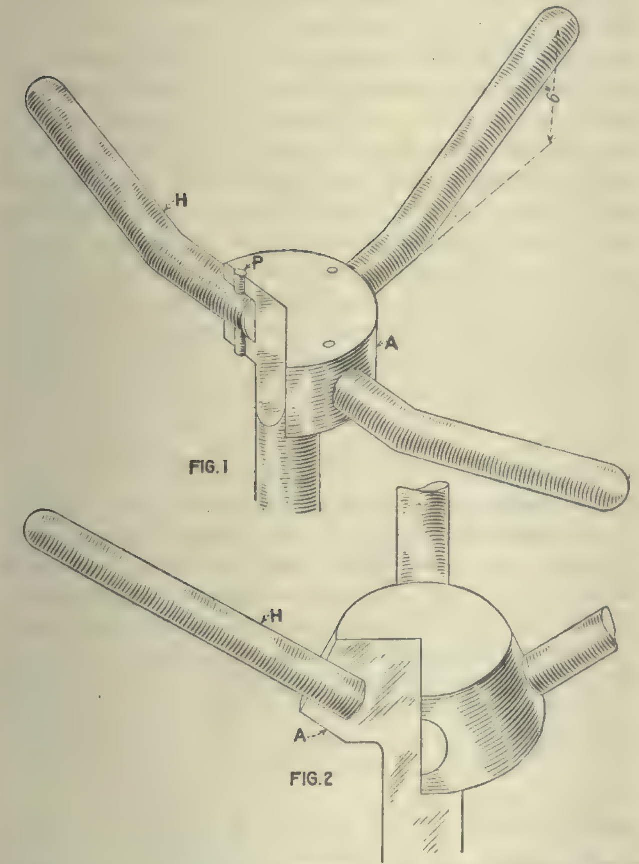


FIG. 1

FIG. 2

FIGS. 1 AND 2. AN INCORRECT AND THE CORRECT WAY OF PLACING SPOKES

Fig. 1 shows the common method of constructing such a wheel. Four radial holes are drilled in the hub *A* at 90 deg. with the axis, and the four spokes *H* are driven, tapped or pinned in the holes. In order to throw the spokes forward, usually to clear an obstruction and to make the wheel more handy, they are offset, say 6 in. Now consider the condition where an operator is able to exert 180 lb. at the end of this spoke; 180 × 6 will give a torque of 1080 lb.-in. at the straight part of the spoke. If the spoke is ½ in. in diameter, the holding device in the hub must be able to withstand a twist of 1080 × 2, or 2160 pounds. This is considerable pressure for a pin of the size that is generally used in work of this kind.

Needless to say, the average drive fit will loosen under this pressure, as will also a thread. A small pin fares but little better, and consequently the handwheel of this type frequently displays spokes radiating at four different angles. Decidedly the best way to do the job is shown in Fig. 2. Here we have the spokes *H* at an angle also, but the hub *A* is made in the shape of a cone frustum and the spokes are entered at 90 deg. with the face; hence it is apparent that no twist is set up in the joint and that a drive or threaded fit will answer.

Difficulties of Gaging Work on the Surface Grinder

By Reed H. Haslam

A Blanchard surface grinder was installed in a shop where I was working about a year ago, and I was called on to operate it.

The first job was a large number of steel disks, 1⅛ in. in diameter by $0.1870^{+0.0005}_{-0.0000}$. I found that the magnetic chuck would accommodate eighty-five of these pieces. My first operation was to clean up one side.

When it came to finish to size I met trouble, for there was no indicator, such as is designed to show the progress of the work toward standard size, with the machine. After I had finished several loads by the process of taking off pieces for "miking," I found it to be a very slow method, for I was accustomed neither to the machine nor to such close limits, and one load under size meant eighty-five pieces spoiled.

I ground one load down to 0.0005 in. oversize, the upper limit, and removed it. From those already finished I selected an equal number which were, as near as I could judge, at the lower limit.

In the next load I placed eighty-three unfinished pieces, and one of each of these two selected lots. These two disks representing my limits I colored with copper sulphate.

When the grinding wheel had removed the copper from the disk which was 0.0005 in. oversize, and before it had touched the smaller one, the load was finished to within the required limits.

The disks when placed on the magnetic chuck were arranged in concentric circles. In the final development of this method I placed a coppered piece in each circle, progressing in size from 0.005 in. oversize down to the lower limit. As each piece was scratched, I adjusted the stop so that the head would feed down an amount equal to the oversize on that block. Thus I always had a margin of safety, due to the wear of the wheel.

A little time spent in preparation when chucking the work enabled me to proceed with the grinding with speed and precision.

Keeping Machines on the Job

By BYRON T. HAWLEY
Machine Inspector, Brown, Lipe, Chapin Co.

SYNOPSIS — *Points out some of the reasons why machine production often falls so far below the estimated output and offers practical suggestions as to how the delays due to breakdown can be largely prevented by care of machines and a closer coöperation between builder and user.*

THIS article is an appeal to the builders of machinery to improve conditions regarding the maintenance of their machines and, when this is done, to disseminate the knowledge gained for the mutual benefit of both the maker and the user.

It seems to be difficult for one without actual experience in the organizing of forces for the systematic maintenance of machines to realize the value of data concerning them which might be furnished by machine builders. This is especially true where they are overloaded to such an extent as to make disabled machines responsible for 10 per cent. of production loss, when it should be not over 3 per cent. Picture a plant with an equipment of 2000 machines, of 600 different types, makes and sizes, with hardly a dozen machines in the whole outfit with so much as a list of parts from which to start a collection of data, and you have a predicament in which many manufacturers find themselves.

Is it not reasonable to suppose, that to deal intelligently with a situation where an average of 30 and sometimes as high as 60 machines of all descriptions are down for repairs at once requires system with the red tape clipped short, and that data are certainly the first requisite? Is it unreasonable for the user of a machine to expect from the machine builder a code concerning the use and maintenance of his machines?

In the designing of a machine, the strength of materials is usually taken into consideration. But when a designer lays out a machine that is composed of units which are practical to manufacture, a machine that has a symmetrical appearance and is one that will produce results, he appears to rest on his oars.

There are six basic causes that make machine repairs necessary, and these might be set down in the following order: (1) Insufficient or improper lubrication, (2) presence of dirt on bearing surfaces, (3) wanton misuse of machine, (4) imperfect adjustments, (5) vibration and (6) unavoidable wear.

In the process of preparing a perfectly good machine for the scrap pile, we are likely to consider that the machine is wearing out when, in reality, of the six basic causes unavoidable wear is but a fraction of 1 per cent. of the total cause, and a large per cent. of the balance is preventable if the maker and the user of the machine apply their combined knowledge to actual practice. The preventive is much more easily and lastingly applied by the machine designer. Improved supervision of machines and systematic inspection must take care of the first four causes—lubrication, dirt, misuse and adjustments. The fifth cause—vibration—is a result of the first four causes, unless the design is seriously at fault.

Standards are necessary to all successful operations, and who is better fitted to set the standards for lubrication, cleanliness and the proper use of the machine than the designer and the maker, who possess a complete knowledge of the stresses and speeds to which the various parts are subject? These two can save much for the machine user by giving their advice and opinion of these things in plain language.

Oil could be saved where a small amount is sufficient, and unnecessary friction could be eliminated by making a plain statement as to the grade and weight of oil to be used on certain bearings. With their knowledge of the bearing surfaces subjected to the presence of chips and dust, the designer and the maker of a machine are in the best position to advise how much attention should be given to keeping the wearing surfaces free from dirt and to sound warning about keeping oil holes covered.

When a machine maker keeps repair parts on hand for rush sundry orders and lists them in a comprehensive manner, he has a new and real selling point that he can play up strong in advertising his machines and the satisfied customers using them. The machine user expects an occasional breakdown; but it is certainly bad for the machine when a gear of perhaps odd pitch cannot be ordered without a sketch and will not be made by the machine builder until the order is received.

A request was made of the builder of a standard automatic machine costing more than $8000, as to when he could deliver certain ratchets, and what these parts, which are always liable to require replacement, would cost. The reply came from the builder that the price of sundry parts was always figured from production, and that he would be pleased to commence work on the order as soon as it was received. Can this be considered satisfactory when a part is wanted immediately?

IGNORING REQUESTS FOR INFORMATION

A manufacturer of tools and machinery was asked to furnish assembly prints or a list of parts for one of his regular machines, and he replied that he had never issued such printed matter but that he was sending a photograph of the machine in question, also the foundation plans. The picture was a good one, but the concern that bought the machine thought it would be interesting and instructive to know what was inside the machine. Many similar examples could be cited.

The good designer knows what the careless operator is liable to do that will injure the machine. Who is better qualified to warn against the laying of wrenches on the ways of the machine? Who knows as well as the maker how fine an adjustment is required on gibs or lock pins and what is liable to happen if they are adjusted too close?

It must be remembered that the machine operators of today are not skilled machinists. Words of warning and instruction as to the care of certain machines would be read if put in the right way, and there can be no doubt that the machines would be kept in better shape as a result.

I have worked in large shops where sufficient time to clean and oil machines was not only allowed the operator, but made a real necessity by virtue of a code which required an inspector to make his chalk mark on each machine before the operator was permitted to leave. The thorough oiling of each machine by the operator was also a requirement.

The machine user might put a code into effect by which a sufficient amount of time is devoted to each machine to clean up, to see that oil holes are clean and covered and, where necessary, to forestall gumming by an application of kerosene oil. This can be done between shifts or after hours. He might install a system of machine repairs by inspection. But we are not likely to come to a point where instructions regarding the care of machines will be carried out to the letter; consequently, bearings will be improperly lubricated, dirt get on the bearing surfaces, machine operators continue to abuse machines—and repairs will still be necessary. So the next best thing for the maintenance man to do is to be prepared, and a large factor in the preparedness is the illustrated parts list sheets which are furnished by the machine maker to facilitate the obtaining of parts to be kept on hand in case of necessity.

ADVERTISE LOW MAINTENANCE COST

In the advertising section of the *American Machinist* certain claims predominate, such as capacity, production, big profits, speed, automatic, strength, accuracy, etc. One manufacturer in a hundred advertises the point of low maintenance, and none makes the point of how well he will take care of machine users on price and the time of delivery of machine parts. It puts the repairman in bad. The management expects to get the advertised production from the machines and puts it up to the repairman to keep them going. The repairman cannot get quick delivery of parts, so he makes a guess and orders ahead. Then the management doesn't want to tie up the money, so the repairman makes some of the machine parts himself when they break. Then the management comes back at him again for making stuff that must cost much more than it costs the machine builder to turn out in quantity. Yet the production department goes up in the air if it is suggested that a machine be stopped while there is still the possibility of production in it. The repairman has no backing, consequently the stitch-in-time rule is not applied.

It seems hard to make managers realize that close-fitting arbors save cutters, that loose bearings throw gears out of line and that constant adjustments are made necessary when a machine is not right. As one experienced repairman said: "Cheer up! Things go like that for a while, then they get worse."

In these days of heavy mechanical production, the machinist is likely to call himself a toolmaker and demand a toolmaker's rate in the tool department. The monkey-wrench mechanic is then called a machinist, and a machinist's helper is termed a repairman. The machine operator is on piecework and cares not what happens to his machine tomorrow if only he can get his work by the inspector today.

When a large manufacturing plant runs some years without looking ahead on machine maintenance, it is no small job to put repairs on an efficient basis that will really lessen the time lost on account of crippled or disabled machines. This is especially true when the plant is working 23 hours a day and looking for 100 per cent. production. The operator doesn't report his machine when it starts to go bad because he may lose a few pieces on today's production. "Let it break down with the night man," says he.

OPERATORS WHO DO NOT KNOW MACHINES

The gang boss is generally a graduate operator and is interested in immediate production only; in fact, he seldom knows the system used to transmit movement to the feed or the drive on the machine his operator runs, so it runs until the work will not pass inspection or the machine breaks down. The operator had noticed that the feed would catch and start with a jump when the machine was started and wondered what could be the matter. He even went so far as to oil places he had never noticed before. On starting the machine again, the feed caught as before, but did not grind so badly, and production was begun. The operator did not know that a ball thrust bearing had gone dry and was running with broken balls. When the wormwheel had lost some of its lubrication, it cramped, stripped a few teeth, spoiled the worm and broke the wormwheel bracket. The operator reported to the gang boss and was assigned another job. The repairman was then called in and told that this was a special rush job and the machine must not be held down long.

The repairman was fairly good and did no worse than disassemble twice the number of parts necessary to get the bracket off. The worm and wheel would require "special hob" to make, and he decided to order all three parts from the factory by wire. There is no parts list sheet at hand, so a description is wired, giving size and type of machine. Two days later a letter comes from the maker asking for a sketch of the parts wanted and the serial number of the machine. Sketches are laboriously made by the repairman, but the chief's pride would not permit it to be sent out, so the parts were all cleaned up good and delivered to the engineering department, which took two days and passed out a blueprint that would serve as a complete working drawing. The repairman spent a couple of hours scraping and cleaning the machine in search of the serial number, and found it stamped on the machine base, where it could not be seen when work was on regular set-up. A full-fledged repair-part order was sent by mail to be delivered "some time."

Why does that machine get a black eye from the production department?

SHOULD LEARN FROM AUTOMOBILE INDUSTRY

The automobile industry is not old, but the makers have learned that if they would sell more automobiles they must keep running those already in use. Hence the successful manufacturers issue instruction books that not only show how to operate the car, but how to oil and care for it. In addition a list sheet showing a picture of each part with its name and number is sent with the book. To the machine user the illustrated list of parts is invaluable. It affords him an opportunity to get ahead of time parts that are likely to be wanted. He can recognize the picture of the part, and its having a definite number gives him an assurance of its interchangeability.

To be sure, some of the automatic machine builders publish handy parts list catalogs, and the operator's manual on the Hartness turret lathe is excellent. But the writer has in mind several different makes of machines costing thousands of dollars each, erected and in operation, without a printed word of caution or instructions regarding their care or maintenance, and no list of parts or blueprint to assist in ordering parts. The best to be had in these cases is a mess of detail blueprints and a huge assembly drawing, without mention of how to disassemble or adjust the parts liable to give trouble. There are oil holes a-plenty, but will the operator or even the instructor machinist find them all before something happens? Many a lathe cone pulley has frozen to the spindle because it did not occur to the operator that there were oil plugs in the surface of the cone. It is very easy to bolt a fixture on to a miller and cover up oil holes, unless warned against it.

I have taken gear plates off automatic gear-cutting machines when the turret was stuck and found oil plugs rusted in and bearings dry. It is considered quite the thing for machine builders to send an expert with the machine to instruct operators. Their interest is to see that the machine is set up and started right to get the guaranteed production; but from the shopman's standpoint, this expert is of the greatest value in giving pointers and information as to what to do when the feed sticks, how to adjust the indexing mechanism, how the turret may be removed with a minimum of effort, and what to call certain parts wanted for replacement. As the expert or engineer knows these things, why not have them set the knowledge down in black and white so that when the necessity arises one may know just what is what without any unnecessary experiment?

To compile and publish instructions on the care and maintenance of a machine and photographs of machine parts costs money, but it would most certainly increase the working life of the machine and make a sales booster of the repair department. With the machine builders coöperating to furnish data and advice, and with the frequent use by customers of a code on the care and maintenance of specific machines, the working life of the average machine would be doubled.

Machining Rifle Parts in the Automatic Screw Machine

By Harry Koontz

An escutcheon for military rifles is shown in Fig. 1, also the turret tool for cutting the teeth in an automatic screw machine. This tool acts as an external broach and cuts on the face. In operation the spindle is stopped by means of the brake commonly used when crossdrilling.

Two cutters are used for slotting the teeth, one rough and one finish, and a groove for relief is formed at *A* by the form tool.

This method of cutting the teeth proved to be superior to the knurling operation previously used, in that it produced a cleaner and deeper tooth, which could be held more closely to size.

The cams for producing the part are of the usual type, and the cam lobe for the broaching operation is given a slow rise for cutting the teeth.

The ejector screw shown in Fig. 2 was completed in an old style B. & S. No. 00 automatic screw machine, and as the part was too long for the ordinary tools and a larger machine not available, the special threading die shown was used to allow the turret to revolve.

This hollow-mill, or prong-type, threading die is made with four flutes cut somewhat wider than usual so that the small stem shown on the end of the screw will pass between the teeth of the die when the turret revolves in the extreme position.

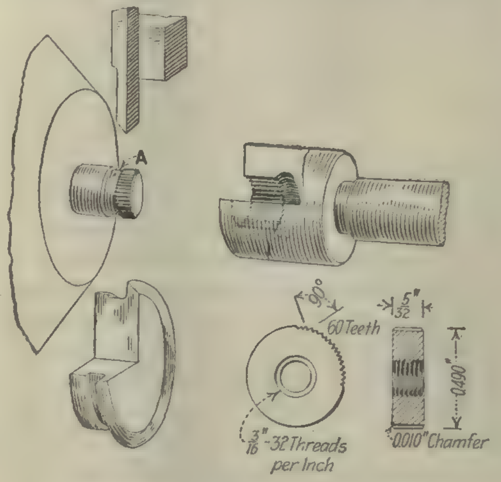
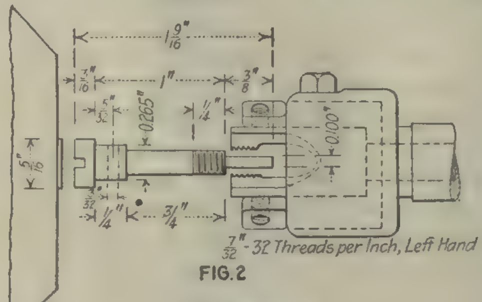


FIG. 1. THE RIFLE ESCUTCHEON

The hole is crossdrilled from the rear slide, making it necessary to perform all turning operations from the turret. The stem, 0.100 in. in diameter, is first turned with the short hollow mill held in the special adjustable holder shown in Fig. 3; the other diameters are turned with longer hollow mills having wide flutes similar to the threading die.



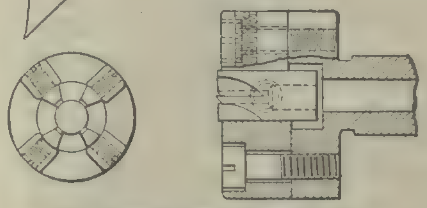


FIG.3 Making a long Screw in the Automatic Screw Machine

FIGS. 2 AND 3. OPERATIONS ON THE AUTOMATIC

Fig. 2—Threading the ejector screw. Fig. 3—An adjustable holder for the hollow mill

The cams for machining this screw are not unusual, and the hole is crossdrilled in the ordinary manner.

It is sometimes the case that a long screw having fine threads of small diameter may be more successfully produced in the No. 00 machine than in larger sizes, owing to the selection of speeds and the sensitiveness of the smaller machine.

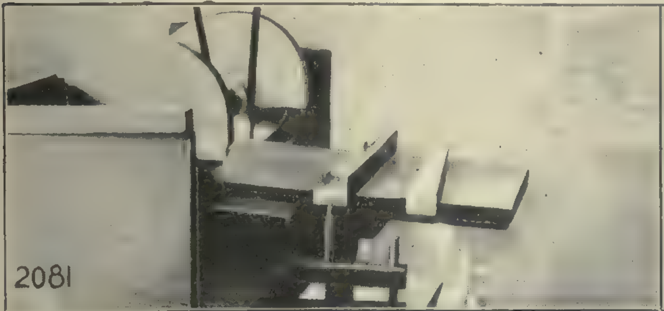
United States Munitions*

The Springfield Model 1903 Service Rifle

Operations on the Hand Guard—I

SYNOPSIS—*This installment begins the manufacture of the hand guard and takes up various sawing, grooving, turning and shaping operations.*

As far as quality is concerned, the walnut used for hand guards is the same as for stocks, but the pieces may be sawed from planks or made from other pieces large enough to form two blanks. The approximate size of the blocks is given in the transformation of operation 1-A. The shape, dimensions and various cuts made on the hand guard are shown in Fig. 2080. After the blocks are sawed into hand-guard blanks, the latter are trimmed to working length on a double saw, as shown in Fig. 2081. This is just an ordinary double-end circular saw fitted with a sliding table to which an angle stop is screwed. Against this stop the blank to be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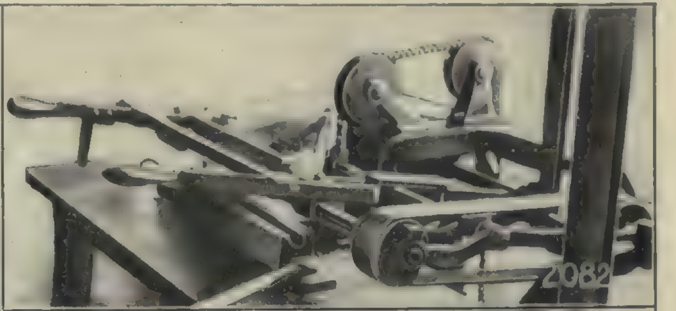
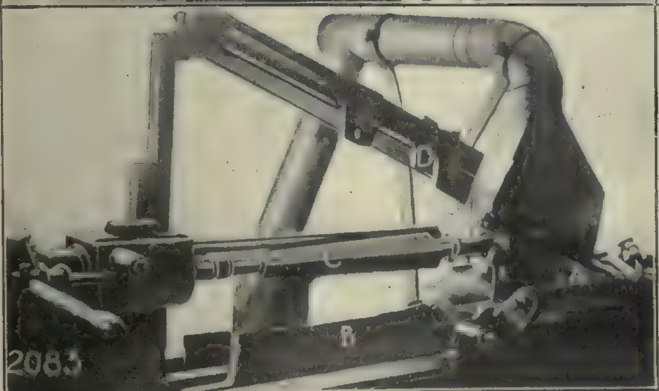
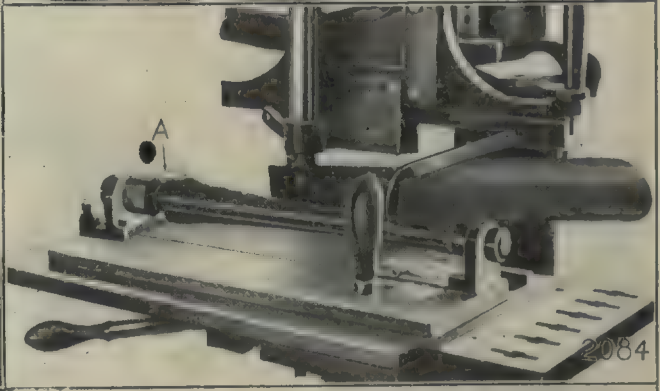
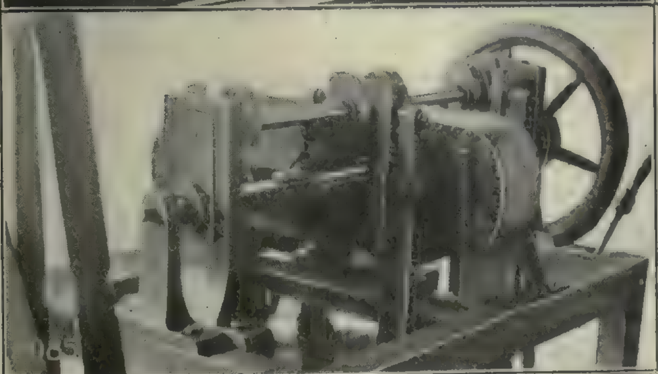
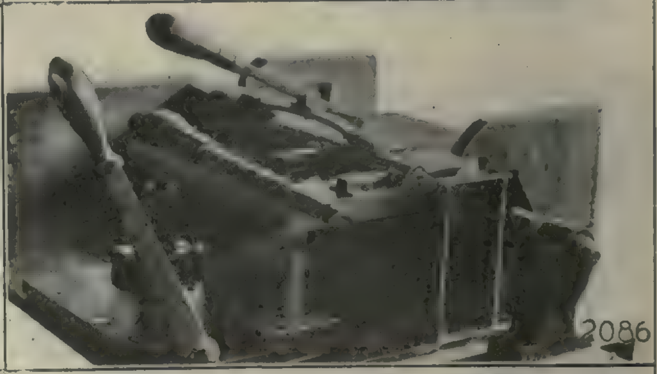

2082


2083



2084


2085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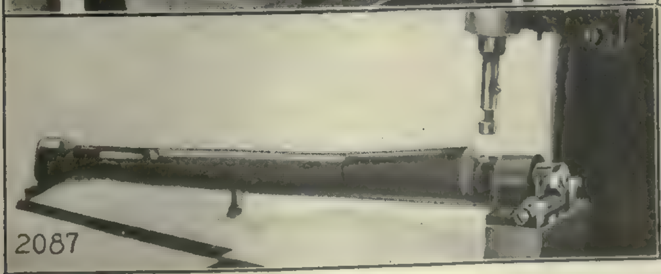
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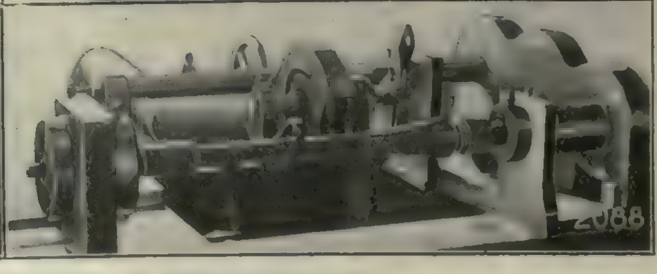
2088

FIGS. 2081 TO 2088. VARIOUS OPERATIONS ON THE HAND GUARD

Fig. 2081—Cutting to length for machinery. Fig. 2082—Grooving for barrel—second cut. Fig. 2083—Turning to remove stock. Fig. 2084—Cutting to match stock for width. Fig. 2085—Turning between bands. Fig. 2086—Cutting to finish length. Fig. 2087—Cutting clearance for windage screw. Fig. 2088—Finish-turning rear end

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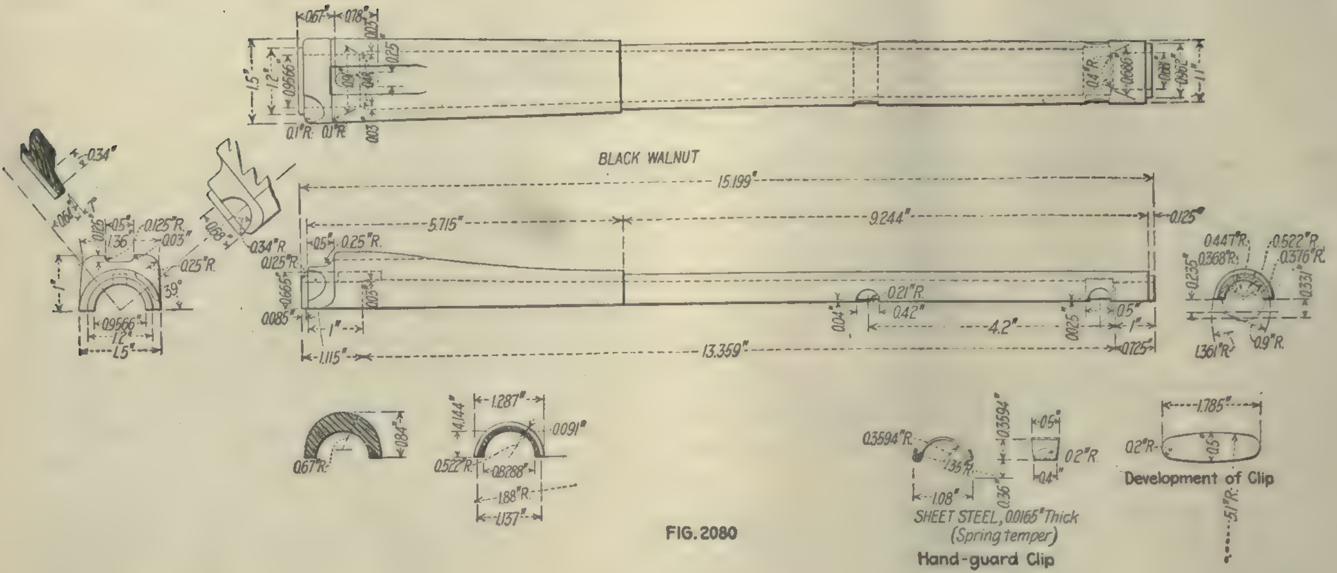


FIG. 2080

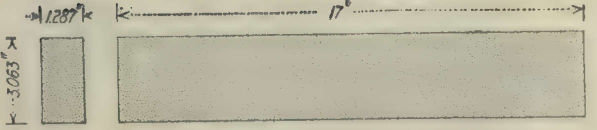


FIG. 2089
OPERATION 1A

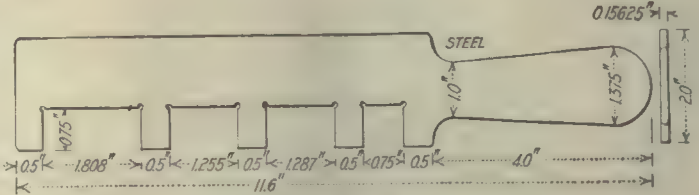


FIG. 2092
OPERATION 1B

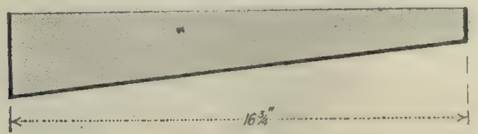


FIG. 2090 OP. 1B

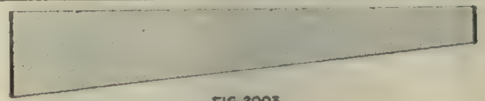


FIG. 2093

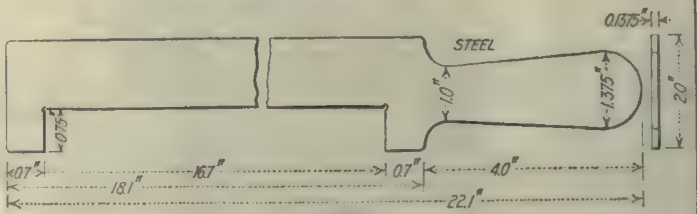


FIG. 2094
OPERATION 2

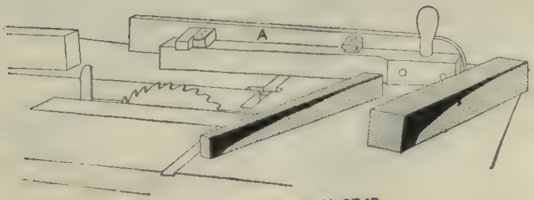


FIG. 2091 OP. 1B

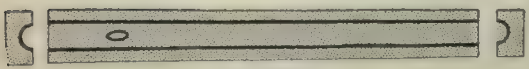


FIG. 2095

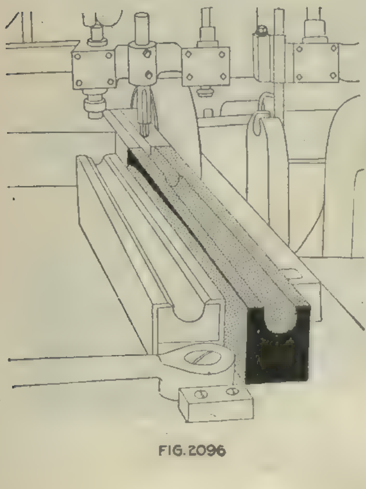


FIG. 2096

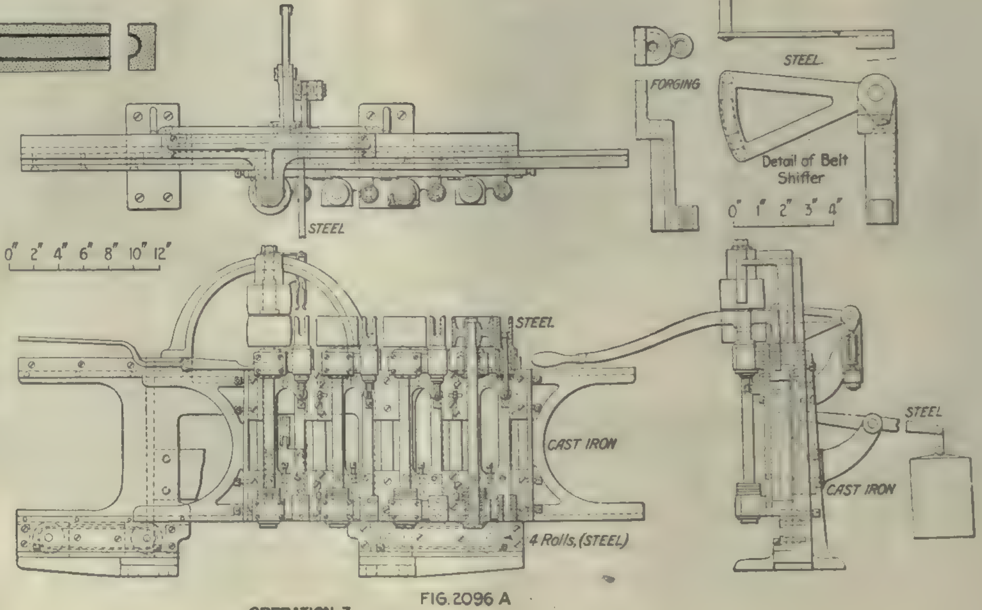


FIG. 2096 A

OPERATION 3

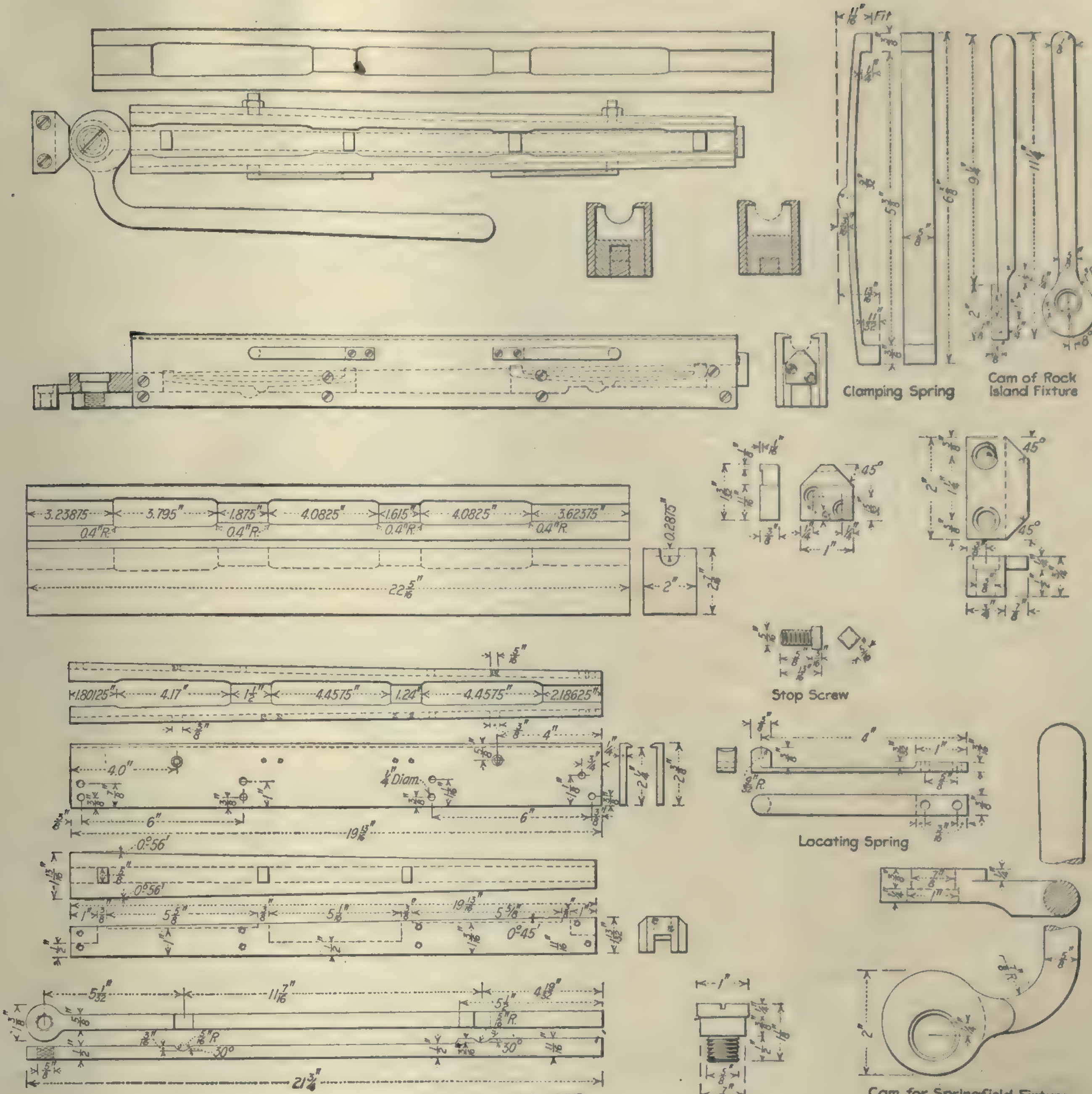


FIG. 2097
OPERATION 3

trimmed is held and fed to the saws. From this point the real machining begins, the order of operation being as follows:

1-a. Sawing from walnut plank or other stock
1-b. Sawing blanks
2. Cutting to length for machinery
3. Cutting groove for barrel—first cut
3½. Cutting groove for barrel—second cut
4. Squaring edges
5. Turning to remove stock—first cut (full length)
11. Cutting to match stock for width
6. Turning for bands
7. Turning between bands
8. Cutting to finish length and crosscutting for clips
9. Cutting clearance for windage screw
10. Turning rear end from lower band to sight base
11½ Cutting field view
Inspect
12. Sanding and finishing
13. Oiling with linseed oil
13½. Cutting for clips
Inspect
13¾. Assembling clips
14. Oiling with cosmoline

The rough-sawed blanks are placed in a bedding machine, Figs. 2096 and 2096-A. They are held in a fixture, Fig. 2097, to which a master profiling form is attached. The tools used are illustrated in Fig. 2098.

Following the rough grooving, the piece is placed in a special heading machine, shown in Fig. 2082 and detailed in Fig. 2100. The heading tool, Fig. 2107, revolves at a high rate of speed and is pressed down into the groove by means of the two handles shown in Fig. 2082. This finishes the shoulder and circular parts of the groove to size.

The squaring of the edges is done on a wood shaper, Fig. 2104, using the work holder seen in Fig. 2105. As the barrel groove fits over a formed mandrel on the work holder, this operation not only squares the edges, but gages the depth of the groove.

In turning to remove surplus stock, the lathe shown in Fig. 2083 is used. Two pieces are clamped on the mandrel *C*, and then the tools at *A* are fed along, guided by the form *B*. There are two turning tools at *A*, one first hogging off the corners and most of the stock, while the second profiles the work. After the pieces have been rough-turned, the slide at the back is fed

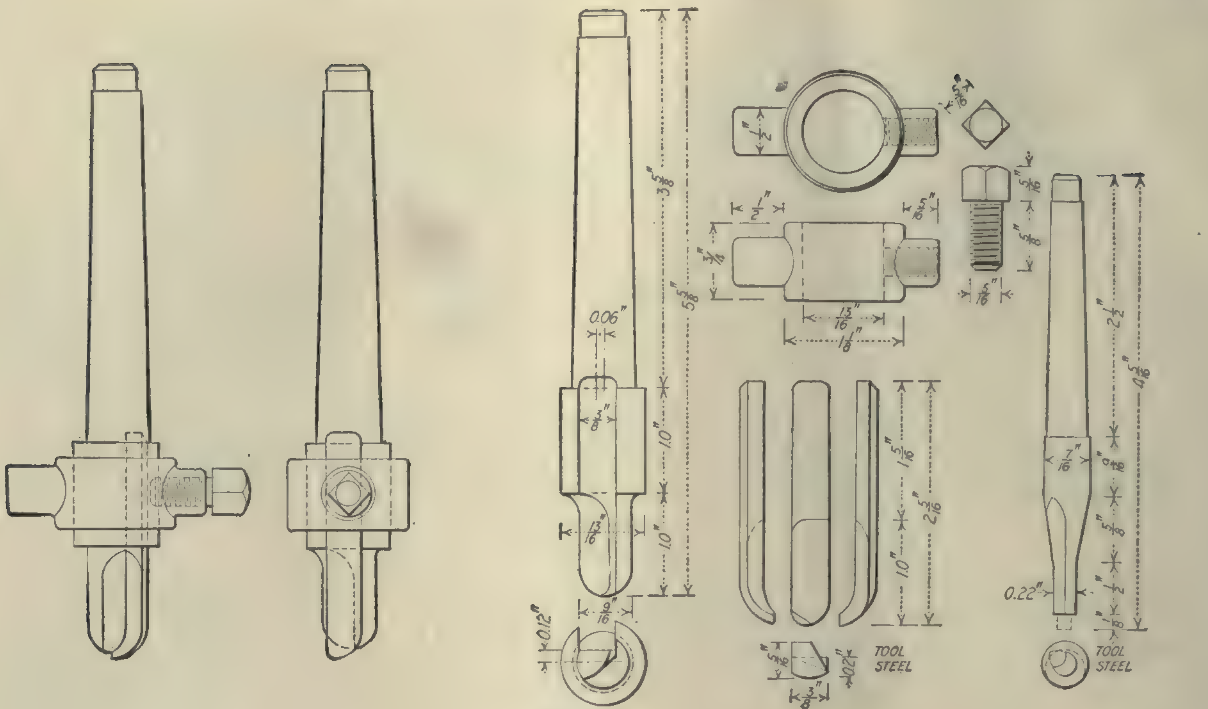


FIG. 2098
OPERATION 3

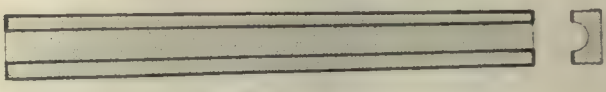


FIG. 2103

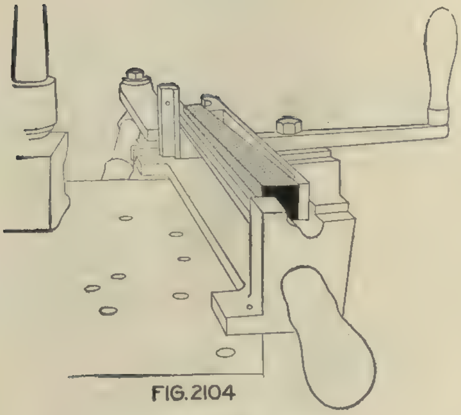


FIG. 2104

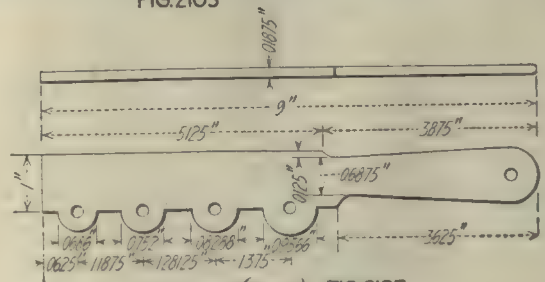


FIG. 2107

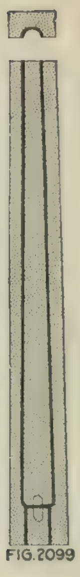


FIG. 2099

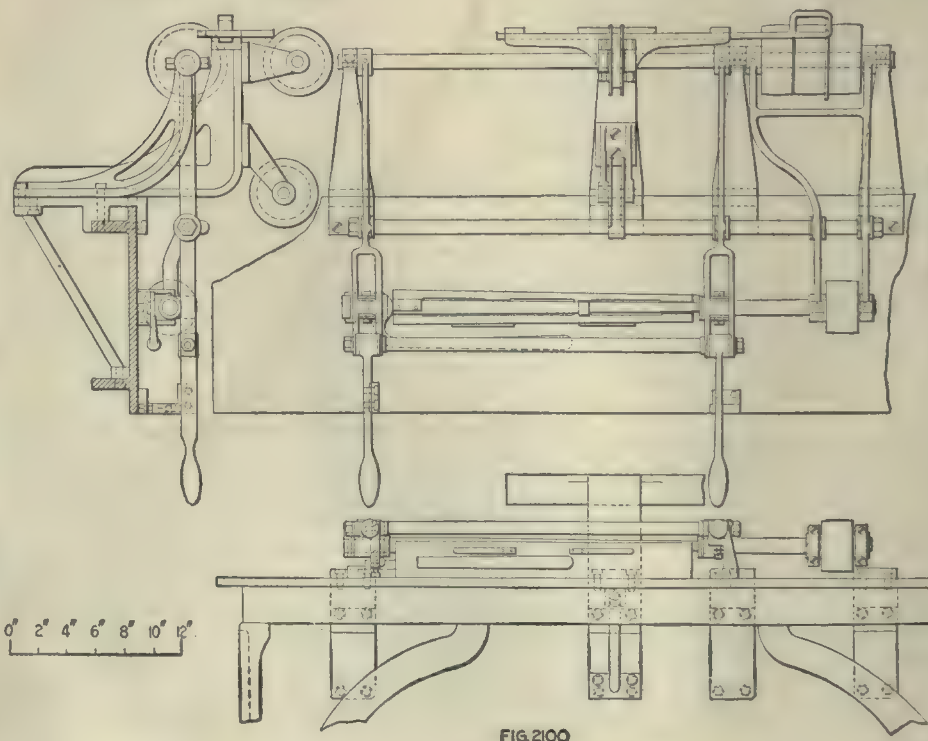


FIG. 2100

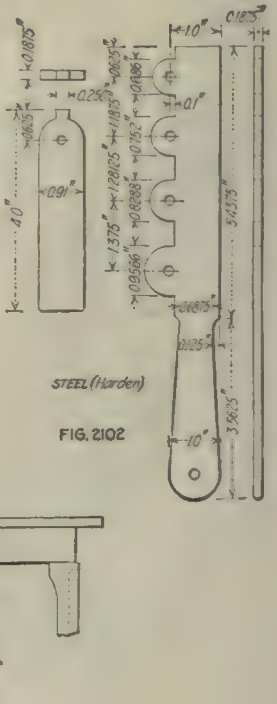
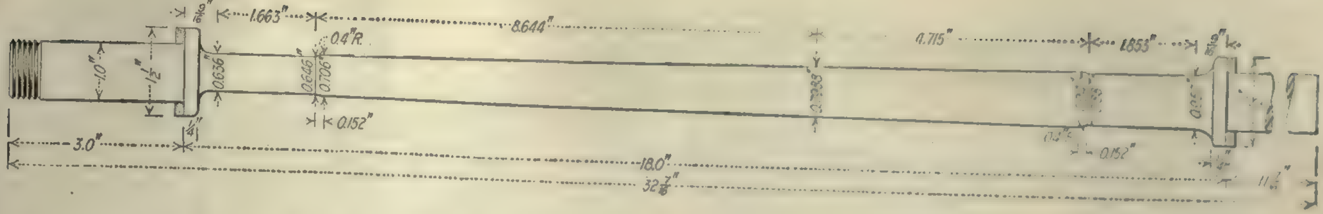


FIG. 2102



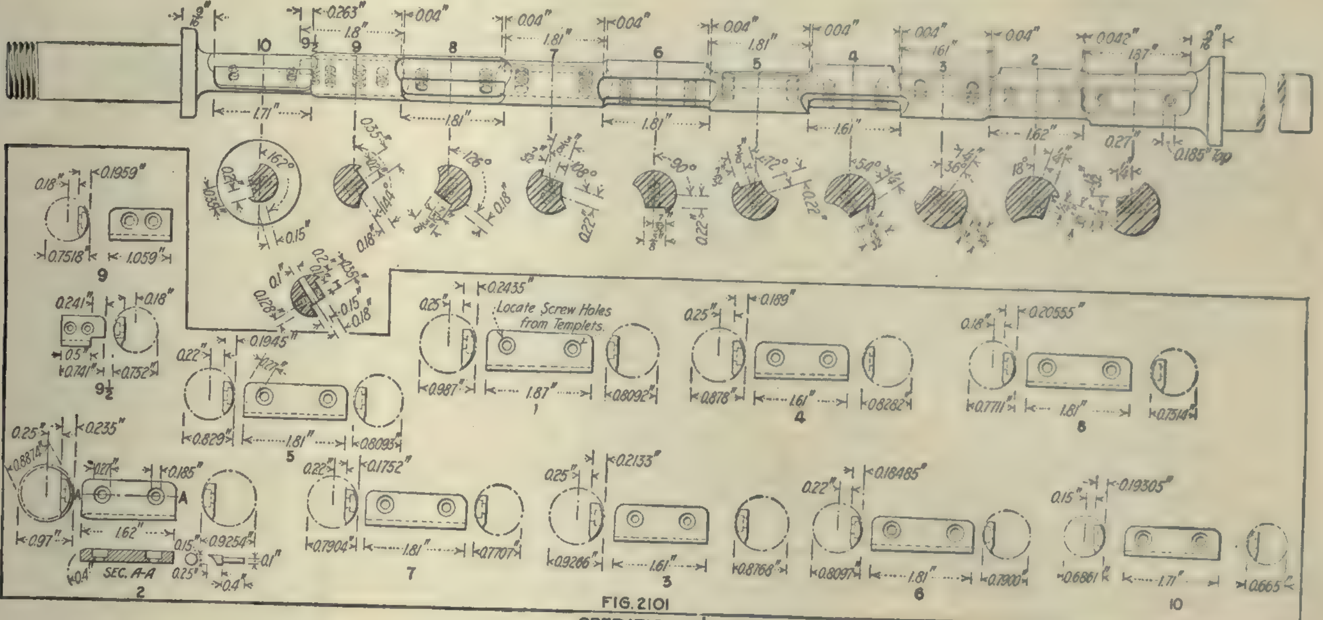


FIG. 2101
OPERATION 3½

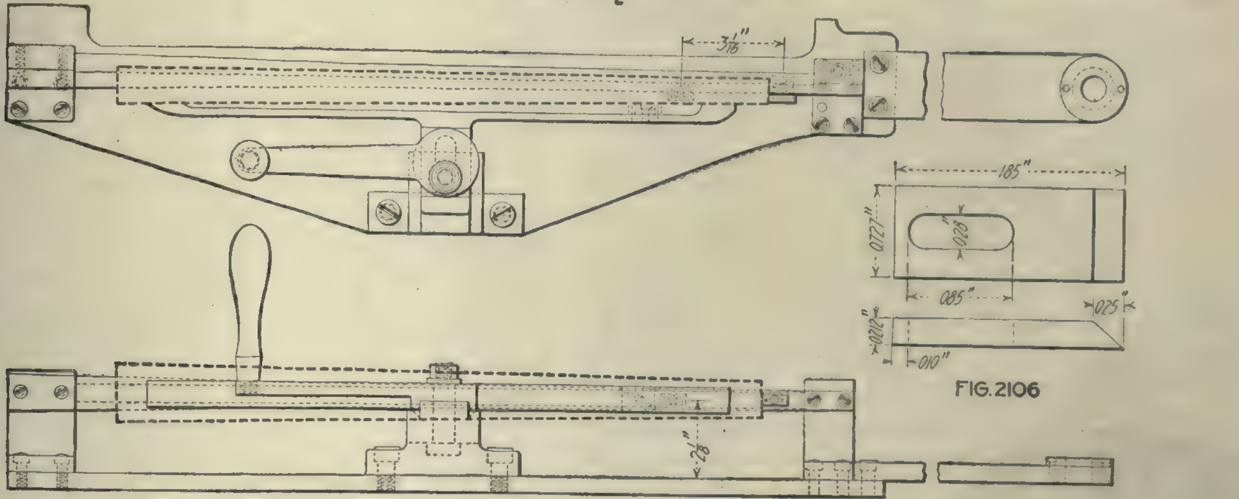


FIG. 2106

FIG. 2105 OPERATION 4

downward and the formed tool *D* cuts a beaded shoulder on the larger ends of the pieces. As in most cases where it is possible, the chips are carried off through a suction hood.

The machine shown in Fig. 2084 is used to profile-trim the edges to match those of the stock for width and outline. Two pieces are trimmed at a time, the work holder being shown in Figs. 2113 and 2115. After the edges are trimmed on one side, the work is indexed halfway over by means of the handle *A*, Fig. 2084, and the opposite edges are finished.

OPERATION 1-A. SAWING FROM WALNUT PLANK OR OTHER STOCK

Transformation—Fig. 2089. Machine Used—Buzz saw. Number of Operators per Machine—One. Gages—Common rule. Production—1210 per 8-hr. day. Note—The length given is practically correct, but the other dimensions vary considerably according to what the piece is cut from, the main idea being to obtain a block large enough to make two blanks.

OPERATION 1-B. SAWING BLANKS

Transformation—Fig. 2090. Machine Used—Buzz saw, Fig. 2091. Number of Operators per Machine—One. Work-Holding Devices—Handled blocks A, Fig. 2091, tapered to suit. Gages—Fig. 2092. Production—605 per day.

OPERATION 2. CUTTING TO LENGTH FOR MACHINERY

Transformation—Fig. 2093. Machine Used—Special duplex saw, Fig. 2081. Number of Operators per Machine—One. Work-Holding Devices—Angle plate on saw carriage. Special Fixtures—Angle plate bolted to saw table. Gages—Fig. 2094. Production—5280 per day.

OPERATION 3. CUTTING GROOVE FOR BARREL (FIRST CUT)

Transformation—Fig. 2095. Machine Used—Garvin special bedding machine, Figs. 2096 and 2096-A. Number of Operators per Machine—One. Work-Holding Devices—Work Holder and master form, Fig. 2097. Cutting Tools—Round-nose hogging-out and small slotting tools, Fig. 2098. Number of Cuts—Two. Average Life of Tool Between Grindings—500 pieces. Gages—See operation 3½. Production—660 per day.

OPERATION 3½. CUTTING GROOVE FOR BARREL (SECOND CUT)

Transformation—Fig. 2099. Machine Used—Special heading machine, Figs. 2082 and 2100. Number of Operators per Machine—One. Work-Holding Devices—See operation 3. Cutting Tools—Heading rod, Fig. 2101. Gages—Fig. 2102. Production—2640 per day.

OPERATION 4. SQUARING EDGES

Transformation—Fig. 2103. Machine Used—Wood shaper, Fig. 2104. Number of Operators per Machine—One. Work-

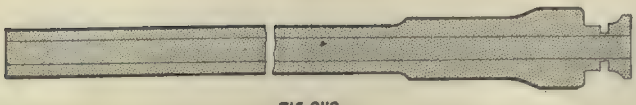


FIG. 2112

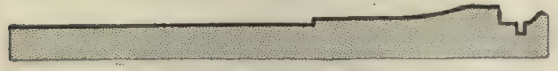


FIG. 2108

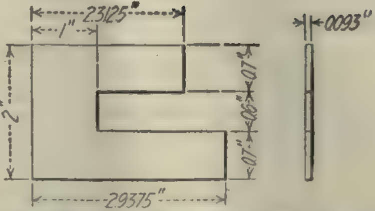
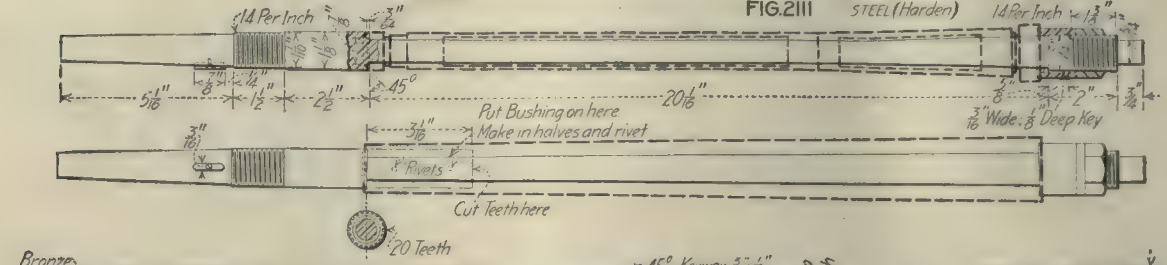


FIG. 2111 STEEL (Harden)



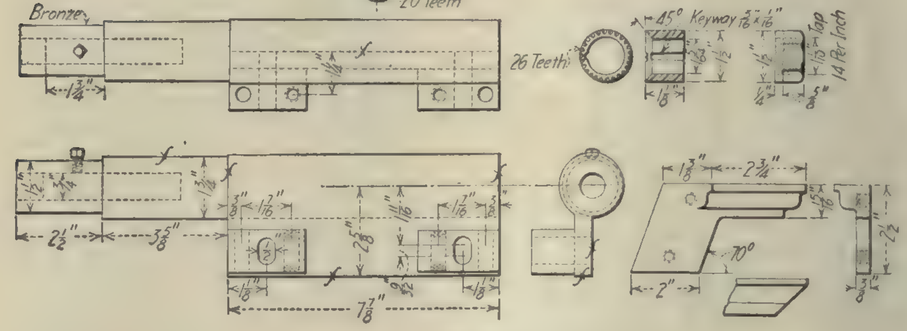
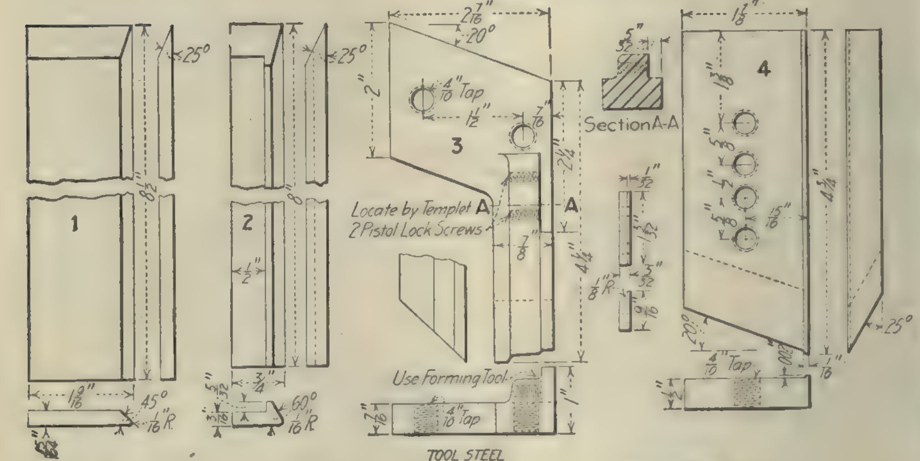


FIG. 2109



TOOL STEEL

FIG. 2110

OPERATION 5

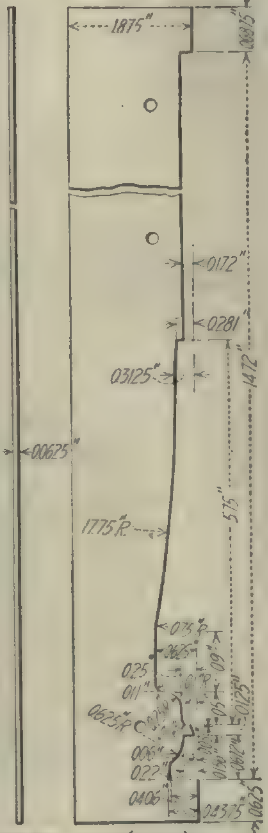
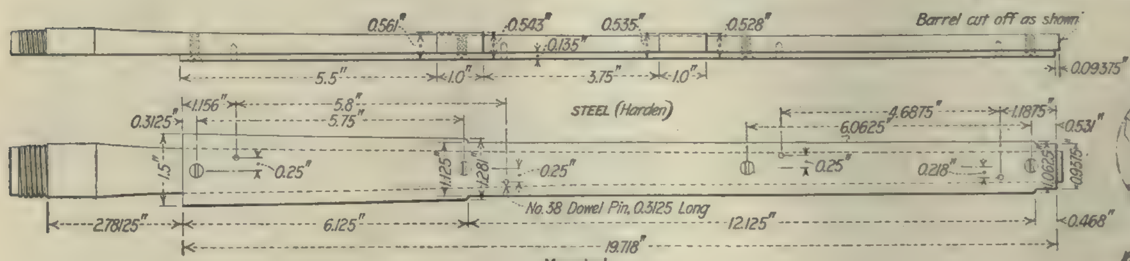


FIG. 2111 STEEL (Harden)



Mandrel
FIG. 2113

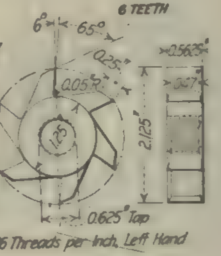


FIG. 2114

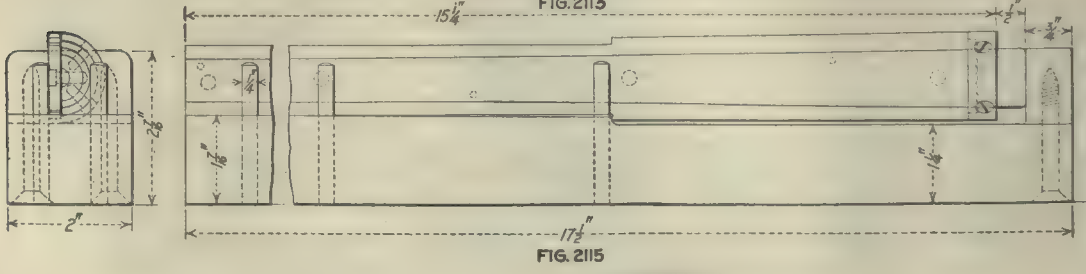


FIG. 2115

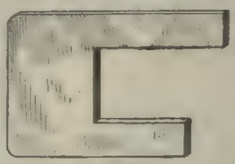


FIG. 2116

OPERATION 11

Holding Devices—Fig. 2105. Tool-Holding Devices—Cutter head. Cutting Tools—Fig. 2106. Average Life of Tool Between Grindings—2000 pieces. Gages—Fig. 2107. Production—2420 per day.

OPERATION 5. TURNING TO REMOVE STOCK

Transformation—Fig. 2108. Machine Used—Special lathe, Fig. 2083. Number of Operators per Machine—One. Work-Holding Devices—Special mandrel, Fig. 2109. Cutting Tools—Tools for body turn and beading, Fig. 2110. Number of Cuts—Three. Average Life of Tool Between Grindings—600 pieces. Gages—Fig. 2111. Production—550 per day.

OPERATION 11. CUTTING TO MATCH STOCK FOR WIDTH

Transformation—Fig. 2112. Machine Used—Wood shaper, Fig. 2084. Number of Operators per Machine—One. Work-Holding Devices—Mandrel, Fig. 2113. Cutting Tools—Fig. 2114. Average Life of Tool Between Grindings—600 pieces. Special Fixtures—Mandrel cradle and master form; see Figs. 2084 and 2115. Gages—Fig. 2116. Production—1232 per day. Note—The gage shown is used to test width of small end, and master form is depended upon for the rest.

Limits and Tolerances for the Manufacture of Munitions

The following extracts were taken from a paper read by A. W. Erdman, of the General Electric Co., at the spring meeting of the American Society of Mechanical Engineers, Cincinnati, Ohio, May 21 to 24, 1917:

The purpose of this paper is to direct attention to some of the practical aspects of the question of limits and tolerances, as customarily applied to the manufacture of munitions, rather than to attempt to establish standards of high technical value in assigning definite limits to the several classes of dimensions involved.

Most mechanical men who have had recent experience with munitions manufacture will agree with the statement that their troubles have not to any great extent been due to inherent difficulties with the tolerances in general, but have principally been caused by such factors as incomplete or inconsistent drawings and specifications, and lack of mechanical judgment on the part of inspectors in interpreting the drawings and specifications and in the use of limit gages. In fact these aspects of the subject are of such major importance that it would seem that technical refinements may be postponed until standards of practice have been established with respect to these factors.

The average munitions drawing is fairly open to criticism and leaves much to be desired in the way of clearness and consistency. Such defects as the following are often encountered:

1. Flat dimensions without any tolerances.
2. Dimensions with one tolerance only, either plus or minus.
3. Overlapping tolerances on two parts which assemble together.
4. The sum of the tolerances on intermediate dimensions are not in agreement with the tolerances on the overall dimension.
5. No limits are specified as to permissible eccentricity between concentric, cylindrical surfaces, or between two parts which assemble together.
6. In the case of screw threads on two parts which assemble together, but where interchangeability is not required, no specifications are given as to the nature of the fit.

Defects 1 and 2 can be readily remedied by establishing an invariable rule that all dimensions must be the mean dimensions with equal plus and minus tolerances.

Defect 3 usually occurs in the tolerances for external and internal threads on two parts which assemble together, and is occasioned by losing sight of the fact that the maximum external thread must be slightly smaller in diameter than the minimum internal thread, in order that these extremes may assemble properly.

Defect 4 can best be avoided by establishing the invariable rule that all dimensions in the same direction must start from a common reference line.

Defect 5 is a fruitful source of trouble to the munitions maker, and consequently in all cases where close concentricity of cylindrical surfaces is essential, definite limits of eccentricity should be specified on the drawings.

Defect 6 can conveniently be illustrated by considering the fit of a nose-piece or base-plug external thread, in the internal thread in a shell. In this case the nose piece or base plug virtually becomes an integral part of the shell after it has been assembled. In fact it is common practice to finish-machine or grind these parts after they have been assembled, and in subsequent operations such as loading keep them together by similar markings. Manifestly, all that is required from the standpoint of utility is that the nose piece or base plug should screw into the shell easily, but without too much looseness. As such threads are usually quite coarse, liberal tolerances are in order, but the dimensions and tolerances must be properly assigned in order to avoid the possibility of too much looseness. This can readily be accomplished by letting them overlap to some extent, which will of course result in producing some nose pieces and base plugs which will be too large to enter shells having minimum threads. This apparent difficulty is overcome by grading the nose pieces and base plugs, as, for instance, small, mean and large. A mark can also be put on a shell at the time it is gaged which will indicate to the assembler which grade of nose piece and base plug to use.

RELATION OF TOLERANCES TO WEIGHT

Perhaps the most striking defect, in shell drawings particularly, is the discrepancy between the tolerance specified for the weight of the shell and the variations in weight of the shell from making one to maximum external and minimum internal dimensions, and another to minimum external and maximum internal dimensions. As a rule, shell drawings and specifications allow a variation in weight of plus and minus 1 per cent. of the mean weight for the smaller sizes and less for the larger sizes, whereas the extreme dimension tolerances would permit two or three times as much variation in weight. Furthermore, no dependence can be placed on the assumption that a shell machined to the mean dimensions will have the mean weight specified on the drawing. Whether or not these discrepancies are intentional or accidental the writer is not informed, but it seems obvious that the drawings should be revised.

From the standpoint of ballistics uniformity in weight of shell is highly desirable, and consequently close weight tolerances are to be expected; but the drawings and specifications should sound a clear note of warning so as to prevent a manufacturer from proceeding on the assumption that the dimension tolerances can be used indiscriminately. Some tolerances bear evidence of having been added—probably to meet some difficulty in manufacture—without perhaps due consideration being given as to the extent to which the weight would be affected. In any event it seems imperative that the drawings should be revised so that shells machined to the mean dimensions, and of steel of the specified quality, will have the mean weight.

If ballistic considerations permit, the weight tolerances should be increased, since they are at present the limiting factor. The drawings plainly state that advantage cannot be taken of all the extreme tolerances on any one shell.

These considerations are not advanced as an argument against larger dimension tolerances than weight tolerances, since liberal dimension tolerances afford a maximum of munitions production; but rather to caution the manufacturer to consider carefully all possible combinations of the tolerances which will produce the greatest uniformity in weight of the finished product, and also to suggest to the ordnance engineer the desirability of plainly pointing the way to attain the desired results.

THREAD TOLERANCES

Perhaps the most difficult operation in munitions manufacture is the cutting of internal and external threads within close limits. The Whitworth form of thread is particularly difficult to cut and has been the cause of endless trouble in recent munitions work. We all regard the rounding of the top and bottom of this thread as particularly iniquitous, and we are apt to regard the United States form of thread as greatly superior. As a matter of experience, it is quite difficult to maintain the size of the United States form of thread within close limits. The requirement that this form of thread shall fit on the top and bottom, as well as on the all-important angle, is the chief source of trouble. The very existence of this requirement results in most of the fitting occurring at the top and bottom of the thread, rather than on the angle. It is practically impossible to avoid this condition since the tops of the threads on a tap wear away very quickly and therefore the tap does not continue to cut internal threads of full depth. As the thread gages are made of standard form, it is obvious that much of the work will not pass the gages, although perfectly correct as to angle diameter and pitch. To a less degree is the same condition true of dies and external threads. This defect is universally recognized in American machine shops and is quite commonly overcome by making the diameter of taps slightly larger than standard, so that they will cut an internal thread deeper than standard and also cut a larger hole or core than standard. This affords a clearance at the top and bottom for the external thread. It seems manifest that this necessary and customary practice should receive official sanction in the drawings and specifications for munitions, and that limits for these clearances should be specified.

INDIVIDUAL JUDGMENT OF INSPECTORS

Next in importance as affecting the manufacture of munitions is the question of mechanical judgment in interpreting the drawings and specifications on the part of the inspectors, and also in regard to the proper use of limit gages. Although many inspectors are men of excellent mechanical judgment and experience, a large number of necessity have not these qualifications. In fact it would be detrimental to other lines of manufacture to require that only experienced mechanics be selected as munitions inspectors. It therefore seems that the obvious solution of this difficulty is to make the drawings and specifications so clear and comprehensive that men with little mechanical experience can become efficient inspectors. The specifications should clearly specify such details as kind and quality of finish for all surfaces, whether by turning or grinding, and if by turning whether the tool marks must be removed by filing. Some surfaces can, in the interest of maximum production, be left semi-finish-turned, and the specifications should in such cases so state. In general this plan can be made most effective by basing the requirement of the specifications on actual results obtainable with modern machine tools, and all unnecessary refinements should be eliminated.

Regarding the proper use of limit gages, it is perhaps difficult to lay down general rules, but certainly such a fundamental one as that gages should never be forced, while taking a measurement, can be advanced without hesitation.

MACHINE-TOOL LIMITATIONS

The limits of accuracy attainable on machine tools must be taken into consideration in determining how limit gages should be used. The screw thread affords a good illustration of this point. In a part where a threaded hole goes entirely through the part it is not very difficult to cut threads of uniform diameter in the sense that the thread is uniform throughout its length and that it does not taper. In bottom-tapping shallow holes, however, or in cutting a short external thread, both are apt to taper slightly, or at least the first thread or two will be thin. In the first case it is perfectly proper to require that the maximum thread gage shall not enter at all; but the second case manifestly demands different treatment. A rational rule would be to allow the minimum thread gage to screw in one-third or one-half the depth of a shallow not-through hole, and the same allowance should be made in the case of a short external thread. This proposition should be judged from the standpoint of utility rather than ideality, particularly when one stops to consider that the mechanic can, by cutting the external thread in the proper direction, make these inaccuracies actually balance each other.

MAXIMUM PRODUCTION THE REAL AIM OF ANY REVISIONS

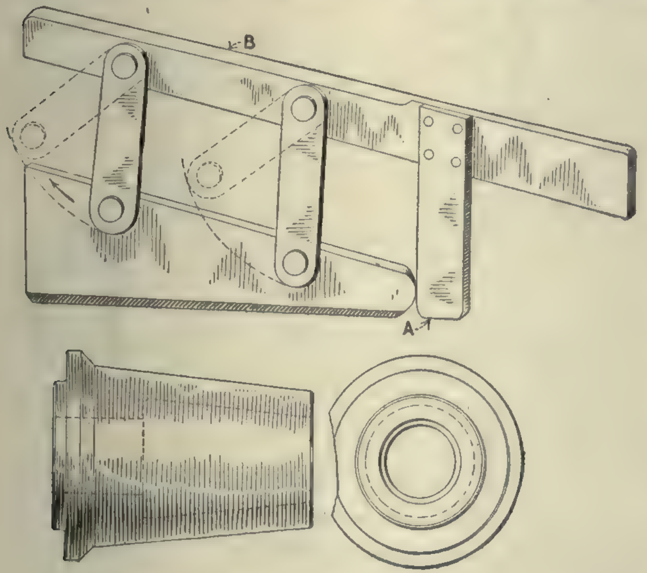
To sum up, maximum production, which is the principal aim of any revisions, can be most readily attained by increasing the weight tolerances in the case of shells particularly. If, however, the ordnance engineer cannot allow any greater variations in the weight of shells, then, at least, the alignment of mean weight with mean dimensions, as outlined in the foregoing comments, will, it is believed, prove to be an important step in the right direction. As regards other munitions, where weight variation is not so important, much can be accomplished by aligning the dimension tolerances with the capacity for accuracy possessed by the type of high-speed machine tools which are being manufactured at the present time.

IDEAS FROM PRACTICAL MEN

Measuring Tapered Hole

By Leigh W. Hunt

The illustration shows the design of a taper gage and the work for which it is used. The taper bushing, as shown, is made in two parts having a tapered hole bored out to receive a lining. These parts must be interchangeable. The gage was designed to give the correct angle on the sides, and also the correct diameter at the large end of the hole.



GAGE FOR TAPERED HOLE

On entering the hole the gage is closed, as indicated by the dotted lines. An opening the exact diameter and angle on the sides is obtained when the lower half of the gage brings up against the stop at *A*. The sides at *B* are ground to a knife-edge to insure an accurate fit on the angle.

Are Ambitious Young Men Really Wanted?

By Harry Koontz

On page 602, Vol. 46, E. P. Baker has written a frank statement of his experience in trying to market his ambition, and he is deserving of opinions from various readers, both employer and employee. I am of the opinion that the ordinary every-day young man has no opportunity whatever to reach the big men mentioned by the editor in the comment at the foot of Mr. Baker's article. If you are a college graduate, and happen to meet a big man, say, for instance, in a Pullman train (provided you can afford the extra fare), and he happens to be a graduate of the same college, and you appear to possess the one hundred and one qualifications, there is a slim chance that you can start at the bottom with his eye upon you; otherwise you can hire out to the little man who works for the big man; and after 10 or 20 years of hard work (and good health) you will be earning $2000 a year.

The reason for this is a natural law, that the strong conquer the weak, and we, the young men of the common people, really do not possess the many qualifications outlined by Theodore Vail in a recent issue of the *American Magazine.*

We may have ambition, initiative—even genius—but lack the health and nerve force to back it up; and the rarest of all qualifications and the one most desired is that something in manner which enables the handling of many men without friction, to accomplish big things smoothly and to possess the rare ability of choosing others to do your work for you.

A word of advice to Mr. Baker. If he will forget the $10,000 job for the present, learn mechanical tracing (it will take three months) and ask no favors, he will land a job the first crack; and if he is a toolmaker, he can be drawing and designing tools for twice $15 a week in less than two years. But from that salary up he will have to fight for every bit of advancement.

Lubricant for Steel Gears

By Douglas T. Hamilton

Advertising Manager, Fellows Gear Shaper Co.

Emil Daiber, on page 254, Vol. 46, asks for the best lubricant for cutting cast-steel gears and small tool-steel gears on the Fellows gear shaper.

In reply to this inquiry I would say that the best cutting lubricant or cutting compound to use on the gear shaper is governed by the nature of the material, the speed at which the machine is operated and several other conditions. It is also the practice in many plants to use a different cutting lubricant for roughing than for finishing. Usually a cutting compound is employed for roughing and a lard-oil combination for finishing. The reason for this is quite evident. In roughing the machine is called upon to take a much heavier cut and usually at a high rate of speed. This naturally calls for a lubricant with not very much body, but with cooling properties to carry off the heat developed.

Various mixtures are used on the gear shaper for cutting steel. For roughing, we find that cutting compounds are used to a considerable extent. Where a high rate of cutting speed—200 to 210 strokes per minute—is used the solution is thinned down by the addition of water, so as to make it more *penetrating* and act as a better coolant. Any gummy substance, such as white lead, is not advisable for roughing purposes. In the first place the lubricant becomes sluggish and does not flow freely; in the second place it gums up the machine, and in the third place it has not as good a cooling effect as a more fluid solution.

There are gear manufacturers who refuse to use any of the cutting compounds and stick closely to lard oil or mineral lard oil for both roughing and finishing. It is the practice with these concerns to dilute the oil with kerosene in the proportion of about 15 parts of mineral lard oil to one part of kerosene. This is used both for roughing and finishing. I believe, however, that where the machine is operating at a high rate of speed, a coolant rather than a lubricant is necessary for roughing purposes. For finishing, however, I advise the use of either mineral lard oil or lard oil. Lard oil, however, being so expensive and having a tendency to congeal and gum up the machine, is not utilized to any great extent.

For cutting soft machinery steel or other soft alloy steels, I find that when mineral lard oil does not give satisfactory results the addition of sulphur in the proportion of 1 lb. of powdered sulphur to a gear-shaper tank full of mineral oil will generally give satisfactory results. When all other lubricants fail, olive oil can always be depended upon. The cost of this lubricant is so great, however, that it is not employed except when absolutely necessary.

Pattern Design To Accelerate Repairs

By M. E. Duggan

The coupling casting between the cylinders on a hydraulic pump broke. A new pattern was required. How the design was altered, the pattern made and a casting produced are shown in Fig. 1. At *A* is the coupling head; *B* is the original shape of the connecting members; *C* the altered design; *D* the cored hole. To make the connecting members *B* curved like the casting would mean considerable work and a delay in the pattern shop. To simplify and hasten the job, these connecting members were altered in design as shown by dotted lines at *C*.

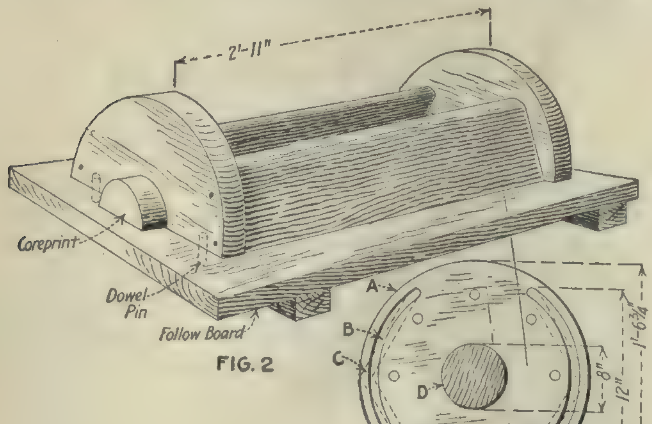


FIG. 2

FIG. 1

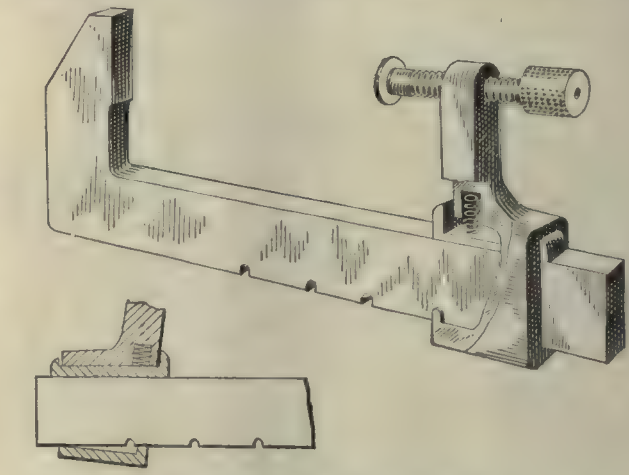
FIGS. 1 AND 2. PATTERN OF A COUPLING

In Fig. 2 one-half of the pattern is seen in position on the follow board, or bottom board, ready for the drag flask. Each half of the pattern consists of four pieces, the two heads and the two sides, loosely fitted and secured in place by dowel pins made of wire nails. The pattern is located and held securely on the follow board by means of the dowel pins in each headpiece. These are shown at one end only. The making of the mold is carried out in the regular way; it is a simple job and requires no description. Very little labor or time was spent in making the pattern.

Quick Adjustable Clamp

By Charles Sehl

The adjustable clamp illustrated is for use on the laying-out table and the surface grinder, and takes the place of at least four clamps of the ordinary variety.



QUICK ADJUSTABLE CLAMP

It is made of ¼-in. sheet steel, case-hardened. The sliding head has a taper slot so that it can be pressed down to relieve the notch at the bottom of the beam. The spring keeps the pawl in position.

Cementing Emery-Cloth Disks

By J. A. Raught

I suppose that each man in charge of this kind of work has his own methods and perhaps his own troubles. Possibly if I give a bit of my experience along this line, it may be of interest to others. The disk grinder, I believe, is here to stay, and every effort possible should be put forth to maintain it.

The first trouble I encountered was in keeping the emery cloth from coming loose in places. This difficulty was supposed to be caused by improper cleaning, handling, etc., of the steel disk. Scraping the old glue or cement off with a steel scraper is said to be poor practice, yet I find that with this method the cloth disks are hard to get off after they are worn out. Other means have been used for removing the old glue, such as washing with lye and rinsing with warm water, then allowing to dry with internal heat, but the hand scraping seems to be the best. In no case should the steel disk be fingered after cleaning; nor should the emery cloth be handled on the smooth side, even though the hands are clean.

After each disk is thinly coated with cement, another little trouble is encountered. The glue that oozes out around the edge causes the disk to adhere to the press. I overcame this difficulty by treating the press to a film of machine oil before laying the disk down. Another trouble is that the disks in stock curl up. The remedy, of course, is to keep them under pressure.

In order to give the glue plenty of time to dry, I do this work the last thing on Saturday; in this way a new sharp disk is ready on Monday morning.

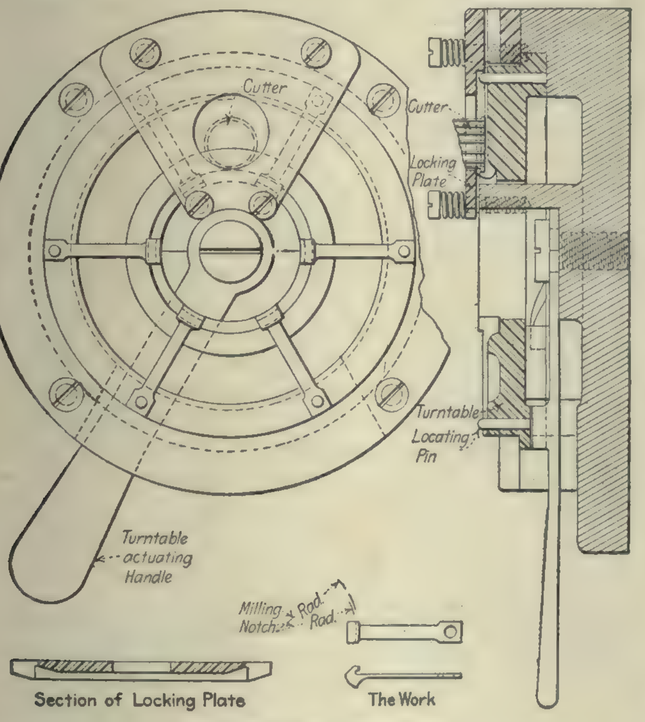
Six-Station Circular Milling Fixture

By John J. Eyre

A description of a turntable type of milling fixture recently designed for milling the circular face and notch in the floor-plate catch of a military rifle may be of interest to some of the readers of the *American Machinist*.

The stock for the catch was first cut in quantities to the required lengths and ground parallel to the desired width of the head on a Blanchard grinder.

The parts were then form-milled across on top and bottom, to give the shape of head and thickness of the spring portion, the outline of the spring being blanked and the hole punched on an ordinary small power punch press.



THE MILLING FIXTURE

The face of the catch and the notch under it had to be circular-milled, and although a fixture for doing this work had been designed and made, the large number of parts to be machined necessitated the making of the fixture shown, which greatly increased the production.

The circular base was cast with lugs for securing it to the miller table. The top face was bored to receive the turntable, and a section of the rim was cut away in front for clearance for the actuating handle; the base also had a hub in the center which was cut away and tapped for the bolt that centered the handle.

The turntable was made of machine steel, chambered out, and six notches cut in the bottom face to receive the pawl on the actuating handle.

In the top face of the turntable six equally spaced seats for the work were machined and holes drilled in them for the locating pins. The center of the turntable was bored for the central hub on the base and a groove turned in the face for finger clearance at the center length of the work.

A circular ring was secured to the top of the base for holding the turntable in its seat. On the rear of the fixture was located the pressure plate, which held the work in its locating seat in the turntable while making the cut.

The pressure plate was held in place by four screws that were tapped into the base and extended above the pressure plate a sufficient height to allow for four compression springs to seat between the head of the screws and the top of the plate, the pressure plate being bored a free fit over the screw diameter.

A hole was bored in the pressure plate to allow for the entrance of the milling cutter, and both edges of the plate were chamfered to allow the work to pass under. The bottom surface of the pressure plate was stepped to bear on the work at the front and back ends when the work was passing under it.

The actuating handle was of tool steel, spring-tempered, with a pawl machined on the top surface for engaging and moving the turntable. In operation the milling cutter, passed through the pressure plate to the desired position, runs continuously. The operator places work in the seat with the hole over the locating pin and moves the handle to the right. He continues placing the work in the following seats in the table and moving the handle backward and forward the length of the slot in the base. This carries the work under the pressure plate and past the milling cutter, thereby making the desired cut.

By this method the work is quickly placed on or removed from the fixture and is held firmly while being milled. A small air tube over the fixture directed on the work removes all milling chips.

Press Kink for Blanking Cloth or Other Soft Material

By C. W. Hinman

If you have a plain blanking punch and die, made for blanking sheet metal, and wish to use the die for blanking felt, cloth, flannel or other soft material, you can do so by running the job with about 0.010 in. thick iron or tin under the cloth and next to the die.

Cloth blanks made in this way are just as good as those made from an expensive compound punch and die. Care should be taken to first grind the punch and die and put them in first-class condition. Also shear both materials to the same width, so that the work may be handled rapidly by the operator.

The foregoing plan was tried with red felt ⅛ in. thick and the blanks that resulted were clean cut. One job was a double-hole washer, the other a round washer ¾ in. in diameter with a ¼-in. hole.

The Real Problem

Special

IT IS probably safe to say that thousands of engineers, not only in this country, but in other parts of the world as well, are giving a great deal of thought to the problem of the submarine, which is so prominent a factor today in the great war. Hundreds of devices have been designed, many have been manufactured, and some few are being used with varying success. The great cry of the engineer who wants to help is: Tell us the problem presented by the submarine, so that we may help to solve it. But the stating of the problem is so much more simple than the solution that it is difficult to state it in mechanical terms. The real problem may be summed up in just three words:

Find the submarine!

That is the real problem. Once the submarine can be located with certainty, it is no longer a menace; its destruction or capture, especially its destruction, is an easy matter.

There seem to be but two methods by which submerged objects can be detected—by sight or by sound. In other words, we must use our eyes or our ears, or both. And as both the natural sight and hearing are limited, we must use mechanical aids to increase their range and power.

There are numerous undersea signaling devices, all based on some modification of the telephone, which have been tried with varying success for locating approaching vessels. But the toll of the submarine, even against naval vessels which have such devices, indicates that these means cannot as yet be wholly depended on for protection. There are, however, possibilities in this field, and no doubt further developments will be made along this line. Here would seem to be an opportunity for the telephone engineer to make further investigations and experiments.

THE AIRPLANE NOT POSITIVE

As to seeing the submarine when it is running at 100 ft. under water, there has as yet been no positive method devised. The ardent advocates of the airplane claim much greater success than the experience of many would seem to justify. Airplane observers have detected and can detect submerged submarines under certain conditions, but these conditions vary so considerably as to make it anything but a positive method. The condition of the surface of the water, the clouds above and consequently the shadows and color of the water, markedly affect the results of such observations. While there are great possibilities in the use of a large number of airplanes over an infested area, their value comes more from observation when a submarine "breaks water" than from seeing it while it is still submerged.

By calling torpedo-boat destroyers or submarine chasers by means of its wireless apparatus, as soon as a periscope appears, or possibly by expert bomb dropping, an airplane could be used to make the life of a submarine commander and crew decidedly uncomfortable. But as long as the submarine is completely out of sight as soon as it submerges to a safe running depth, it remains the most elusive and the most dangerous enemy that can be imagined.

Some of the characteristics of a modern submarine may give a better understanding of the real problems and emphasize the necessity of finding the enemy before positive and destructive action can be taken against him.

Some of the larger submarines are between 250 and 300 ft. long and have a diameter of perhaps 20 ft. Above this is the periscope, which may extend another 15 ft., making it 35 ft. from the keel to the top of the periscope. In running submerged, the periscope is drawn down by means of a telescoping tube, to reduce running resistance and also to avoid damage to the periscope, should it be necessary to dive beneath a vessel.

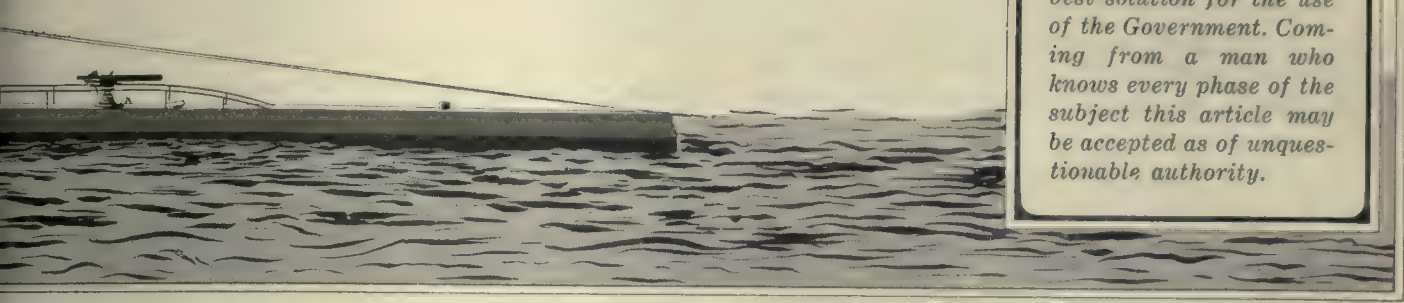
The speed of submarines varies greatly, both submerged and on the surface, it being claimed that some of the new German boats can make 16 knots when running beneath the surface. This is probably a maximum, however, and it is safer to count the submerged speed at not over 10 knots.

Next to finding and destroying the submarine is the problem of combating the torpedo, although in the case of unarmed or at least unarmored merchant ships the submarine frequently resorts to gunfire. This is probably to save its torpedoes, as its carrying capacity is limited, torpedoes being both bulky and expensive.

# of the Submarine

Correspondence

SYNOPSIS—*This is a clear statement of the problem that our navy has to solve in the elimination of the submarine. It is given with the idea that it may aid inventors and others in finding the best solution for the use of the Government. Coming from a man who knows every phase of the subject this article may be accepted as of unquestionable authority.*



Torpedoes vary in ranges from 4000 yd. up to 20,000 yd., the latter being theoretical and not an accomplished fact, so far as accurate information can be obtained. The submarine commander, however, always endeavors to get within 1000 yd. before releasing his torpedoes, to insure his hits and prevent wastage of torpedoes.

The large torpedoes are about 21 in. in diameter and weigh approximately a ton each. They travel at about 40 knots on leaving the tube and, as can be seen, have a tremendous momentum or striking energy, even without an explosive. With practice heads they will dent a ship's plates very noticeably and might even start some of the seams to leaking. There have been cases where the heads were fitted with a wooden plug and drove this plug through the side of a vessel. The average speed of the torpedo during the run is perhaps in the neighborhood of 28 knots.

The depth at which the torpedo is to run below the surface can be determined before launching, the usual depth being from 7 to 15 ft. If the torpedo traveled deeper than this, it might pass beneath the ship being attacked, if the latter happened to be of light draft or rose on a swell at the instant the torpedo approached its mark.

THE USE OF NETS OR "CRINOLINES"

Defense against torpedoes is also to be considered, although the destruction of the submarine is much more important. It is, however, a very difficult problem from every point of view. The use of torpedo nets, or "crinolines," as the navy usually calls them, has so many disadvantages that they were never adopted by our navy and have been abandoned in most of the others. They are very heavy, retard progress of the ship to an alarming degree and do not afford much protection at their best; for torpedoes can be fitted with knives which will cut through any net that it is practicable to use for this purpose. Then too, the nets would be sure to get into the screws if any of their supports gave way or were shot away in action, and the ship would be helpless without power to move.

The use of plates held away from the sides of the ship has been advocated by some, but such contrivances have the great objection of reducing speed to a dangerous degree, while speed is the greatest safeguard against the submarine and its deadly torpedo. The purpose of these plates is to explode the torpedo at a sufficient distance from the ship's sides to prevent damage to the hull, and there is much dispute as to what this distance must be. It has been tested out to a considerable extent by the Department of Construction and Repair, and the results of the tests can be made available to those who are working along this line. This line of attack does not, however, seem as promising as the main problem of finding the submarine, although defensive methods have their place. But David Harum's advice about "getting the other feller fust" applies especially to the problem of the submarine.

OTHER PROTECTIVE DEVICES

Trapping the submarine by means of nets works out in some cases, but depends on the submarine coming where you have the trap set. These nets seem to have done fairly well in protecting certain small areas, but when the submarine builder knows that a net stands between him and his prey, he promptly equips the submarine with knives which, aided and abetted by excess motive power, will cut through the nets and attack the quarry, which is lying in fancied security.

Then there are buoys of various kinds which indicate when their appendages are disturbed by the passing of a submarine beneath them. Unless this passage fires a mine, the submarine may be a mile away before a chaser can reach the spot. Anchored mines that will explode when a submarine strikes them may become double-edged swords, as the mine does not discriminate as to whose submarine or what kind of vessel it destroys.

These considerations are all sidelights and should not detract from the main problem of finding the submarine. We have the X ray, which shows through solid bodies, and other rays that have special functions and qualities of their own; why not an S, or "submarine" ray, which shall show objects through considerable depths of water?

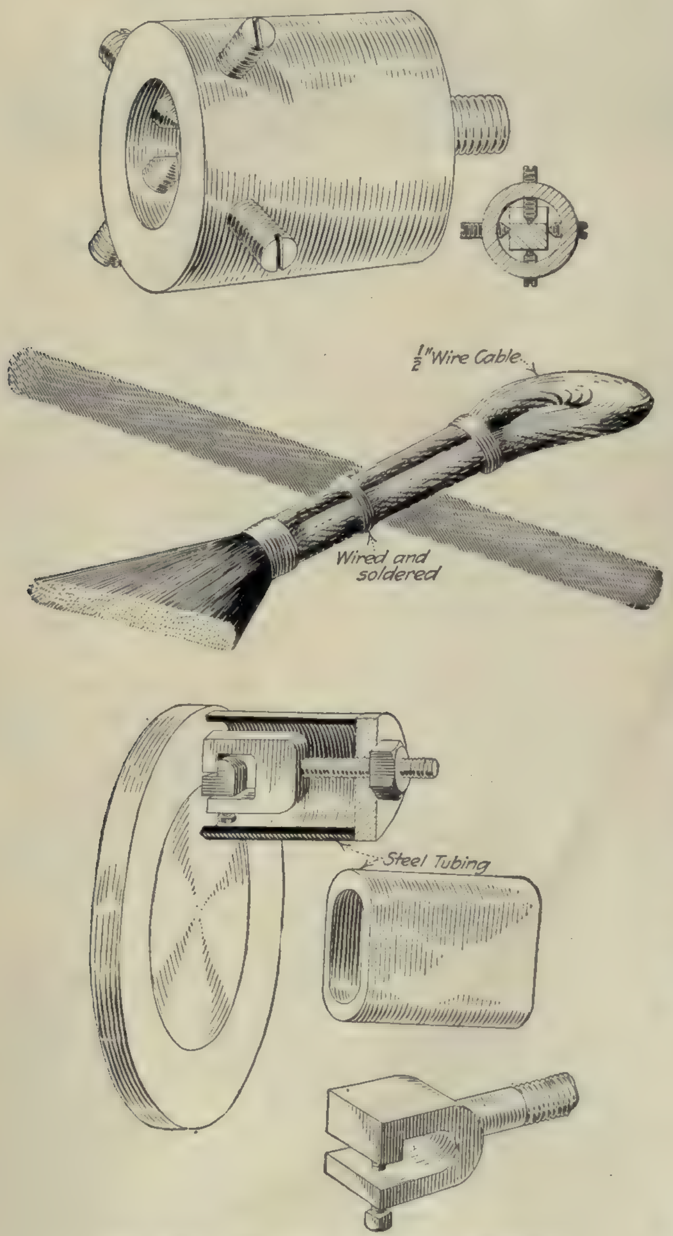
The whole problem seems to be up to the electrical engineer. We must be able to see the submarine or to locate it by sound, in order to escape from it or to destroy it. Or we must be able to divert the torpedo from its course, which again seems to be an electrical problem. The latter is but a makeshift, however. The main problem remains:

Find the submarine!

Key Pullers and Cleaning Brush

By C. H. Willey

The illustrations show two key pullers and a cleaning brush made from discarded wire hoisting cable. One of the helpers in the copper shop made 125 brushes from an old coil of ½-in. cable at an average cost of 3c. each, considering the coil as scrap. They outwear the dust brush or the corn whiskbroom and can be used in places and corners where the ordinary brush cannot. The key pullers are self explanatory.



KEY PULLERS AND CLEANING BRUSH

Hardening High-Speed Steel Tools

By A. D. Hallett

Referring to the request on page 126, Vol. 46, in regard to hardening high-speed tools and cutters odd in form, I submit the following facts. They are based on my observations during the last six years and relate to one style of cutter only.

It was found that cutters used for blocking gears, when purchased from standard tool firms, would not stand up under the feed required of them After some experimenting on our part, it was easily seen that to eliminate breakage the cutters must be drawn to some temperature to toughen them, but not too much to cause excessive grinding.

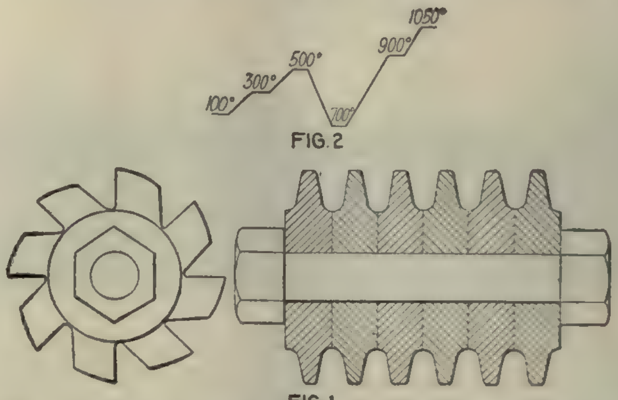


FIG. 2

FIG. 1

FIGS. 1 AND 2. CUTTER HOLDER AND CURVE, SHOWING RELATION OF DRAWING TEMPERATURES

The following method of handling gives good results: The cutters are preheated six at a time, held as in Fig. 1, to 1550 deg. F. and then submitted to a heat of 2330 to 2380 deg. (according to the amount of carbon) in the high-speed furnace. The cutters, however, are not allowed to reach this heat, but are handled faster by running it high. They are then plunged into oil at from 200 to 400 deg. and either kept moving or the oil circulated.

After removing the bolt, they are brought up gradually to 1050 deg., the drawing point, and cooled in oil. Fig. 2 shows the relation of other drawing points to 1050 degrees.

Cutters treated as outlined above will block out a bevel-gear tooth 0.400 in. deep in 13 sec.—that is, a 48-tooth bevel will require 10 min. Under fair conditions, regarding hardness of stock to be machined and the state of repair of the machine, 40 gears may be blocked at one grind.

Old Planer Vise as a Turntable

By J. A. Raught

Recently we had several cast gears that were to be ground. A flexible shaft outfit was used for grinding the sand out from between the teeth, but to complete the outfit a turntable, on which the gears could be placed while being ground, seemed necessary. In the scrap pile I found an old planer vise with the solid jaw broken off. I bolted the bottom ring on skids, then laid two 2 x 4's across the top part of the vise, bolted a barrel onto that, and cut it down to the right height. This proved to be a strong and durable turntable.

Editorials

New Occasions Teach New Duties

It is very difficult for any of us to realize the magnitude of the task of organizing our varied resources and industries so as to use them to the best advantage, and it is particularly difficult for those who are busy in their individual businesses, as before the war began. The inability to realize the extent of the undertaking makes it seem as if nothing were being done to utilize the vast resources at our command. This is far from true, however, for a great amount of work is already under way, and organization is proceeding much faster than appears on the surface. In fact, a vast amount of useful preliminary work is being done which may never appear; only the facts that shipments do not go astray and that shipping space is well utilized will be noticed by those in charge, but will never be appreciated by the general public.

The sooner we do realize the great work to be done and that each of us must play his or her part, the better. We have so long been accustomed to go ahead in our individual way that it is difficult to think of doing things collectively, either voluntarily or by direction, but this is the only way in which the war is going to be won without undue delay and at unnecessary cost. We must, to a large extent, forget our past methods or at least be pliable enough to change them when it is for the best interest of all to do so. We can no longer be individuals to the same extent as before, at least until the war is over; and we must learn to think collectively, to consider how our actions and our methods affect the whole country instead of our own particular shop, town or section.

* * *

But this is only one of the many questions that all must carefully consider. It is absolutely certain that, with the most careful management in the world, all our industries are bound to lose valuable men. It is impossible to exempt all the valuable men in any industry, and we must make up our minds to train new men and new women in parts which they can perform. Men who are unfit for military duty can be trained to do more than we perhaps realize, especially in the clerical departments, and this without in any way underestimating the value of these departments. Women can be trained to make good storekeepers, to give out tools in toolrooms and to do the preliminary work, at least, in the making of many fine tools. They have proved especially adept on grinder work and can probably soon learn to turn out very accurate tools and gages with a little instruction.

We must make up our minds to all sorts of inconveniences in the teaching of new people in our shops, and the sooner we begin to prepare for it with the broad spirit of helpfulness instead of grudgingly, the sooner we can be of real service to the country. Do not lose sight of the fact that we are all helping war preparation when we are doing our level best in our own line, even if we never see a shell or get an order direct from the Government. We must plan to use women in the shops and must make conditions such that the work will be as pleasant as possible. We must plan to use older men than we have employed in many cases and, to some extent, to utilize, on work that they can perform, those who are crippled.

We must not hope to be let alone because we are making a product that the Government must have, for all the useful industries are doing likewise. The machine business will receive careful consideration, as its great usefulness is fully appreciated by those in charge of raising an army, from Secretary Baker down, but we must be prepared for changes that will test our powers of management to the utmost. For, after all, this is a test of management more than anything else, and those who can best handle the problems presented can congratulate themselves on earning the past master's degree, whether any title be conferred or not. The exemption boards will undoubtedly use their best judgment in most cases, and all the really necessary men who can be returned to their respective shops will be sent back to do their bit at home. But it is the part of wisdom to prepare for some of these emergencies in advance and so prevent unnecessary delays when the time comes to make the changes that are inevitable.

* * *

The American shop has long been noted for the freedom with which it exchanges experiences and information with its neighbor, and to this characteristic is undoubtedly due its rapid strides in machine-shop progress. Without the very free interchange of ideas which has taken place between the manufacturers of automobiles, we should not have attained our preëminent position in that line. Similar interchanges are even more vital at the present time, when every hour that can be saved in manufacture may conserve lives and dollars. An even greater spirit of coöperation is vitally necessary now and is sure to be accomplished when its great value is fully appreciated. No true American would at this time withhold information that would enable other shops to make more or better ammunition or other supplies. There will be work enough for all; and whether we are making ammunition or mowing machines, a maximum product per hour of labor is equally essential to victory and to success after the war.

* * *

Perhaps no one has summed up the whole situation better or more concisely than Frank A. Scott, chairman of the General Munitions Board, in a communication to the National Machine Tool Builders' Association at Cincinnati, under date of May 19. This message, coming from a man who has had wide business experience and is a part of the machine industry, with the added advantage of being able to see the situation from within the war councils, can well be carefully studied by every machine builder in the country. The letter follows:

> Our mechanical engineers and machine-tool manufacturers must be called upon to play one of the most important parts on the war program. The ability to make modern war does not go far outside of the four "M's" that represent Men, Metal, Machinery, Money. A nation is strong in modern war about in proportion as it has metal and machinery.
>
> As a nation, we have been trying since the Civil War to occupy a position that has never been occupied long by any nation—to be rich, weak and safe all at one time. The present war gives us an opportunity to strengthen ourselves by training, service, discipline and experience.
>
> Great changes in our national life and ideals are certain to take place; and it is equally certain that in the important industry represented at your meeting many changes will transpire before the era now opening has reached its conclusion. Too strong an effort to adhere to old traditions, and methods once satisfactory and efficient, would retard the progress of our industry.
>
> "New occasions teach new duties;
> Time makes ancient good, uncouth."
>
> It appears to me now that, except in certain lines, no great expansion of machine-tool producing capacity will be required, although I expect that the maintenance of present volume will continue to be necessary. I strongly advise all possible economies in production rather than a policy of price increases to meet changing economic conditions, if at all possible.
>
> No one appreciates more than myself how confidently our country may rely upon the willingness and ability of its engineers and machine-tool producers to do their full duty in this crisis of our history.

Not as Easy as It Looks

A VISIT to any of the United States arsenals will reveal the fact that hundreds of manufacturers are visiting these places in order that they may be in a position to bid intelligently on gun carriages, caissons, limbers, harness and other equipment needed by the army at the present time. Further investigation reveals the fact that few of these men have any idea of the requirements demanded by the Government or the equipment needed to handle the work to advantage.

Contracts have been let by the Government for a number of 1916 model 3-in. gun carriages, caissons and limbers, and it is to be hoped that the manufacturers receiving these contracts will be able to fill them to the satisfaction of the Government and themselves. That these carriages are going to cost much more by contract than by Government work is very evident; these difficulties are found in the necessary special equipment required and in the training of men for the special operations.

The officers in charge of these Government shops are doing everything possible to aid the private contractors and have shown investigators every possible courtesy; but at the present time, with all the additional war work piled upon them, it has proved a burden in many ways.

* * *

Great reductions in the cost of arsenal work have been made during the past few years. An example of this is the hub for the 56-in. wheel that is used on 3-in. carriages, caissons and limbers. At present, the cost of these, based on labor, 100 per cent. overhead and cost of material, is just about one-third of what it was.

Another item to be considered is the special forging dies and fixtures required, some of which have taken a long time to develop to their present stage of efficiency.

A manufacturer recently inspected the shops of an important arsenal and at first glance made the statement that his shop could make two sets of "spring" cylinders to the arsenal's one; but by the time he had investigated the matter quite thoroughly, he decided that he could not improve on the present methods to any great extent. First glance would lead one to believe that a great deal of this work is easy; but when the limits required are taken into consideration, it assumes a different aspect. These limits are not given with the idea of holding the work so close that manufacturers cannot compete with the Government, but are given because of the conditions to be met with in service, because they are actually required and because separate parts must in many cases be sent to the field, where it is impossible to fit them to the guns. They must be absolutely interchangeable. Manufacturers should not, however, become discouraged and throw up their hands on account of this; for there are many parts of this equipment that can be made without undue care or outlay for tools. They should give the matter careful consideration and study, should familiarize themselves with the methods and tools now in use at the arsenals and should learn the points of difficulty.

We do not wish to go on record as suggesting or criticizing the methods that have so far been used in placing contracts, for they have no doubt been handled in the best manner possible under existing circumstances; but it would seem that considerable advantage and saving could be made if, instead of placing contracts for completed equipment, subcontracts were let in such a way that one manufacturer would have only a limited number of different parts to make. In this way a great saving in equipment and time of delivery could probably be made.

* * *

One manufacturer, for illustration, has a contract for over 3000 caissons and 3000 limbers. Another has a contract for 900 caissons, another for 900 limbers, and others for smaller amounts of one each. This means that each one must make all the special tools and other things required for all the component parts of this equipment. There are many parts common to both caissons and limbers, such as wheels, hubs, diaphragms, etc., and the making of them means thousands of dollars' outlay in special tools. If these parts were let out in such a way that one manufacturer best equipped to handle the work could make all the hubs, another all the pressed-steel parts, etc., it would tend greatly to expedite delivery and reduce costs.

We believe that manufacturers, as a whole, have been very broad-minded and patriotic in giving their competitors and the Government the benefit of their experience on munition and other work. We could name many of national repute who have done this, but we are sorry to say that we could also name a few who take the other view of matters. If manufacturers seek to handle Government contracts solely for the dollars and cents to be gained, they are pretty sure to kill the goose that laid the golden egg; and the Government may find it necessary to take possession of such factories and run them at a nominal profit to their owners.

This is no time for us to haggle over dollars. We are in the greatest fight in the world's history, and the sooner we realize that we are fighting for the continuance of our own liberty as well as world liberty, just that much sooner will we crush the enemy of democracy.

Shop Equipment News

Lamb Ball-Bearing Grinder

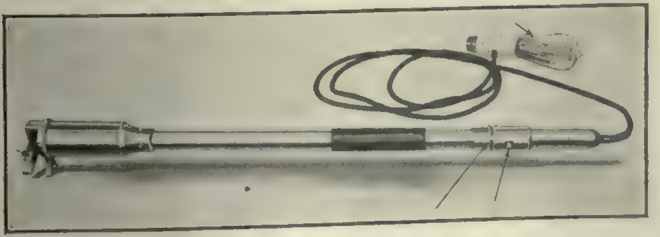
The ball-bearing grinding, polishing and buffing spindle illustrated is now being marketed by the Lamb Knitting Machine Co., Chicopee Falls, Mass. It is equipped with self-aligning ball bearings housed in dustproof chambers and lubricated by a constant flow of oil from a reservoir. A sight feed gage is fitted to the oiling system. The head is made up separate from the base, so that the machine may be used either as a bench or as a pedestal-type machine.

LAMB BALL-BEARING GRINDER

Diameter of spindle between bearings, 2 in.; diameter of wheel seat, 1½ in.; length of spindle, 30 in.; height of bench type of machine. floor to spindle, 39½ in.; wheels, 2 x 12 to 2 x 16 in.

Pyromagnetic Indicator

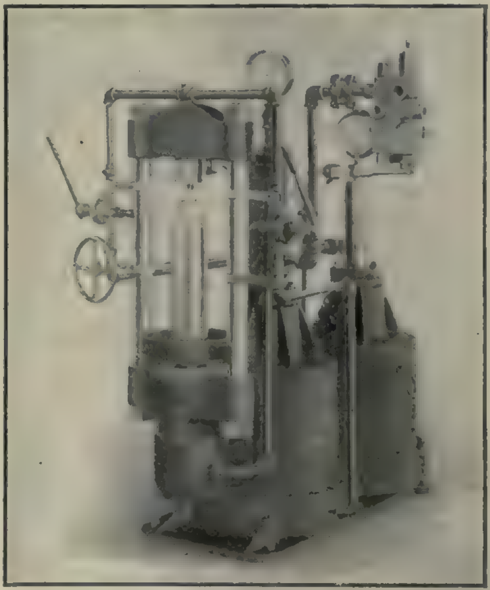
For indicating the critical point on steel parts being heated for hardening, the Pyromagnetic Instrument Co., 175 North Jefferson St., Chicago, Ill., has placed on the market the instrument illustrated. The curved needle indicated by the small arrow at the left end of the instrument is energized by means of an electric current. On being placed in the furnace in such a position that the magnetic needle is brought into contact with a part of steel being heated, the needle will cling to the part. The piece is tested in this manner at frequent intervals until a heat is reached where the needle refuses to cling to it. This point, at which the steel part becomes nonmagnetic, is the proper heat for quenching. The instrument may be used on work of practically any size, and it is equipped with a pilot lamp, switch, needle control, and fittings to attach to a standard lamp socket.



DECALESCENCE-POINT INDICATOR

Metalwood Hydro-Pneumatic Press

For the purpose of subjecting high-explosive and shrapnel shells to internal pressure, the Metalwood Manufacturing Co., Leib and Wight Sts., Detroit, Mich., has placed on the market the hydro-pneumatic press shown in the illustration. Compressed air is used as the prime mover at a pressure of 100 lb. per sq.in. The press is built in various sizes for different sizes of shells, developing pressures of from 2000 to 21,000 lb. per sq.in., according to the size and nature of the shell.



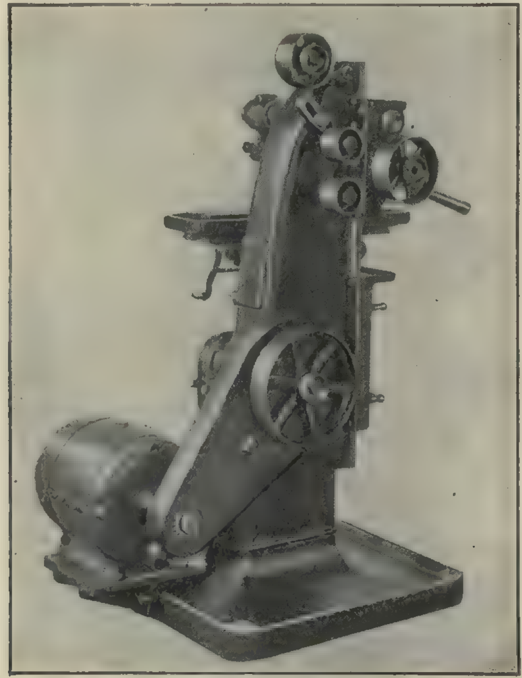
HYDRO-PNEUMATIC PRESS FOR TESTING SHELLS

All parts of the press under stress are forgings or alloy-steel castings, and all pipe carrying hydraulic pressure is seamless steel tubing. Cylinders are of cast iron, and the pistons are fitted with three rings. In operation the shell is placed on the clamping press in the foreground and raised to clamping position against the nosepiece, a copper gasket being used for sealing purposes. Pressure is then applied by admitting air to the cylinder, which raises the pressure in the intensifying cylinder and transmits it to the clamping cylinder. Air pressure is left on the clamping cylinder and is then admitted to the intensifying cylinder, causing the pressure to rise to the desired point.

Superior Hand Miller

The illustration shows a new motor-driven hand miller recently placed on the market by the Superior Machine and Engineering Co., 51 Fort St. East, Detroit, Mich. Spindle speeds are controlled by means of a speed box with sliding and transposing gears.

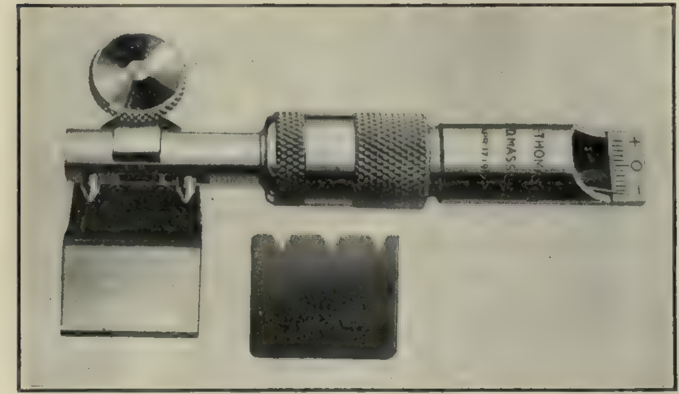
The lower pulley near the bottom of the column, the pulley on the end of the spindle and the upper pulley on the swinging arm are interchangeable, and these in combination with the two-speed gear box and transposing gear give 12 spindle speeds varying approximately from 150 to 1035 r.p.m. All gears are keyed to their shafts, and bronze bearings are used. All chains and sprockets are inclosed as a protection against dust and injury to workmen.



SUPERIOR HAND MILLER

Bicknell-Thomas Thread-Lead Indicator

The Bicknell-Thomas Co., Greenfield, Mass., is now manufacturing the thread-lead indicator illustrated, which may be used either on a screw or inside a tapped hole. The illustration shows the tool equipped with a small table upon which a screw is rested while being tested.

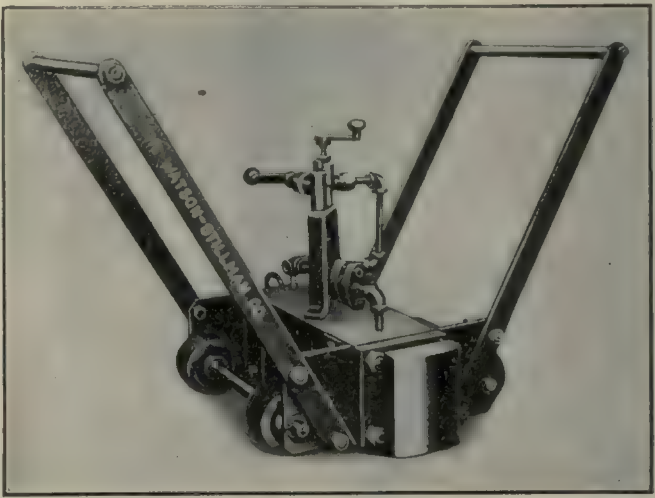


THREAD-LEAD INDICATOR

When the two small points are pressed against the threads, the indicator needle will register zero if the threads are normal, on the plus side of the zero mark if the lead is long, and on the minus side if the lead is short. For gaging in a tapped hole, which may be as small as ½ in. in diameter, the table is removed by loosening the thumb-screw. A master gage is furnished so that the operator may test the instrument for accuracy. If desired, a master can be furnished to set the points for testing threads of an odd pitch.

Watson-Stillman Ship-Frame Bender

The Watson-Stillman Co., 42 Church St., New York City, has recently brought out the machine illustrated, which is designed for bending heavy steel shapes for ship frames, deck beams, etc. The machine consists of a cylinder ram and operating valve. It is mounted upon rollers, so that it may be quickly moved to the desired position. A loose pin is fitted into holes in the bending slabs and serves as an abutment for the machine.



SHIP-FRAME BENDER

The ram is double acting, both its forward and reverse movement being under control at all times. Provision is also made to prevent too great a stroke. The machine illustrated is equipped with a screw-stem stop and release valve, but a single lever-operating valve can be furnished if desired. The machine is built with a movement at right angles to the axis of the ram, as illustrated, or in a direction parallel to it. The stroke of the ram is 10 in., and a pressure of 18 tons is developed at 1500 lb. per sq.in. Its weight is 750 pounds.

Ezy-Out Screw Extractor

The Cleveland Twist Drill Co., Cleveland, Ohio, has placed on the market a number of additional sizes of the "Ezy-Out" screw extractor described on page 129, Vol. 46.

The extractor is now made in 12 styles varying in size from a point diameter of $\frac{1}{16}$ in. and a large diameter of $\frac{1}{8}$ in. to a point diameter of $1\frac{7}{8}$ in. and a large diameter of $2\frac{5}{16}$ inches.

Oakley Cutter and Tool Grinder

The No. 2 Oakley cutter and tool grinder shown in the illustration is the latest product of the Oakley Machine Tool Co., Cincinnati, Ohio. It will handle surface, cylindrical and internal grinding and is adapted for such work as jig bushes, straight-edges, snap gages, slitting knives, reamers, rose bits of formed tools, etc. Fig. 1 shows the entire machine. Fig. 2 shows the set-up for grinding a reamer, while Fig. 3 illustrates an internal-grinding job. The base and column are separate castings, the former being of the cabinet type. The wheel head swivels 180 deg. each way on the column and is provided with dustproof taper bronze bearings adjustable for wear. Vees 16 in. apart are used for the knee, to prevent any rocking of the saddle. Box-type construction is adopted for the knee, and adjustable taper gibs allow for compensation for wear. Extension bearings on the saddle protect the knee vees from dust and grit. The table slide has one narrow dovetail guide and one flat way and is equipped with an adjustable taper gib. The table, which is supported at both ends and at the middle, is provided with degree and taper-per-foot graduations and a fine pitch screw for set-over. The amount of swivel is 270 deg., and the taper adjustment is up to 2 in. per ft. Coarse table feed, used for cutter sharpening, is operated from either side of the machine by a clutch lever and rack and pinion. Fine table feed is also operated from either side of the machine, but is controlled by means of a handwheel. Micrometer dials are supplied. Provision is made to gear up the screw with the spindle of the index head for grinding spiral fluted hobs.

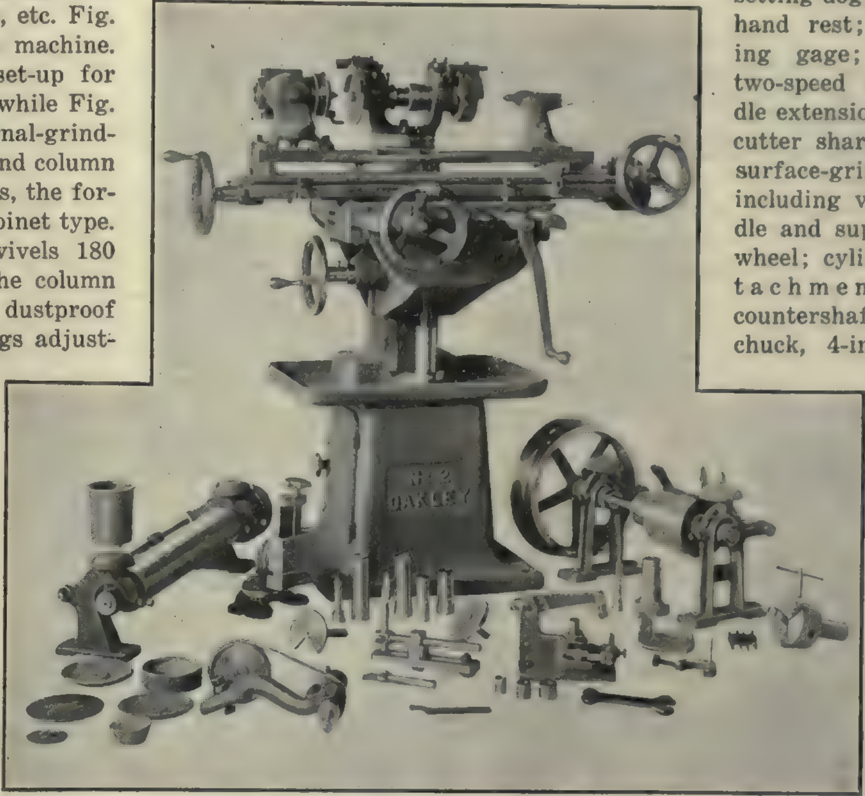


FIG. 1. THE NO. 2 OAKLEY CUTTER AND TOOL GRINDER

Longitudinal movement, 17 in.; vertical movement, 10½ in.; cross movement, 9 in.; table surface, 5¼ x 33¾ in.; distance from center of spindle to table, 0 to 10½ in.; maximum swing on centers, 10 in.; maximum length between centers, 20 in.; wheel speeds, 3683 and 5950 r.p.m.; distance spindle to floor, 48½ in.; capacity, face mills up to 16 in. in diameter, formed cutters up to 7½ in. in diameter, saws on table up to 48 in. in diameter; floor space, 49 x 68 inches

Complete equipment includes headstock and tailstock with four reducing collets; tooth rest with two blades; setting dog; two wheel guards; hand rest; wrenches; centering gage; grinding wheels; two-speed countershaft; spindle extension; water pot; gear-cutter sharpening attachment; surface-grinding attachment, including vise, extension spindle and support, and grinding wheel; cylindrical-grinding attachment, including drum countershaft, saw-grinding chuck, 4-in. chuck, universal grinding dog and two grinding wheels; internal-grinding attachment, including pulley, endless belt and grinding wheel. Due to the large number of attachments, the machine is adapted to be used on a large and varied list of tools and cutters. It may be readily set up for handling the following types of work: Face grinding slitting saws, side teeth of side mills, gear cutters, reamers, spiral mills, angular cutters, taps, large face mills, jig bushings, taper reamers, forming cutters, inserted-tooth cutters, etc. If it is desired to use the machine continuously on one type of work it will be furnished with only those attachments that are required. The wheel of the internal grinding attachment runs at speeds of from 12,250 to 19,800 r.p.m.

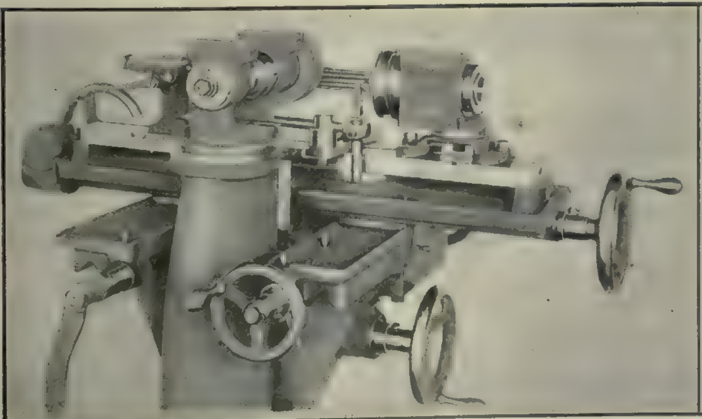


FIG. 2. GRINDING A REAMER

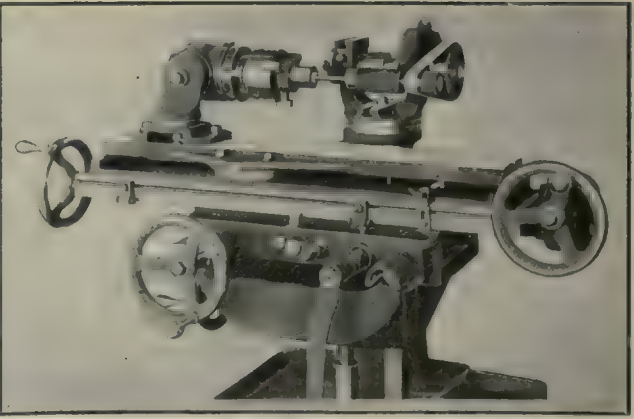


FIG. 3. INTERNAL-GRINDING JOB

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Aircraft production, which continues to be the leading topic of conversation, is receiving a tremendous amount of study. The board established for this purpose, and headed by Mr. Coffin, has done more work on the proposition than will probably ever be known, and there is every reason to believe that in a few months there will be an undreamed of activity in this field. It is a bit difficult to see why more was not accomplished by airplane builders before the war, as many attempts were made to have them get into shape for quantity production. While there seemed to be a general willingness, the efforts did not materialize so far as being able to produce motors in large quantities is concerned.

Now that it seems to be generally agreed that we can be of the greatest service to our allies on the fighting lines by supplying a vast number of airplanes, and we have concentrated in a large measure on this point, we may expect to see many interesting developments. One of the first things is to impress Congress with the necessity of appropriating sufficient money for the purpose, $600,000,000 being estimated as the proper figure at this time. We can all lend a hand by getting in touch with our representatives and senators.

There is little doubt that ten thousand airplanes will be of far more service than a hundred thousand men on the firing line, while some estimate the ratio as being far greater. This gives us the opportunity of letting our dollars serve to better advantage than our men, thereby saving the lives of thousands who will be of far more value as citizens and workmen in rebuilding and rehabilitating the war-torn world than as heroes who have fallen for the flag. Every life we can save by the expenditure of money and mechanical skill will not only be a financial asset to the world, but will reduce the sorrow and heartaches for years to come.

THE APATHY OF CONGRESS

Now is the time to let our representatives in Congress know that we approve of any appropriation for aircraft or other mechanical devices that will help win the war in the shortest possible time and save the lives of our men at the front. If there is any doubt that prompt attention is necessary in this matter, a visit to either the House or the Senate will dispel the illusion. At this writing the House is spending valuable time in discussing our old and ever recurring friend the River and harbor bill, under the guise of making it a war measure. One creek in Georgia, which a representative of that state says he can jump across, is down for a good slice of pork, and all told there are several million dollars' worth of jobs that cannot be called war measures by any stretch of the imagination. Yet the few representatives who stayed on the job voted down an amendment that would have taken this out of the hands of political jobbers.

Fortunately, the President can probably nullify the measure by assigning the engineering officers who would naturally carry on this work to duties that are more necessary at this time. It shows, however, that many of our representatives evidently do not appreciate the seriousness of the situation. If they feel that they are representing our feelings in the matter, it is high time they were made to understand that we want active steps taken for the vigorous prosecution of the war rather than that Podunk creek and similar useless bodies of water shall be given either money or attention at this time. When only 15 per cent. of the members of each house take enough interest to be present while the country is entering on the greatest war in history, it is up to us to let them know that we demand better representation. On the other hand, it is gratifying to find that some representatives, who never before seemed to take life seriously, are keenly alive to their responsibilities and are breaking party ties to do what they believe to be the right thing at this time.

THE MOTORS TO BE BUILT

Returning to the actual production of aircraft, it is encouraging to learn that active steps have already been taken to produce motors on a manufacturing basis. Here is where America should shine, if things are managed as there is every reason to hope and believe they will be. Builders who have motors that can pass the necessary requirements will be given orders for all they can build. Two or three of the most successful types of motors in use in Europe will be brought here and put into factories where the methods and the advantages of manufacturing on a large scale are already understood. These will naturally be the automobile builders, who have developed quantity production to a much greater and more efficient point than any other industry. Plans are already under way, and it promises to be but a short time before we shall begin turning out motors at a rapid rate.

This will give us the beginning of our motor supply and form a constant source of motor power for airplanes. At the same time, there are substantial developments in the way of an improved motor which will embody the good features of all the motors now in use and eliminate many of the defects. This motor is to be made the standard, and production will be pushed in as many factories as necessary to secure a production large enough to give us the unqualified control of the air. It is to be regretted that we did not begin active work earlier, but we now have many good engineers on the job. The best engineering brains of the country are studying the problem, and the makers of motors of all kinds are doing their level best to coöperate in order that maximum production may be secured in minimum time.

HOW IT AFFECTS MACHINE BUILDERS

All this means that in some cases machine builders must supply new equipment and in others add to equipment already installed, and be ready to do their share, as of course they will, in shaping their output to meet the needs of this very important branch of the munition field. In instances where this demand conflicts with orders already on the books, it may be necessary to apply to the Priority Board of the Council of National Defense, Munsey Building, as has been mentioned before, although there is little doubt that airplane work will be given precedence over almost everything else needed in the general line of war supplies.

Builders of machines used in airplane motor work, or other parts of airplanes for that matter, will do well to give careful consideration to the probability of a large demand from this source and prepare for it, so far as can be done. This means lathes, both engine and turret, automatic screw machines for smaller parts, internal and cylindrical grinding machines, millers, and, of course, drilling machines of various sizes, particularly those of the small, high-speed type.

Then, too, shops that are in a position to make tools such as boring bars and cutters, jigs and fixtures for holding the work and for securing duplicate production, gages for holding the parts to size and securing interchangeability, as well as accessories of all kinds, should get ready to help in their particular line. Those who are not familiar with airplane motor work can get some idea regarding it from the articles that have been appearing in the *American Machinist*. As these will show, the work resembles that of automobile motor building, but there are many refinements necessary in the airplane motor that would be a waste of time and money if incorporated in the motor for the automobile.

New Publication

Reviewed by Dexter S. Kimball, Professor of Machine Design and Industrial Engineering, Sibley College, Cornell University.

The Driving of Machine Tools—By Thomas R. Shaw, A. M. I. Mech. E., Lecturer on Machine Tools at the Royal Technical Institute, Salford, England. Two hundred and twenty 5 x 7½-in. pages; cloth bound; 129 illustrations. Published by Scott, Greenwood & Co., London. Price 4s. 6d.

This little book is the outcome of a series of lectures on machine tools given by the author at the Royal Technical Institute at Salford, England, and its object is to present simple and rational methods of designing drives for machine tools and similar machines and to gather together such formulas, rules and data as apply to work of this kind. The book consists of eight chapters and an appendix, as follows:

Chapter 1, Introduction, is a general discussion of the important features to be considered in such work, as for instance, durability, control and accessibility.

Chapter 2, Cone Pulleys and Gearing, contains a discussion of the principles underlying the design of cone pulleys such as speed range and the correct method of proportioning cone pulleys to meet the required range. This section contains also a brief discussion of the cutting pressure on machine tools and some hints on the power of belts, strength and endurance of spur gears and other matters connected with cone-pulley design.

Chapter 3, Application of the Cone Pulley, is devoted to practical application of the cone pulley, the illustration being taken from practice. The use of clutches in connection with cone pulleys is also discussed.

Chapter 4, The All-Gear Drive, contains an interesting analysis and discussion of the geared-head drive, as it is sometimes called. The author classifies such drives into sliding-key drives, clutched-gear drives, sliding-gear drives and combination drives. These types are illustrated and discussed, and in conclusion an interesting summary is presented in the form of 13 diagrammatic gear drives, which is very instructive.

Chapter 5, Application of Motor Drive, contains first an elementary discussion of the kinds of electric motors followed by illustrations showing actual applications of motors to machine tools. The latter part of the chapter is devoted to a brief account of electric controlling apparatus.

Chapter 6, Planing-Machine Drives, is a special chapter on the application of belts, clutches and motors to the problem of driving planers.

Chapter 7, Drives for Various Machines, is devoted to the problems of driving shaping machines, boring mills, drilling and boring machines, millers, etc.

Chapter 8, Miscellany, is a discussion of details used in the work under consideration, as for instance, clutches, epicycle gearing, ball bearings, countershafts, etc.

The Appendix contains tables showing the power transmitted by belting, strength of gear teeth, tables of cutting speeds, sizes and speeds of motors, horsepower required for various machines, etc.

The discussions in the book are, for the most part, nontechnical and very practical, so that it is of immediate and direct use. Such mathematical discussions as are given are simple and of such character and form as to make them of use to the practical man. The same is true of such graphical methods as are presented. They are offered without demonstration or proof of their accuracy and in usable form. These mathematical and graphical demonstrations are of course those that are in common use and are undoubtedly correct. The book is concise, yet it has evidently been written with care, and it contains a great amount of information for its size. It is also well illustrated. The author, furthermore, has not confined himself to English practice, as would be expected, naturally, but many of his illustrations and some of his data are taken from American practice. Quite a large number of prominent American machine-tool builders are represented by illustrations of one kind or another, and the author acknowledges his indebtedness to the "American Machinist" and "Machinery" for the use of illustrations.

The book is well written, attractively printed and contains 129 illustrations. It should be of interest to shopmen and designers, particularly those who are designing machine tools or equipping factories. Teachers of machine design will also find the book very helpful as showing in concise form the development to date of an important type of apparatus of which little as yet has appeared in textbooks.

Trade Catalogs

Pipe Threading Machinery. Landis Machine Co., Waynesboro, Penn. Catalog No. 23. Pp. 46; 6 x 9 in.; illustrated.

Tool Steels, Alloy Steels, etc. Colonial Steel Co., Pittsburgh, Penn. Catalog No. 16. Pp. 48; 4½ x 7 in.; illustrated. This contains methods of treatment and other useful information.

"Libby" Turret Lathes. International Machine Tool Co., Indianapolis, Ind. Catalog. Pp. 46; 6 x 9 in.; illustrated.

Acorn Die and Holders. Greenfield Tap and Die Corp., Greenfield, Mass. Booklet. Pp. 20; 6 x 9 in.; illustrated. A brief description of the origin and development of this die and shows application of same.

"American-Wadsworth" Sand Blast Machine. American Foundry Equipment Co., 52 Vanderbilt Ave., New York. Catalog. Pp. 32; 6 x 9 in.; illustrated.

Forthcoming Meetings

The twelfth annual exhibit of foundry and machine-shop equipment and supplies will be held under the auspices of the American Foundrymen's Association in the Mechanics Building, Boston, Mass., from Sept. 25 to 28, 1917. The officers of the exhibit committee are: President, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; vice president, Benjamin D. Fuller, Westinghouse Electric and Manufacturing Co., Cleveland, Ohio; secretary and treasurer, A. O. Backert, 12th and Chestnut Sts., Cleveland, Ohio; manager of the department of exhibits C. E. Hoyt, 123 West Madison St., Chicago, Illinois.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

The American and Canadian engineers and architects of Norwegian birth and descent will hold an informal congress and reunion at the Chicago Norske Klub, Logan Square, Chicago, Ill., Sept. 27 to 29, 1917.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Qutations were current as follows at the points and dates indicated:

	July 6, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$47.00	$40.00	$14.50
No. 2X Northern Foundry, New York..	52.75	46.00	19.75
No. 2 Northern Foundry, Chicago......	55.00	47.00	19.00
Bessemer, Pittsburgh	57.95	50.95	21.95
Basic, Pittsburgh	52.00	45.00	18.95
No. 2X, Philadelphia...............	52.00	45.50	19.75
No. 2, Valley......................	52.00	45.00	19.25
No. 2, Southern Cincinnati...........	49.90	42.90	16.90
Basic, Eastern Pennsylvania..........	50.00	42.50	19.00
Gray forge, Pittsburgh..............	47.95	43.95	18.70

STEEL SHAPES—The following base prices in cents per pound are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	July 6, 1917	One Month Ago	One Year Ago	July 6, 1917	One Year Ago	July 6, 1917	One Year Ago
Structural shapes ...	5.25	5.00	3.25	4.50	3.25	5.00	3.10
Soft steel bars......	5.00	4.75	3.30	5.00	3.25	4.50	3.10
Soft steel bar shapes.	5.00	4.75	3.25	4.50	3.25	4.50	3.10
Plates	9.00	8.00	4.00	8.00	3.65	8.00	3.50

BAR IRON—Prices in cents per pound at the places named are as follows:

	July 6, 1917	One Year Ago
Pittsburgh, mill	4.75	2.50
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		July 6, 1917	One Month Ago	One Year Ago	July 6, 1917	One Year Ago	July 6, 1917	One Year Ago
*No. 28 black......	8.25	10.00	9.50	3.65	9.50	3.20	9.50	3.20
*No. 26 black......	8.15	9.90	9.40	3.55	9.40	3.10	9.40	3.10
*Nos. 22 and 24 black	8.10	9.85	9.35	3.50	9.35	3.05	9.35	3.05
Nos. 18 and 20 black	8.05	9.80	9.30	3.45	9.30	3.00	9.30	3.00
No. 16 blue annealed.	9.10	9.70	9.20	4.45	9.70	3.70	9.70	3.60
No. 14 blue annealed.	8.85	9.60	9.10	4.35	9.60	3.60	9.60	3.50
No. 12 blue annealed.	8.65	9.55	9.05	4.30	9.55	3.55	9.55	3.45
No. 10 blue annealed.	8.25	9.50	9.05	4.25	9.50	3.50	9.50	3.40
*No. 28 galvanized..	10.25	13.00	12.00	5.40	11.00	5.20	11.00	5.10
*No. 26 galvanized..	9.95	12.70	11.70	5.10	10.70	4.90	10.70	4.80
*No. 24 galvanized..	9.80	12.55	11.55	4.95	10.55	4.75	10.55	4.65

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring fair-sized lots, the following quotations hold:

	July 6, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	40%	45%
Cleveland	40%	45%
Chicago	45%	50%

SWEDISH (NORWAY) IRON—This material per 100 lb. sells as follows:

	July 6, 1917	One Year Ago
New York	$20.00@26.00	$6.00
Cleveland	12.30	6.30
Chicago	12.00	5.25

In coils an advance of 50c. usually is charged.
Note—Stock scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16 ..	
No. 18	
No. 20	

*Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York July 6, 1917	Cleveland July 6, 1917	Chicago July 6, 1917
Tire	5.00	5.00	4.50
Toe calk	5.00	5.50	4.75
Openhearth spring steel...	7.00	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Carbon tool steel, base price	10.00	13.00	....
Special best cast steel....	14.00@18.00	20.00	....

*In bars.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh basing card in effect May 1, 1917:

BUTT WELD

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
⅛, ¼ and ⅜..	42%	15½%	¾ to 1½.....	38%	22%
½	46%	31½%			

LAP WELD

2	42%	27½%	1¼	23%	8%
2½ to 6.....	45%	35½%	1½	30%	16%
			2	31%	17%
			2½ to 4......	33%	20%
			4½ to 6......	33%	20%

BUTT WELD. EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜..	38%	20½%	¾ to 1½.....	38%	23%
½	43%	30½%			
¾ to 1½.....	47%	34½%			

LAP WELD. EXTRA STRONG PLAIN ENDS

2	40%	28½%	1¼	24%	8%
2½ to 4.....	43%	31½%	1½	30%	16%
4½ to 6.....	42%	30½%	2	32%	19%
			2¼ to 4......	34%	22%
			4½ to 6......	33%	21%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	34%	20%	43%	28%
3½ to 6 in. steel lap welded	28%	10%	38%	23%	39%	25%

Malleable fittings, Class B and C, from New York stock sell at 5% from list price. Cast iron, standard sizes, 27 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound:

	July 6, 1917	One Month Ago	One Year Ago
Copper, electrolytic (carload lots).....	30.00	31.00	27.00
Tin	62.00	61.00	38.75
Lead	11.50	12.00	6.50
Spelter	9.25	9.50	9.00

*Third-quarter copper; for spot copper the market price is 33c.

ST. LOUIS

Lead	11.25	10.75	6.37½
Spelter	9.00	9.25	8.50

At the places named, the following prices in cents per pound prevail:

	New York			Cleveland		Chicago	
	July 6, 1917	One Month Ago	One Year Ago	July 6, 1917	One Year Ago	July 6, 1917	One Year Ago
Copper sheets, base.	42.00	42.00	37.50	42.00	37.50	42.00	37.50
Copper wire (carload							
Brass pipe, base...	47.50	47.50	46.50	46.00	45.00	47.00	45.00
Brass sheets	45.00	45.00	44.50	38.00	42.00	43.00	38.00
(case lots)	39.125	41.25	24.12½	39.50	27.00	39.37½	25.50
Solder ½ and ½ lots	39.50	39.50	37.50	39.00	33.00	39.00	38.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	July 6, 1917	One Month Ago	Six Months Ago
Mill	$42.00	$42.00	....
New York	45.50	45.50	$44.50
Cleveland	38.00	38.00	38.00
Chicago	42.50	42.50	40.00

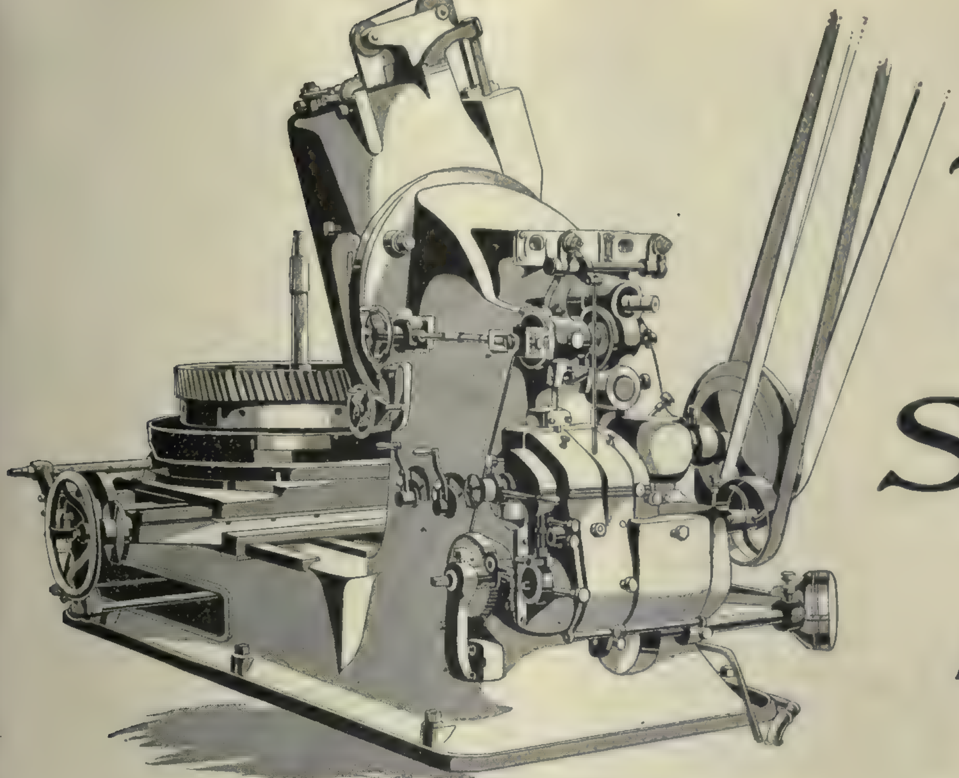
ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.. 19.00

	In Casks		Broken Lots	
	July 6, 1917	One Year Ago	July 6, 1917	One Year Ago
New York	21.00	21.50	21.50	22.00
Cleveland	23.00	22.75	23.25	23.25
Chicago	22.50	20.00	23.50	21.00

ANTIMONY—Chinese and Japanese brands in cents per pound for spot delivery, duty paid:

	July 6, 1917	One Year Ago
New York	19.00	14.00
Cleveland	21.00	19.00
Chicago	19.50	20.25



The Maag Gear System

By

Dexter S. Kimball*

SYNOPSIS — *The Maag system makes possible the use of gears of low-numbered teeth while retaining the strength and accuracy of action that are wholly lost in standard gears of low-numbered teeth. In this article, Professor Kimball describes this system of gearing, and also shows the mechanical means by which these gears are produced.*

THERE has recently been introduced into this country an interesting method of cutting gear teeth. The method was developed originally by Max Maag, of Zurich, Switzerland, where Mr. Maag now operates a good-sized establishment devoted to gearmaking according to his own methods. A branch of the Maag Gear Co. has recently been established in this country at Yonkers.

In order to appreciate fully what the Maag Gear Co. is endeavoring to do it is necessary to review briefly some of the elementary principles underlying gear-tooth action. While all of these are generally well known to gearmakers, there are some characteristics that are sometimes overlooked. There is no doubt that the time has arrived when we shall be compelled to modify some of our ideas regarding gears, so far at least as standardization is concerned, and these characteristics will then come in for a closer scrutiny.

Satisfactory operation of any machine element must always depend on two things—namely, the accuracy of the theory on which the design of the element is based and the exactness with which this theory can be embodied in the actual element. The degree of accuracy, either in theory or construction, that may be necessary to secure satisfactory results will depend on the circumstances. Thus it is obvious that perfectly cylindrical forms are best for rotating bearings, but for many years bearings that were far from being perfectly cylindrical were operated satisfactorily under trying conditions. However, as operating speeds and loads went up, it was found necessary to produce more accurate bearings; and the advent of grinding finally provided a method that enables the engineer to produce a form almost theoretically correct. These general statements apply with marked emphasis to gear teeth. As operating speeds have gone up, greater and greater stress has been laid on accuracy, both of theory and construction; and as in the case of all accurate machine work, we must probably look to grinding methods for any advances along these lines.

So far as theory is concerned, practical experience has eliminated all other curves for use as tooth outlines in favor of the cycloidal curves. And of this family of curves the involute has, apparently, survived all others, not because of its greater theoretical accuracy, but because of certain practical considerations. Of these considerations three may be mentioned: First, any involute curve will operate accurately as a tooth outline with any other involute curve, provided other conditions are satisfactory. Second, the distance between the centers of the mating gears need not be fixed for accurate operation of involute teeth, but can be varied one way or the other without affecting the accuracy of operation of the teeth or changing the velocity ratio, provided again that all other conditions are satisfactory. Third, the rack tooth face in the involute system is always a plane surface and hence can be generated quite accurately.

Now it is possible, theoretically, to construct gears, even with a small number of teeth, with involute outlines, which will work perfectly, provided that certain practical considerations are neglected, and where every pair of gears can be designed and constructed with reference only to the place and conditions under which they are to work, accuracy of theory can be maintained. It is axiomatic, however, that if parts can be made in quantity, the cost per unit can be reduced, and gear manufacturers long ago adopted standard proportions for gear teeth, thus securing interchangeability and consequently the opportunity to manufacture in quantities.

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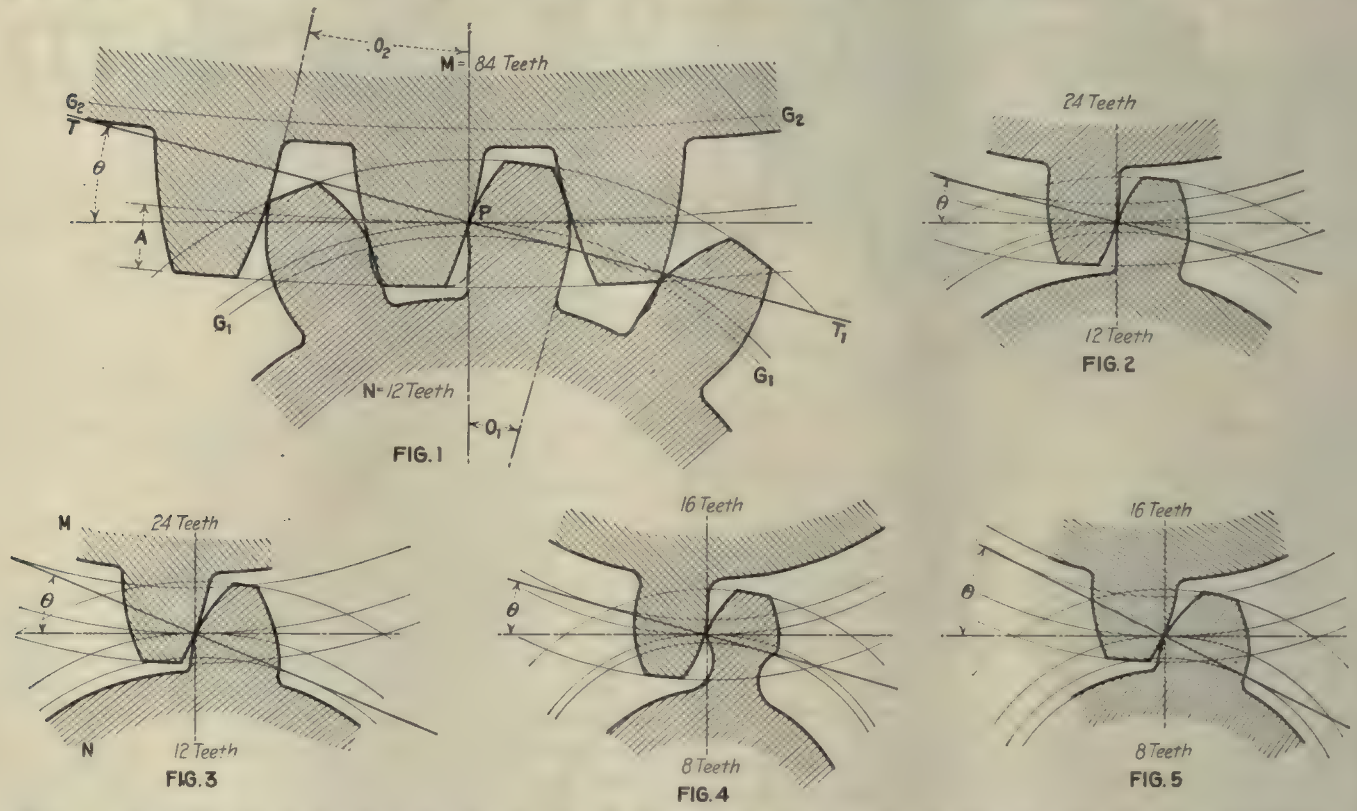
*Professor of Machine Design and Industrial Engineering, Cornell University.



FIGS. 1 TO 5. TOOTH CONTACT AND PROPORTIONS FOR THE STANDARD INVOLUTE AND FOR THE MAAG SYSTEM
Fig. 1—Standard involute gears of 12 and 84 teeth. Fig. 2—Standard gears of 12 and 24 teeth. Fig. 3—Maag gears of 12 and 24 teeth. Fig. 4—Standard gear set of 8 and 16 teeth. Fig. 5—Maag gear set of 8 and 16 teeth

These standard proportions are necessarily somewhat of a compromise. This can be seen by referring to Fig. 1, which illustrates a pair of standard gears of 12 and 84 teeth respectively. In this illustration, G_1 and G_2 are the base circles from which the involute outlines are generated simultaneously by a point on the common tangent $T\ T_1$. All contact between the mating involute tooth outlines must be along this line $T\ T_1$. Furthermore, if the action is correct and contact takes place only along $T\ T_1$, the pressure between the teeth will also be transmitted along $T\ T_1$ and the velocity ratio will be also constant. The tangent $T\ T_1$ cuts the line of centers at the point P, and the intercepts O_1P and O_2P fix the velocity ratio of the two gears.

It is obvious, however, that the length of the tooth is somewhat arbitrary and has to be fixed partly with reference to strength. Thus, in the gear M the tooth outline has not been carried down to the base circle, while the addendum A has been fixed by an empirical rule. In the gear N, on the other hand, the tooth outline is carried far below the base circle by means of a radial line. This radial line is not theoretically accurate, however, and any contact on this portion of the tooth outline is likely to be imperfect. In Fig. 1 this error is so great that either the points of the teeth of M must be rounded off or else the flanks of the teeth in N must be cut away as shown, to permit motion, and any tooth contact on the flanks of N must be imperfect. Of course, this difficulty can be obviated by rounding the ends of the teeth or by shortening the length of the teeth; but limitations are found to this procedure, since if the teeth are shortened too much, the driving action will not be continuous, one tooth going out of action before another comes in.

It is clear also that the diameter of the base circles is a somewhat arbitrary matter. Thus, if the angle θ in Fig. 1 is increased, the diameters of the base circles will be decreased and the length of the involute outlines on both sets of teeth will be lengthened. The undercutting due to the interference of the teeth of M on the teeth of N can in this way be avoided. The common tangent to the base circles will still pass through the point P, and the action will in all respects be theoretically correct. The pressure angle will, however, be increased, and the component force that tends to separate the centers of the gears will be increased; greater frictional resistance will be created at the bearings with a consequent loss in efficiency. This loss, however, is not in general a very important matter; and under conditions where the Maag gear is of peculiar service, it can well be neglected, considering the advantages that will be gained.

It is not necessary, furthermore, that the addendum of both gears shall be the same length, so far as accurate working is concerned, and brief reflection will show that, if the addendum of the gear M in Fig. 1 is shortened and if that of N is lengthened, the interference will be diminished and the action made more accurate. All systems of standardized gearing aim to secure interchangeability by making compromise adjustments of the features that have been briefly discussed. With the angle, θ Fig. 1, fixed at about 15 deg. and proportions of teeth as shown therein, it was found that the amount of correction for interference was not excessive so long as the number of teeth in the gear was not too small. An examination of Fig. 1 will show that the length of the true involute decreases as θ is decreased or as the diameter of the gear is decreased.

The introduction of electric-motor drives, the application of gearing to automobiles and other similar demands for higher gear ratios and small yet strong pinions long ago accented the weaknesses of standard gearing noted in the foregoing. While the old standards will probably be largely used for a long time to come, there can be no doubt that there is a demand for stronger and more accurately cut gears, especially in the smaller sizes and wherever high speeds make correction for interference important.

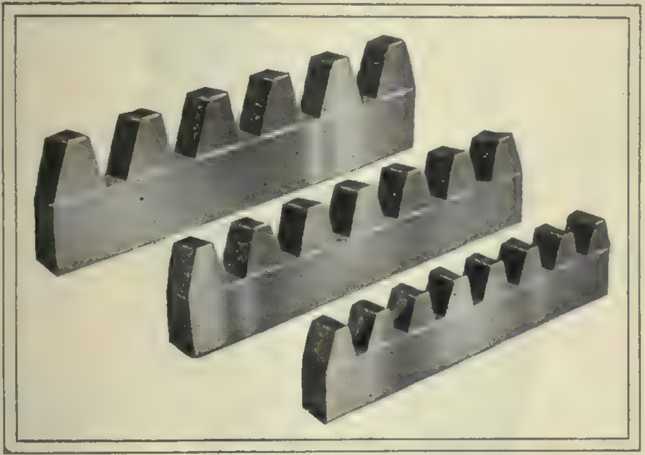


FIG. 6. RACK TYPE OF CUTTER USED ON THE MACHINE

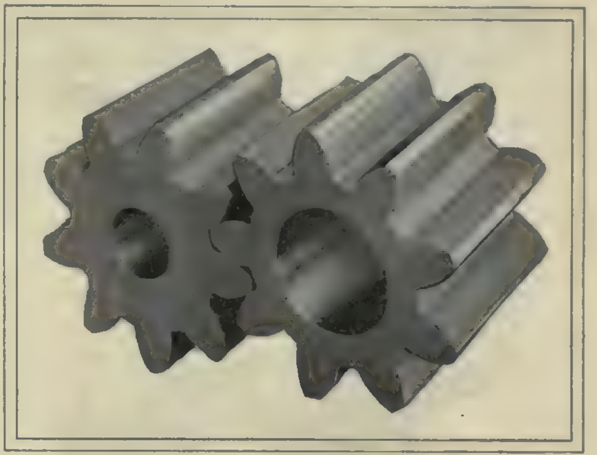


FIG. 7. NINE-TOOTH PINIONS CUT ON THE MAAG SYSTEM

If, however, the requirements of standardization as now understood are disregarded and every pair of gears is made to fit as closely as possible the conditions under which it is to work, the defects of the involute system that have been noted can be eliminated even in gears of low-numbered teeth. This is the basic idea in the Maag system. Obviously, also, if these gears can be produced as cheaply as the old standard gears, they will find a great use. Fig. 2 shows a pair of standard gears of 12 and 24 teeth respectively. The weakness due to the radial flanks is very evident, and it is apparent that a large part of the tooth action is not theoretically correct. Fig. 3 shows a similar pair of gears cut on the Maag system. It will be observed that the angle θ has been increased, thus increasing the angle of pressure and hence also increasing somewhat the journal friction. The addendum of *M* is much shorter than that of *N*, but the action of the mating teeth is theoretically correct throughout contact, and the teeth on both gears are much stronger than those on the standard gear. It will be noted also that in Fig. 3 the active profiles do not reach the base line, where excessive sliding would occur.

The advantages of this new system are more evident when gears of lower-numbered teeth are considered. Figs. 4 and 5 show gears of 8 and 16 teeth cut respectively by the ordinary methods and according to the Maag method. The gain in strength and accuracy of action is here very marked, the action in the case of the standard gears being entirely inaccurate. In all standardized gearing the 12-tooth pinion is considered to be the smallest that can be used with safety and with regard to accurate tooth action. Yet almost every designer has faced the problem of obtaining large velocity ratio with comparatively small gears, and with the 12-tooth gear as a minimum this is often an embarrassing problem. The Maag system of gears makes possible the use of gears of low-numbered teeth while retaining strength and accuracy of action that are wholly lost in standard gears of low-numbered teeth.

The Maag Gear Co. has also constructed a gear cutter which, in theory at least, obviates some of the inaccuracies of form inherent in gear teeth that are cut by prevailing methods. It may be of advantage to summarize briefly some of these inaccuracies.

The most common method of cutting gears is by the series-cutter system, socalled. In this method a separate cutter should properly be furnished for every size of gear and for every pitch of tooth to obtain theoretically accurate results. In practice, only a limited number of cutters are used for each pitch, hence some error must arise, and this error may be very important in fast-running gears. It is possible under modern methods of manufacturing to make these gear cutters with great accuracy. But the error just mentioned, due to the use of a limited number of cutters in each series and the errors due to springing of the cutter because of unequal hardness of the metal, especially when the teeth are large and the surface of the tooth space is considerable, may be excessive.

For these reasons manufacturers long ago turned their attention to "generating" methods, socalled. The basis of such methods is that some one gear of a series is selected and used as a cutter, the gear blank and cutter being driven so that the cutter cuts out its own path in the blank and thus forms teeth that will mesh correctly, not only with a gear similar to the cutter, but with any gear of the series. The theory looks enticing, but brief reflection shows that errors such as interference will not be corrected in this way if a standard gear is used as a cutter. It is true that the standard gear cutter will remove the metal at the root of the tooth where interference takes place, but the errors of theory already discussed will still remain. This method has the advantage, however, of requiring only one cutter for each pitch. It is obvious also that the motion of such cutters must be axial, the cutter planing the tooth as it reciprocates to and fro.

A very common method of applying this theory is to use a helical hobbing cutter set at an angle with the gear blank so that the action of the helical teeth approximates the action of a rack. This method is obviously very rapid. There are difficulties in operation, however, that should be noted. The cutting surfaces approximate true rack action only, and the inevitable shrinkage of the hob in hardening cannot be easily corrected. This method as practiced at present does not produce teeth of great accuracy.

With these matters in mind, the Maag Gear Co. adopted a true rack section as its generating element. This rack element is given a reciprocating or planing motion, and the gear blank is moved relatively to the cutter so that the teeth are generated upon it. The surfaces of the rack cutter, being all plane surfaces, can be accurately ground after hardening and also for the purpose of sharpening them, so that the cutter is formed with great theoretical accuracy. By combining the tooth forms discussed in the first part of this article with this method of manufacture a very superior gear tooth is obtained.

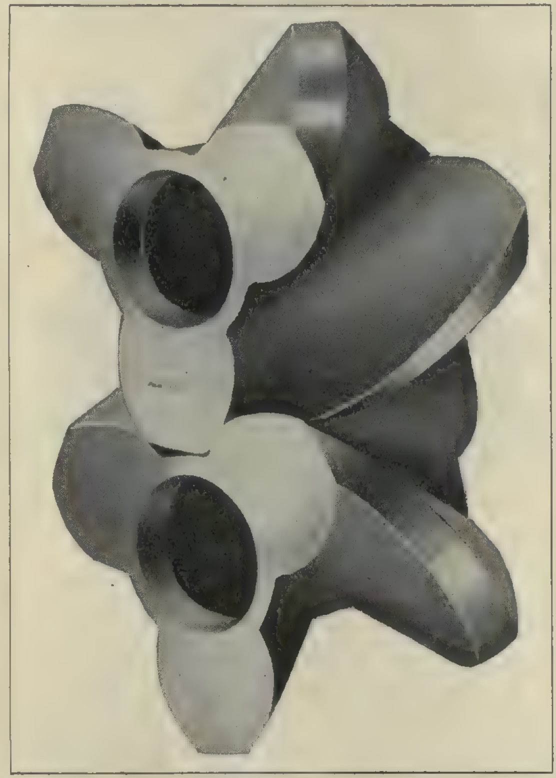


FIG. 8. THREE-TOOTH MAAG PINIONS WITH TWISTED TEETH

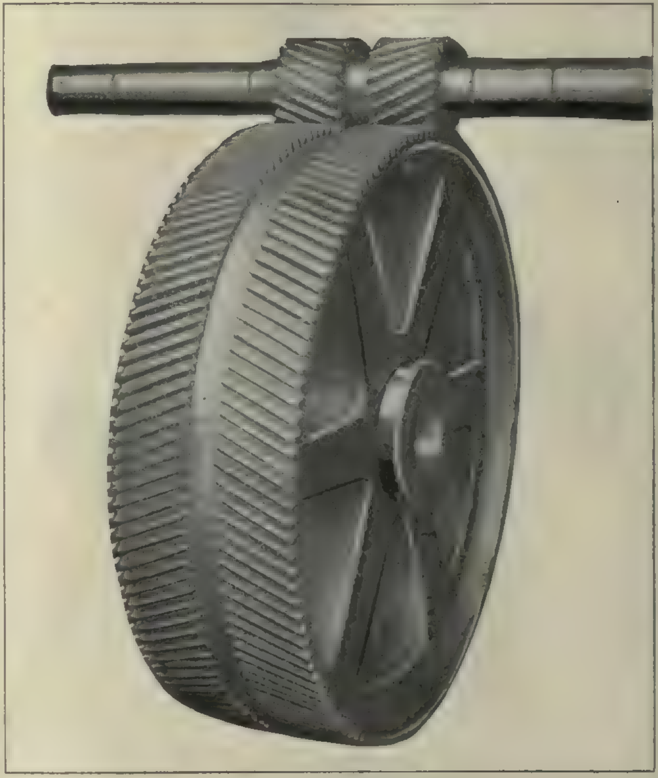


FIG. 9. HERRINGBONE GEARS PRODUCED ON THE MAAG SYSTEM

The headpiece is a general view of the Maag cutter. In general construction it is not unlike an American slotter. The slider, which carries the cutting rack, is itself carried in a guide that can be swiveled so as to cut helical gears, and the illustration shows the head so swiveled for this purpose. The cutter operates on the downward stroke and is automatically and positively cleared for the upward stroke. The gear blank is given a rolling motion with reference to the cutter by rotating it upon its own axis and at the same time moving it bodily along the face of the cutter. When the limit of cutting has been reached because of the motion of translation, the cutter stops automatically; the saddle, which carries the gear, moves back to the initial position, and the cutting operation is resumed automatically.

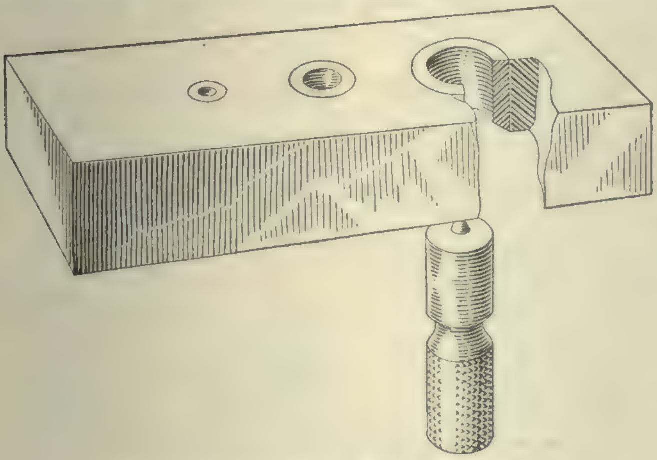
This might appear at first sight to be a slow process and, of course, time is lost as compared to hobbing. But in the machine which is shown, which is one of the larger sizes, the action is singularly quick, the starting and stopping of the machine being almost instantaneous, the controlling clutches being especially easy and effective in operation. Every precaution has been taken to secure and maintain accuracy. The feed screws, for instance, are in duplicate, one doing the heavy work of traversing the table while the other acts simply as a guide. No appreciable work is therefore brought upon this last, or guiding, screw, and hence the wear is negligible. Fig. 6 shows three of the cutters. These cutters are mounted on a heavy steel backing plate, so that the cutter proper can be worn down very thin and hence have a long life. The grinder is very simple, since the cutters are sharpened from the top surface.

It will be clear that, if standardization as commonly understood is disregarded, it is possible to cut much more accurate gears than are produced under such restrictions. It is obvious also that there are many places where special gears would be warranted even at a price higher than that of standard gears, and there are many other places where the quantity used will easily warrant a departure from standards even on the basis of price. If the Maag company can compete in the open market with its improved tooth forms, they certainly should come into extended use. Fig. 7 shows a pair of nine-tooth gears cut by the Maag company, and the superior shape and strength of the teeth as compared to standard gears with low-numbered teeth are evident. Fig. 8 illustrates a pair of the Maag three-toothed pinions with twisted teeth, while Fig. 9 shows a pair of herringbone gears cut on the Maag machine.

The Drill Plate

By C. Ontario

On page 469, Vol. 46, Mr. Pusep describes a drill plate and its application. From experience I can fully indorse all he says. I would like to tell of the first one I saw used and a little about the work on which it was employed.



DRILL PLATE AND TRANSFER CENTER

Many years ago I worked in a toolroom where a toolmaker by the name of F. J. Miller was employed—the same Miller who some time afterward became editor-in-chief of the *American Machinist*. He was making a square box jig about 12 in. in dimensions. After planing both inside and outside, a plate was let into one of the open sides and permanently fastened. On the opposite side a lid was let in and hinged in such a manner that there was no lost motion in opening or shutting it. This was held shut by a latch. On all six sides there were to be drill bushings of various sizes let in, the object being to drill all the holes in a certain casting at one setting. The exact places for the bushings were all located by the use of the surface plate and proper gages.

As you will see by the sketch, his drill plate had but three holes in it. If my memory serves me right, they were ½, ⅜ and ¼ in. The plate was machinery steel. The dimensions I do not remember, but they were suitable for the work in hand. The plate was planed, drilled and reamed ready for the bushings, which were made out of tool steel in the usual way. They were then hardened, ground and lapped to size and pressed into the plate. He then made three transfer center plugs of a suitable length and size for the three bushings; about 1 in. was knurled. They were hardened, ground and lapped a nice fit in the bushing. Then, with a proper wheel, the end was ground down to a point or tit of the same taper as the center punch that was used in locating the centers of the holes.

To set the plate, he took the size of plug needed, pushed it a little way through the plate, entered the point in the center punch mark of the hole to be drilled and then dropped the plate down on the work and clamped it. The plug was then taken out and he proceeded to drill. Of course, Miller's plate did not give all sizes of holes needed, but piloted counterbores and reamers gave what other sizes were necessary. After all the bushings were in place, a casting was placed in the jig and drilled.

Some years afterward I was employed in a shop that did not have a grinder of any kind, and wanting a plate for some work I had in hand, I made one of cast iron. After hardening the bushings and lapping them to size inside, I forced them into the plate. The plugs I turned to size; the ends I finished at one setting and used them soft. By careful grinding I made them last for a long time and did some very good work.

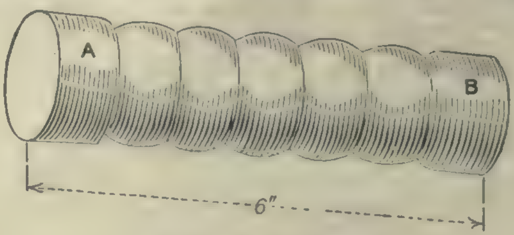
Expanding Hollow Cylinders

By A. D. Hallett

Referring to page 516, Vol. 46, of the *American Machinist*, in regard to expanding bushings, I believe that a soft taper plug would soon load up and become useless if any large number of pieces were to be drifted.

In the illustration is shown a button broach that is cheap to make and the life of which is practically endless when used on metal that has not been hardened. Added to this, it leaves a mirrorlike finish in the drifted hole when lubricated with a heavy oil.

I have made a large number of these broaches, using about 110-point carbon steel and allowing nothing for a grind; but after hardening they were polished with emery cloth. In machining a gradual increase of 0.002 in. to the button was used, while the ends *A* and *B* were left 0.005 in. under the diameter of the hole to be expanded. By making these broaches in progressive sizes the limit of expansion of any metal can be reached and many otherwise spoiled pieces reclaimed.



BUTTON BROACH

Alignment Chart for Milling Cutters

By A. LEWIS JENKINS
Professor of Machine Design, University of Cincinnati

SYNOPSIS — *An alignment chart for figuring speeds, feeds and power of milling cutters, both spiral and face mills, used on cast iron and steel.*

DEFINITE information regarding the feeds and speeds for milling cutters, of practical value to users of millers, has been difficult to find among the contributions to the literature on the art of cutting metals. On account of the great variety of work it is difficult to formulate a rule that is general in its application, for expressing the relations of speed, feed and depth of cut. The conditions are quite different for a simple milling operation in which a spiral milling cutter mounted on an arbor takes a cut of moderate depth and feed, as compared with a gang of cutters taking a cut of irregular outline. In the latter case much of the metal is removed by the individual cutters of the gang by taking cuts that are relatively deep compared with their widths. Another extreme condition is encountered when taking a cut of moderate depth and unusual width. These are merely examples of the many reasons why no one is willing to propose rules for general application, to be used by the novice as well as by the master.

DATA ON MILLING

In its recently published book, "A Treatise on Milling and Milling Machines," the Cincinnati Milling Machine Co. presented several rules and sets of curves in an attempt to give the users of millers a guide for the determination of the feeds and speeds on a given piece of work. These curves are based on practice and cover basic milling operations on cast iron and steel when using spiral mills on arbors and face mills. The text accompanying the curves calls special attention to the fact that these curves must not be adopted arbitrarily for any cut that happens to have the same product of depth and feed per revolution as the cuts on which the curves are based. Milling operations cover an almost infinite variety of contours of cuts as well as the different ratios between the depth and width of cut; and these are only two of the many reasons why it is practically impossible to devise either rules or curves that will apply to any and every milling job.

Some of the data given by the curves found in the above-mentioned book are presented here in the form of an alignment chart, as shown graphically between the axes for cutting speed and for feed. This chart has the same limitations as the curves, in that it is not expected to cover all possible conditions met with in general types of milling practice.

The relation of power, feed, depth, and width of cut is based upon information supplied by them to the effect that 1 hp. will remove 1 cu.in. of cast iron or ¾ cu.in. of steel in 1 min. The horsepower computations for the machines are based on the assumption that the effective pull per inch of width of belt is 50 lb., and no deduction is made for the friction of the machine.

The relation of diameter, revolutions per minute and cutting speed is in accordance with the well-known formula

$$V = \frac{\pi DN}{12}$$

where

V = Cutting speed in feet per minute;
D = Diameter of the cutter in inches;
N = Revolutions per minute of the cutter;
π = 3.1416.

PRACTICAL VALUES FOR CUTTING SPEEDS

The cutting speeds given in the above-mentioned book are based on the performance of wide-spaced, wide-angle cutters. The paragraph on this subject reads as follows:

> Safe Practical Speeds—In general practice the following cutting speeds can be safely used with modern cutters and an ample supply of coolant for the cutter on that work which requires coolant:

Cast Iron	Ft.
Spiral Mills:	
Rough milling	65 to 75
Finish milling	80 to 120
Face Mills:	
Rough milling	65
Finish milling	80 to 110
Machine Steel	
Spiral Mills:	
Rough milling	70 to 75
Finish milling	100 to 140
Face Mills:	
Rough milling	60 to 85
Finish milling	90 to 110
Tool Steel—Annealed	
Spiral Mills:	
Rough milling	50
Finish milling	70 to 80
Chrome-Nickel Steel (0.03 to 0.04-carbon drop-forgings)	
Rough milling	45
Tobin Bronze	
Spiral Mills with Lubricant:	
Rough milling	90
Finish milling	125 to 150
Brass	200
Aluminum	600 to 1,000

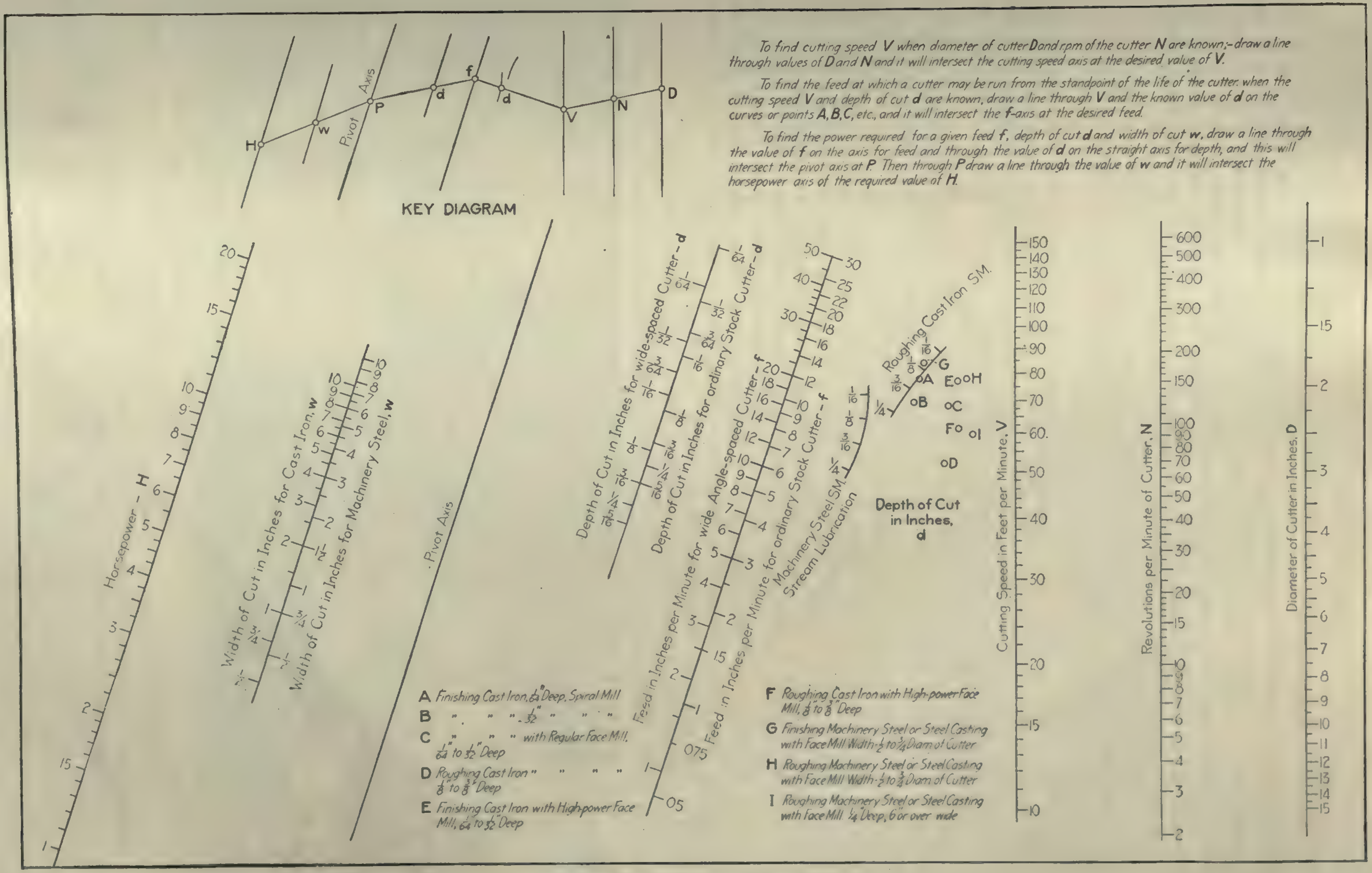
THE SPEED-POWER RELATION ON MACHINES

When a single-pulley machine is used, all the speeds have the same available power, which is limited either to the width and speed of the driving belt or the power of the motor.

On a cone-type miller the available power varies, depending upon the countershaft speeds and the number and diameters of the steps on the cones. For each different countershaft speed there are as many different powers as there are steps on the cone pulley, and for two countershaft speeds there are twice as many powers as there are steps on the cones. The method of determining the available power for each speed may be shown by the solution of the following problem:

What are the speeds and powers of a No. 3 universal cone-drive miller having the following specifications: Diameters of steps on cone on countershaft are 13.25, 12.125 and 11 in.; diameters of steps on cone on machine are 12, 10.875 and 9.75 in.; width of double belt, 3.5 in.; back-gear ratios, 10.1 to 1 and 3.15 to 1; countershaft speeds are 145 and 260 revolutions per minute.

The answers to this problem are given in the accompanying table, in which the numerals 1, 2 and 3 sig-


KEY DIAGRAM
H
w
Pivot Axis
P
d
f
d
V
N
D
Horsepower – H
20
15
10
9
8
7
6
5
4
3
2
1.5
1
Width of Cut in Inches for Cast Iron, w
Width of Cut in Inches for Machinery Steel, w
Pivot Axis
Depth of Cut in Inches for wide-spaced Cutter – d
Depth of Cut in Inches for ordinary Stock Cutter – d
Feed in Inches per Minute for wide Angle-spaced Cutter – f
Feed in Inches per Minute for ordinary Stock Cutter – f
Machinery Steel SM. Stream Lubrication
Roughing Cast Iron SM.
Depth of Cut in Inches, d
Cutting Speed in Feet per Minute, V
Revolutions per Minute of Cutter, N
Diameter of Cutter in Inches, D

To find cutting speed **V** *when diameter of cutter* **D** *and r.p.m. of the cutter* **N** *are known;–draw a line through values of* **D** *and* **N** *and it will intersect the cutting speed axis at the desired value of* **V**.

To find the feed at which a cutter may be run from the standpoint of the life of the cutter, when the cutting speed **V** *and depth of cut* **d** *are known, draw a line through* **V** *and the known value of* **d** *on the curves or points* **A, B, C,** *etc., and it will intersect the* **f**-*axis at the desired feed.*

To find the power required for a given feed **f**, *depth of cut* **d** *and width of cut* **w**, *draw a line through the value of* **f** *on the axis for feed and through the value of* **d** *on the straight axis for depth, and this will intersect the pivot axis at* **P**. *Then through* **P** *draw a line through the value of* **w** *and it will intersect the horsepower axis of the required value of* **H**.

A *Finishing Cast Iron, $\frac{1}{64}$" Deep, Spiral Mill*
B " " " $\frac{1}{32}$" " " "
C " " " *with Regular Face Mill, $\frac{1}{64}$" to $\frac{1}{32}$" Deep*
D *Roughing Cast Iron* " " " " *$\frac{1}{8}$" to $\frac{3}{8}$" Deep*
E *Finishing Cast Iron with High-power Face Mill, $\frac{1}{64}$" to $\frac{1}{32}$" Deep*
F *Roughing Cast Iron with High-power Face Mill, $\frac{1}{8}$" to $\frac{3}{8}$" Deep*
G *Finishing Machinery Steel or Steel Casting with Face Mill Width–$\frac{1}{2}$ to $\frac{3}{4}$ Diam. of Cutter*
H *Roughing Machinery Steel or Steel Casting with Face Mill Width–$\frac{1}{2}$ to $\frac{3}{4}$ Diam. of Cutter*
I *Roughing Machinery Steel or Steel Casting with Face Mill $\frac{1}{4}$" Deep, 6" or over wide*

ALIGNMENT CHART FOR MILLING CUTTERS

nify the first, second and third pulley ratios, having values equal to $\frac{13.25}{12}$, $\frac{12.125}{10.875}$ and $\frac{11}{9.75}$ respectively. The letter *A* signifies that the larger back-gear ratio, $\frac{1}{10.1}$, is in gear; and the letter *B* signifies that the smaller back-gear ratio, $\frac{1}{3.15}$, is in gear. The letter *C* signifies that the speeds are obtained through the cones without using either of the back gears. The letters *F* and *S* signify the use of the fast and slow countershaft speeds respectively. Hence, 2*BF* signifies that the belt is on the second or middle step of the cone pulley, the small back gear is in gear, and the fast countershaft speed is used. This method of designating speeds is due to Carl G. Barth.

SPEEDS AND POWERS FOR NO. 3 UNIVERSAL MILLER

Speed	R.P.M. of Spindle	Speed	R.P.M. of Spindle	Speed	R.P.M. of Spindle	Belt Velocity	Hp.
1AS	13.2	1BS	42.5	1CS	133	417	2.22
2AS	16.0	2BS	51.3	2CS	162	461	2.45
3AS	19.5	3BS	62.5	3CS	197	504	2.67
1AF	23.6	1BF	75.7	1CF	238	748	3.97
2AF	28.7	2BF	92.0	2CF	290	826	4.38
3AF	39.4	3BF	112.0	3CF	353	904	4.80

The 1*CS*, 2*CS* and 3*CS* spindle speeds are obtained by multiplying the cone-pulley ratios by the slow countershaft speed, 145; and the 1*CF*, 2*CF* and 3*CF* spindle speeds are obtained by multiplying the cone-pulley ratios by 260. The speeds involving *A* and those involving *B* are found by dividing those involving *C* by 10.1 and 3.15 respectively.

It is rather interesting to note that in this particular machine the consecutive spindle speeds are obtained by first using the slow countershaft speed in combination with all of the cone-pulley ratios by merely shifting the belt to produce the changes from the first to the second and third; and then changing to the fast countershaft speed to get the fourth, fifth and sixth speeds by using it in combination with the pulley ratios. Ordinarily, the consecutive spindle speeds are obtained by alternately changing the countershaft speeds and the cone-pulley ratios.

The six belt velocities are found by taking the circumferences, in feet, of the 13.25-, 12.125-, and 11-in. steps and multiplying each of them by 145 and 260. The belt velocities multiplied by 50 × 3.5 = 175 lb. and divided by 33,000 gives the horsepowers. Since there are only six different belt speeds, there are only six different powers, or one power for three speeds such as 2.22 hp. is available for the speed 1*AS*, 1*BS* and 1*CS*, having numerical values equal to 13.2, 42.5 and 133 r.p.m. respectively.

To make the chart specially adapted to any machine, special graduations are laid off on the *H*-axis for each power and designated by writing the corresponding speeds opposite, either symbolically as 1*AS* or numerically as 13.2. The special graduations for the spindle speeds and table feeds may also be laid off and similarly designated.

USE OF CHART

The alignment chart illustrated embraces all the three independent sets of relations—namely, the diameter revolutions per minute and cutting-speed relation; the relation of cutting speed, feed and depth of cut; and the power relations. The selection of the proper feed or width of cut for a given job, when the permissible cutting speed is known, necessitates the solution of at least three problems.

The various uses of the chart may best be shown by the solution of a few typical problems.

Example 1. At what revolutions per minute should a cutter 3 in. in diameter be run in order to give a cutting speed of 55 ft. per minute?

Through 3 on the *D*-axis and through 55 on the *V*-axis draw a line, and it will cut the *N*-axis at 70, which is the required revolutions per minute.

Example 2. A spiral mill running at a cutting speed of 65 ft. per min. takes a roughing cut ¼ in. deep in cast iron. What is the fastest practical feed in inches per minute?

Draw a line through 65 on the *V*-axis and through ¼ on the small curve marked "Roughing Cast Iron S. M.," and it will cut the left *f*-axis at 15.5 which is the required value for the feed in inches per minute for a wide-spaced cutter.

Example 3. What horsepower is required in taking a cut 1.5 in. wide, ⅛ in. deep, at a feed of 16 in. per min. in machinery steel, with a wide-spaced cutter?

Through 16 on the left side of the *f*-axis and through ⅛ on the left side of the *d*-axis draw a line cutting the pivot axis at some point such as *P* (shown in "Key Diagram"); and then from this point draw another line through 1.5 on the right side of the *w*-axis, and it will cut the *H*-axis at 4, which is the required horsepower.

Example 4. What is the greatest width of cut that may be taken on a No. 3 cone-type miller in removing a roughing cut ⅛ in. deep in cast iron with a wide-spaced spiral mill 3.5 in. in diameter?

THE CUTTING SPEED

The permissible cutting speed for this condition may be as high as 65 to 75 ft. per min. It is seen that drawing a line through 3.5 on the *D*-axis and 75.7 r.p.m. on the *N*-axis gives 70 ft. per min. From this point a line drawn through the point representing ⅛ in. depth of cut on the curve marked "Roughing Cast Iron S. M." intersects the *f*-axis at 28, which is the greatest safe feed from the standpoint of the cutter. Through this value for the feed and through ⅛ on the left *d*-axis draw a line until it intersects the pivot axis, and call the point of intersection *P*. From the table it is seen that the available power for the spindle speed of 75.7 r.p.m. is 3.97. A line joining the point *P* on the pivot axis with the point corresponding to 3.97 hp. cuts the *w*-axis for cast iron at 1.1, which is the safe value for this width of cut.

This is not the greatest width of cut that this machine will pull, because the machine may stand any load that the belt will carry; and if the belt is tight, it may easily deliver 75 per cent. more power without slipping, and this would permit the width of cut to be increased in the same ratio. A continued practice of using greater widths than those given by the chart will cause belt and other troubles that will result in a lower economy in the long run.

Example 5. What feed and speed should be used in taking a cut 1⅞ in. wide and ⅛ in. deep with a regular face mill 6 in. in diameter in cast iron, on the above-mentioned machine?

The safe limits for cutting speed for this condition are 60 to 85 ft. per min. Drawing a line through 6 on the *D*-axis and 39.4 on the *N*-axis gives 63 ft. per min. on the *V*-axis. A line through this point and through the point *D*, lying between axes for feed and cutting speed, gives a feed of 4 in. per min. on the left *f*-axis. A line through this feed and through ⅛-in. depth of cut on the left *d*-axis cuts the pivot axis at some point *P;* connecting this point with 4.8 hp. shows that there is sufficient power to remove a cut 9.6 in. wide. This indicates that too high a value has been taken for the cutting speed.

Using revolutions per minute of 28.7 and having a corresponding horsepower of 4.38 gives a cutting speed of 45 ft. per min.; feed, 17 in. per min.; and width of cut, 2 in. This combination removes the cut at about four times the rate at which the higher speed will remove it.

Forging Rifle Barrels

By FRED H. COLVIN

SYNOPSIS — *A special plant for forging and heat-treating rifle barrels to meet any specification that might be desired involved not only very large outlay, but the adaptation of a wide experience to new problems. The problem of cooling the oil for heat-treating was solved in an interesting manner.*

THE forging of rifle barrels in large quantities and heat-treating them to meet the specifications demanded by some of the foreign governments led Wheelock, Lovejoy & Co. to establish a complete plant for this purpose in connection with their warehouse in Cambridge, Mass. This plant, designed and constructed by their chief engineer, K. A. Juthe, has many interesting features.

The stock, which comes in bars of mill length, is cut off so as to make a barrel with the proper allowances for trimming. Bars come on trucks to the cutting-off shear, as in Fig. 1, and then pass to the forging or upsetting press in the adjoining room. This press, which is shown in more detail in Fig. 2, can handle the barrels from all the heating furnaces shown. The men change work at frequent intervals, to avoid excessive fatigue.

Some of the details of the cutting off may be seen in Fig. 3. The stock stop *A* is bolted to the side of the frame, the ledge formed by the strip bolted to the stop serving to keep the stock level. The hold-down *B* prevents the back end from flying up when the stock is cut. The knife *C* has several notches in which the barrels can be cut, so that it need not be taken out for grinding until all the notches are dull. Then the barrels are reheated in the continuous furnace, shown in Fig. 4, and straightened before being tested.

The barrels are next tested for straightness on the rollers illustrated in Fig. 5, then straightened by the screw on the press. After the heat-treating, the ends are ground, a spot ground on the enlarged end and each barrel tested on a Brinell machine, as shown in Fig. 6. The pressure used is 3000 kg., or 6614 lb., and a depression of 3.9 mm., or No. 241, is usually secured.

The heat-treating of the rifle blanks covers four separate operations: (1) Heating and soaking the steel above the critical temperature and quenching in oil to harden the steel through to the center; (2) reheating for drawing of temper for the purpose of meeting the physical specifications; (3) reheating to meet the machineability test for production purposes; and (4) reheating to straighten the blanks while hot.

A short explanation of the necessity for the many heats may be interesting. For the first heat, the blanks are slowly brought to the required heat, which is about 150 deg. F. above the critical temperature. They are then soaked at a high heat for about one hour before quenching. The purpose of this treatment is

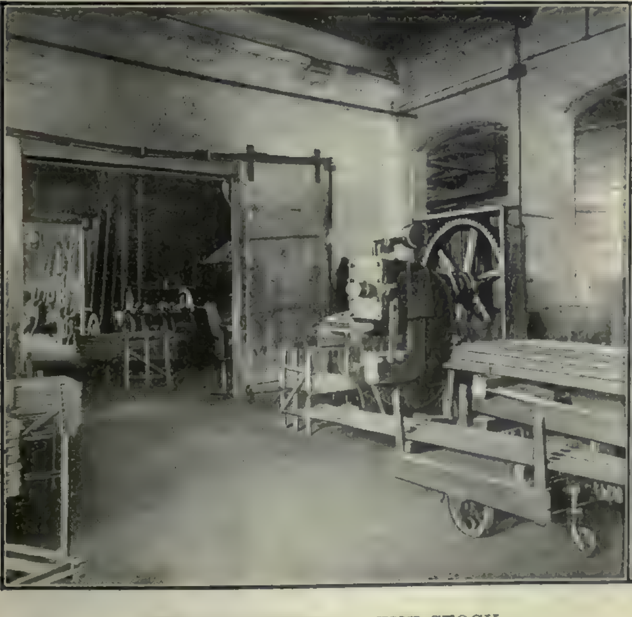


FIG. 1. CUTTING UP THE STOCK

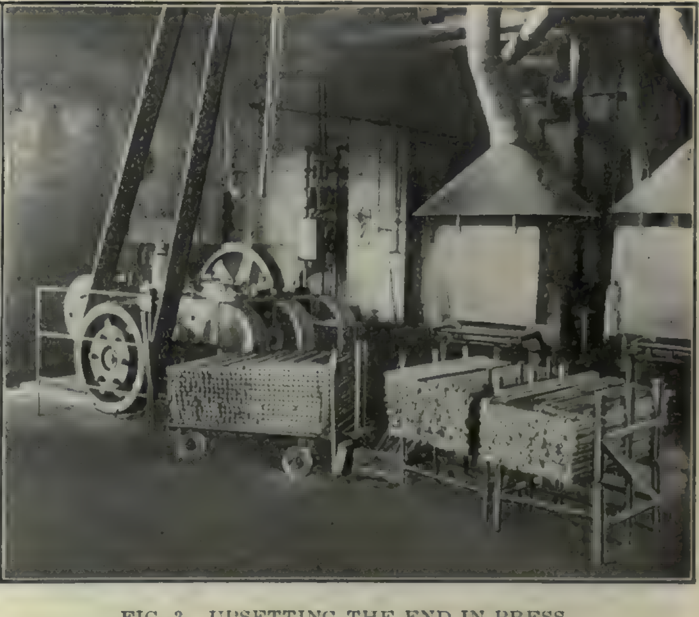


FIG. 2. UPSETTING THE END IN PRESS

to eliminate any rolling or heat strains that may be in the bars from mill operations; also to insure a thorough even heat through a cross-section of the steel. This heat also causes blanks with seams or slight flaws to open up in quenching, making inspection of defective blanks very easy.

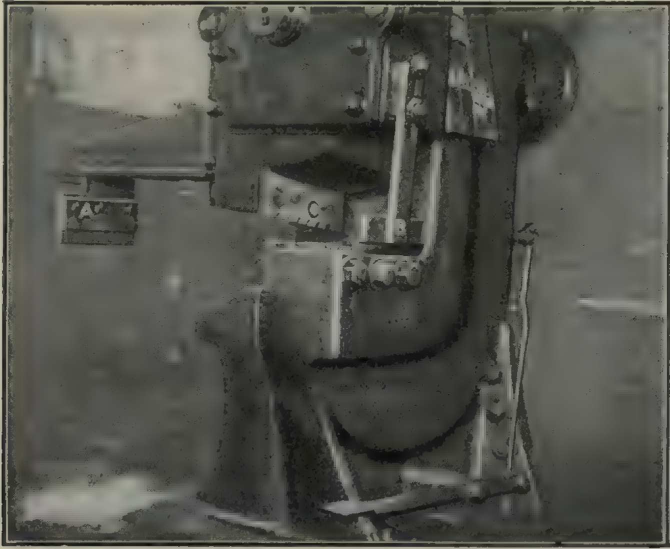


FIG. 3. THE SHEARING PRESS

The quenching oil is kept at a constant temperature of 100 deg. F., to avoid subjecting the steel to shocks, thereby causing surface cracks. The drawing of temper is the most critical operation and is kept within a 10-deg. fluctuation. The degree of heat is entirely dependent on analysis of the steel, there being a certain variation in the different heats of steel as received from the mill.

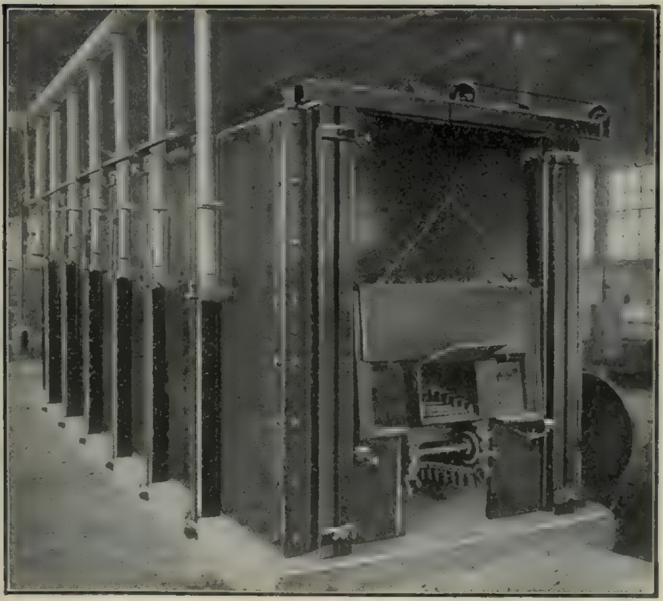


FIG. 4. REHEATING FURNACE FOR STRAIGHTENING

Reheating for machineability is done at 100 deg. less than the drawing temperature, but the time of soaking is more than double. After both drawing and reheating, the blanks are buried in lime where they remain, out of contact with the air, until their temperature has dropped to that of the workroom.

For straightening, the rifle blanks are heated to from 900 to 1000 deg. F. in an automatic furnace 25 ft. long, and this operation takes about two hours. The purpose of hot straightening is to prevent any strains being put into the blanks, so that after rough-turning, drilling or rifling operations they will not have a tendency to spring back to shape as left by the quenching bath.

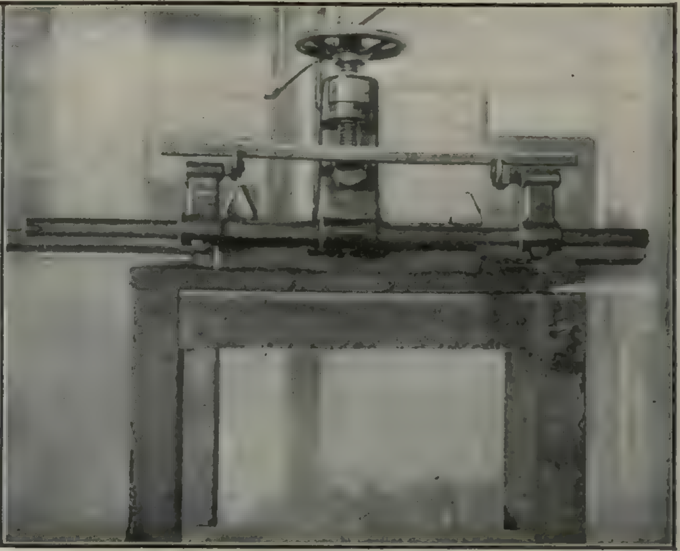


FIG. 5. STRAIGHTENING THE BARRELS

A method that produces an even better machining rifle blank, which practically stays straight through the different machining operations, is to rough-turn the blanks, then subject them to a heat of practically 1000 deg. for four hours. Production throughout the different operations is materially increased, with practically no straightening necessary from drilling, reaming, finish-turning or rifling operations.

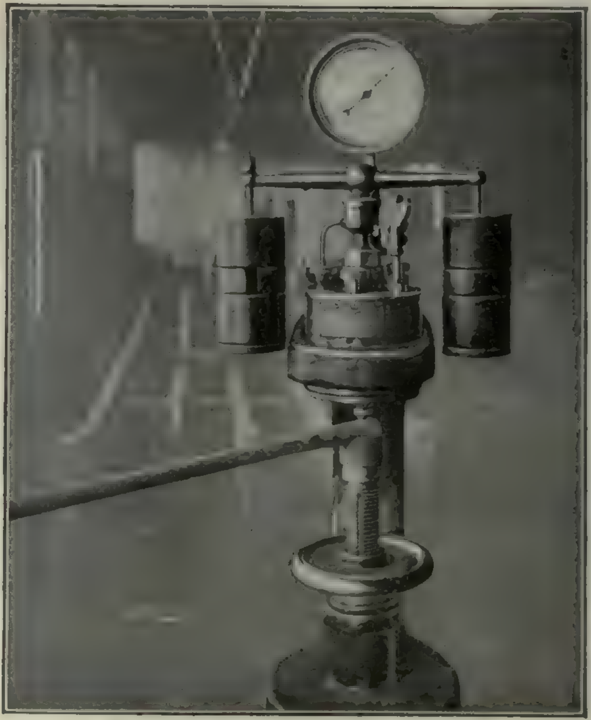


FIG. 6. TESTING HARDNESS ON BRINELL MACHINE

This method has been tested out by one of our largest manufacturers and has proved to be the best way so far adopted to eliminate a very expensive finished gun-barrel straightening process.

The heat-treating requires a large amount of cooling oil, and the problem of keeping this at the proper temperature required considerable study. The result was the cooling plant on the roof, as shown in Figs. 7, 8 and 9. The first two illustrations show the plant as it appears complete. Fig. 9 shows how the oil is handled in what is sometimes called the ebulator system. The oil is pumped up from the cooling tanks through the pipe *A* to the tank *B*. From here it runs down onto the breakers or separators *C*, which break the oil up into fine particles that are caught by the fans *D*. The spray is blown up into the cooling tower *E*, which contains banks of cooling pipes, as can be seen, as well as baffles *F*. The spray collects on the cool pipes and forms drops, which fall on the curved plates *G* and run back to the oil-storage tank below ground.

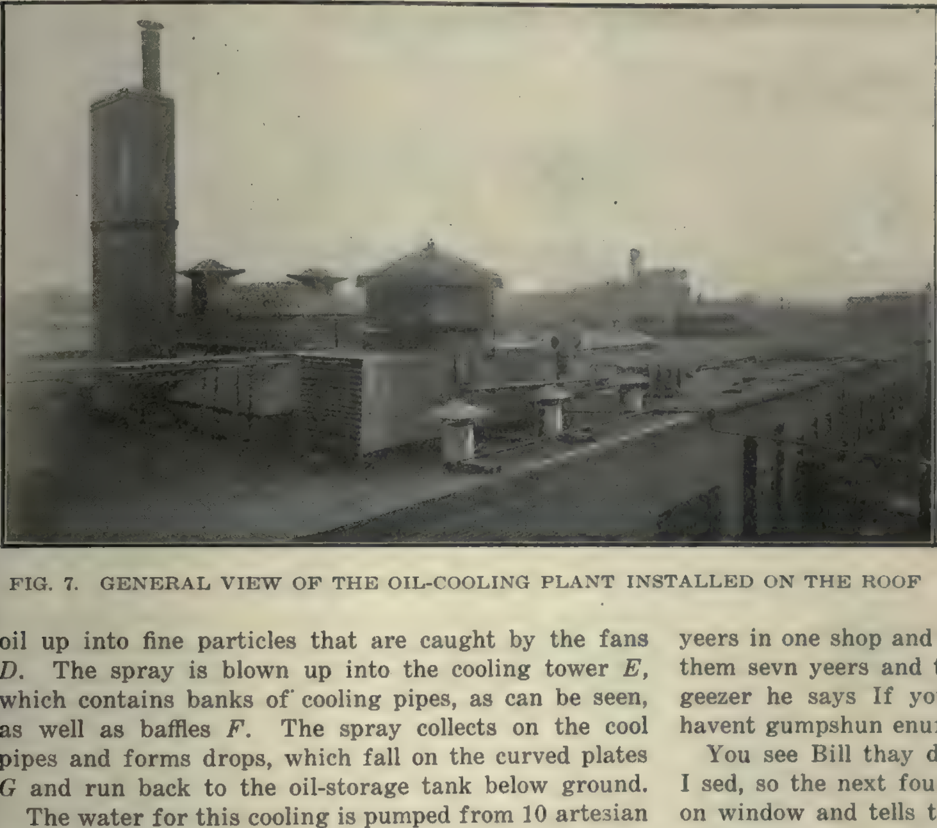


FIG. 7. GENERAL VIEW OF THE OIL-COOLING PLANT INSTALLED ON THE ROOF

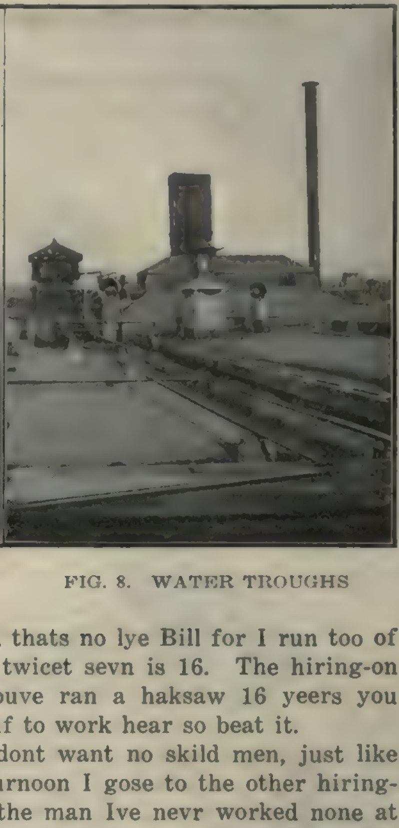


FIG. 8. WATER TROUGHS

The water for this cooling is pumped from 10 artesian wells at the rate of 60 gal. per min. and cools 90 gal. of oil per minute, lowering the temperature from 130 or 140 to 100 deg. F. The water as it comes from the wells averages around 52 deg. F. The motor is of a 7½-hp. variable-speed type with a range of from 700 to 1200 r.p.m., which can be varied to suit the amount of oil to be cooled. The plant can handle 300 gal. of oil per minute.

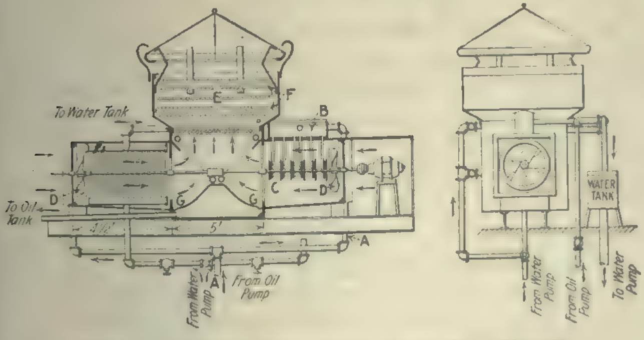


FIG. 9. DETAILS OF THE COOLING SYSTEM

Letters from Jack to Bill—A Job in a Munitions Factory

Deer Bill—Im mitey glad you advised me to get in a munishions factry in room of trying for the tool job in the shop whare you work at, for Ive got a fine chants hear. Lots of men no longer at the traid than what I be are puling down thare 50$ a weak. One funy thing Ive lurned, skild masheenists dont get near as good pay as the unskild men, speshlists thay call em hear, that nevr was into a shop befour.

When I furst tryed to hire on I didnt kno that, so in room of conseling my skil at the traid I toled the guy at the hiring-on window that Id ran a haksaw 16 yeers in one shop and thats no lye Bill for I run too of them sevn yeers and twicet sevn is 16. The hiring-on geezer he says If youve ran a haksaw 16 yeers you havent gumpshun enuf to work hear so beat it.

You see Bill thay dont want no skild men, just like I sed, so the next fournoon I gose to the other hiring-on window and tells the man Ive nevr worked none at the traid only ran a millur, for whats a haksaw Bill but a millur cutter that gose back and fourth? The gink says Why did you leev your job, to hunt a better climit for your helth? I says becaus I lost my wife. That ant no lye neether Bill, for tho I ant nevver had no wife, that dodgasted yeller hedded Eliza she mite of bin my wife if she hadn't of shook me to taik up with that barkeper.

So I acsepted a position to run a millur, its peace work Bill, and I nevr did have no use for peacework which is a trick of the boses to keep from paying all masheenists the same salleries like thay ort to, but thinks I a man can stand for a good deel for 50$ a weak, so hear gose.

Thay shode me whare to punch a clock with my number, number 1635 and then took me to my masheen and give me a lot of round steal to cut in peaces. The fourman says These parts is to finish one and three eights, so maik em one three eight sevn or nine. What kind of talk is that Bill, no United States talk. After the fourman he had went away the man on the next masheen he says give her one three eight sevn on the dyal, so I looks round and seen a dinky little dyal all marked like a scail, but no such things on it like the man sed, only ten and twenty and such up to 120, so I gose by my good old faithfull scail you kno Bill, the one that laithe man chuckd in the scrap just becaus the both ends got ground off a little. I give em one and three eights and then some.

Pritty soon a inspeckter whom I think is a forrener, he come and mezhured some of em with his mikes, say Bill did you kno there was too-inch mikes? I nevver hurd of no such but will by me a pare with some of my furst 50$ sallery. He larfed and sed some forren heethen talk like ler shar lays apportayt eel I dont kno what it meens but shure it sounds like it was cusswords Bill. I dont think no inspeckter ort to be aloud to use such talk, but he didnt kno I was a skild workman and I spose they hav to talk ruff to the muts lik ar round heer.

Deer Bill I rote all this wensdy and now it is friedy and we all have went to dror our salleries, and what do you think thay kikd about the clock. The one thay toled me to punch was to far from the stares so I used one handy by the stares and it didnt have no 1635 onto it so I punched a 16 and a 35 and the bos kikd and sed my card didnt sho no time atall, no not a nours work. Then thay sed Id went and spoiled all my parts only but a few and all that was cumming to me was a meezly 2$ and 35 sents and thay fired me befour I could ketch my breth and jack up thare theevish old job.

I tell you Bill a onest workingman dont get no desent sho in a munishions factry all thay want is to work us hard and kik us out without no good pay for our harduus laber. Now Bill, pleese tell me the naim of that shop out in Misshegun whare they nevr fire noboddy and Ile go out thare and hire on. Thay say everybody in that shop gits 5$ a day which is little enuf for a skild mecanik like I am and the boses roling in welth, but me for Misshegun, for time clocks and heethen inspeckters is full as bad for a shop as what movies are.

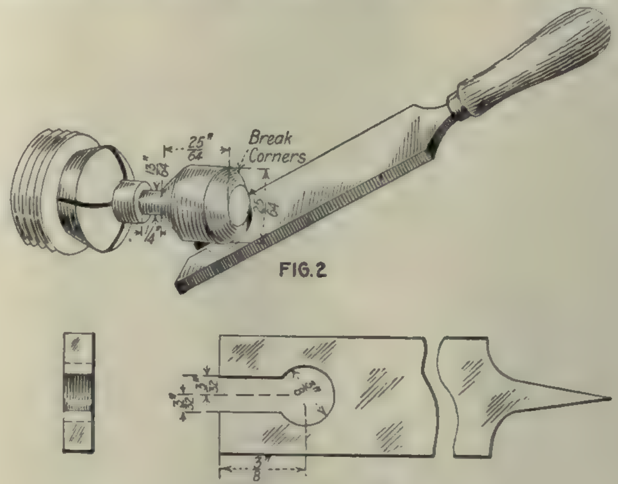
JACK.

P S Bill wen you send the adres cant you leav me borro off you enuf for my car fair and Ile pay you out of my furst weaks sallery.

Turning Accurate Ball Joints

By J. W. Ackerman

When a ball-turning rest is not available, I have found the following method both quick and accurate for turning ball cutters or balls for joints. For example, a $\frac{3}{8}$-in. ball is required with a $\frac{3}{16}$-in. shank. To make the tool, take a piece of flat steel $\frac{1}{4}$ x $\frac{3}{4}$ x 6 in.; $\frac{3}{8}$ in. from the end, drill and ream a $\frac{3}{8}$-in. hole; cut a $\frac{3}{16}$-in. slot from the hole to the end and central with the hole. See that all edges are sharp and without taper; harden and draw, and the tool, shown in Fig. 1, is ready for use.



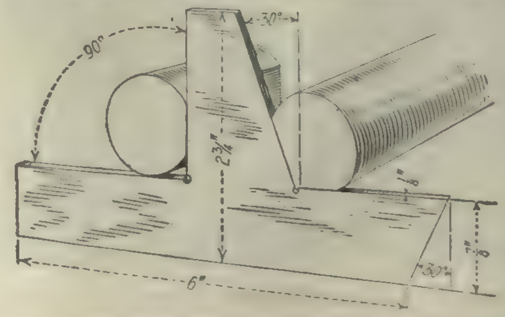
FIGS. 1 AND 2. TOOL FOR TURNING BALLS

A piece of the kind of material required, $\frac{25}{64}$ in. in diameter, is inserted in the spring chuck of the lathe and roughed out, as shown in Fig. 2. The hand rest is placed in front of the work, and the form tool is put under the work and over the rest. Run the machine slowly and press steadily on the tool handle until the tool has passed up over the work, leaving a ball. A little lard oil will improve the finish and also save the tool.

Square and Hexagon Gage

By H. W. Dickhub

The accompanying illustration shows a gage for laying out or setting up work to be made hexagonal or square, when no dividing head is available. The gage is made of $\frac{1}{8}$-in. steel. The method in which it is used is quite clear, no description being necessary in connection with the illustration.



SQUARE AND HEXAGON GAGE

Depreciation of Electrical Machinery

By WILLIAM H. EASTON
Westinghouse Electric and Manufacturing Co.

SYNOPSIS—*The information and suggestions contained in this article will be found very useful in checking up on the depreciation of the class of machinery discussed. It also brings out the point that depreciation by wear is not the only thing to consider in certain cases, as more may have to be installed to replace out-of-date equipment.*

For bookkeeping purposes the depreciation of electric machinery is always figured at 10 per cent. This is a good, conservative figure which is well on the safe side and provides ample allowance for accidents, carelessness and exceptionally severe service conditions. It does not, however, indicate the life of a good motor that is properly installed and is given good care in the average machine shop, for in 10 years such a motor should hardly begin to show signs of wear.

The truth of the matter is that the length of the useful life of the modern high-grade motor is not known, because it has not been in existence long enough to supply reliable data on this point. A study of the behavior of the oldest motors, however, and a comparison of their construction with that of modern motors allow us to form a pretty fair judgment as to the life that can be expected.

DIRECT-CURRENT MOTORS

The vital parts of a direct-current motor that are subject to depreciation are the bearings, the commutator and the armature and field windings. A motor that is worn out all over, like the "one-hoss shay," suffers from the following disabilities: The babbitt of the bearings is gone in places, and the bearing surface of the shaft is cut. The commutator is burnt and pitted and is worn down under the brushes until there is not enough copper left to conduct the current properly. The brush holders are battered, burnt and rickety. The field and armature insulation is roasted until it has no physical strength and will fall to powder if the coils are disturbed; it is filled with carbon and copper dust from the brushes and commutator, and its dielectric strength is practically zero, so that short-circuits may develop anywhere. Such a motor is, of course, good for nothing but scrap.

Needless to say, however, these "points of depreciation" have been given the most exhaustive study by motor manufacturers. Though wear is inevitable, it can be retarded greatly by careful selection of materials, skillful design and proper care; and in the case of the modern forged-steel frame, commutating-pole motor these three factors combine to reduce the normal annual wear to a very small amount. Let us take up these wearing parts separately and consider what has been done to diminish depreciation and what special care each part should receive.

Wearless bearings are of course an impossibility, so that the solution of the problem of bearing depreciation consists in obtaining the longest possible life together with easy and inexpensive renewals. As a result of countless experiments and years of observation on the wear of bearings, the modern motor bearing, for use where it can receive even fair attention, has the following characteristics: It is an unsplit, babbitt-lined, steel sleeve solidly mounted in the housing. The babbitt is of a special composition, selected because of its excellent wearing properties, and the pressure per square inch of bearing surface is low. The bearing is lubricated by automatic oil rings. The bearing housing is dustproof and so designed that oil can not leak out. The sleeves themselves can be renewed readily in a few minutes, and their cost is so low, because of the large output, that it is cheaper to buy new sleeves than to rebabbitt old ones.

The actual life of the bearing depends on the service in which it is used and the care it receives. Gear drive is the most severe condition and loose belt drive the easiest. It is hardly possible to give figures with any degree of accuracy, but a range of from 4 years minimum to 15 years maximum, depending on conditions, is probably a fair estimate. As to the care bearings should receive, little need be said to readers of the *American Machinist* except to point out that a motor bearing is worn out when the armature gets out of center. The clearance between the armature and the field coils should therefore be checked from time to time.

COMMUTATOR

Since the brushes press continually on the commutator, it too must inevitably wear; but, as a matter of fact, it was not the brush friction that used to destroy commutators, but the sparking. Sparking damages the commutator and necessitates turning it down, and since the old-time motors sparked more or less all the time, the life of their commutators was short. But in the modern, well-designed, commutating-pole motor sparking is completely suppressed, and in consequence the life of the commutator (and of the brushes as well) is lengthened indefinitely—to what extent, indeed, is not even yet determined.

Oil was another source of commutator trouble in the older motors. Oil on the commutator dissolves the bond of the mica, causing short-circuits. This trouble has been remedied by placing oil-thrower rings on the shaft, using unsplit bearings which do not leak and providing the oil wells with overflow plugs so that the oil wells can not be filled too full and the commutator flooded.

Brush tension has been carefully studied, and in modern motors the brush pressure is just great enough to allow the brushes to ride well and conduct the current properly; friction is therefore minimized.

The life of the commutator is also extended by "undercutting" the mica—that is, cutting the mica out slightly below the level of the copper. If, from any cause, the copper becomes worn down too rapidly at any point, the mica, if not undercut, projects and causes severe sparking whenever a brush strikes it. Undercutting prevents this.

Commutators should be lubricated occasionally by holding against them a rag with a few drops of oil on it. High-grade brushes should be used, and if the commutator becomes roughened from any cause, it should be smoothed with sandpaper and not with emery. Gritty dust on the commutator will, of course, cause rapid wear.

WINDINGS

The insulation of the armature and field windings of a motor can be injured in normal service by heat, moisture, oil, dirt and vibration.

The heating of motor coils is unavoidable, since heat is always developed by the passage of the current through a conductor. Hence steps must be taken to eliminate, as far as possible, its injurious effects. Two means are employed in good modern motors—namely, the selection of insulating materials that can withstand the temperatures obtaining in service, and secondly, arrangements for ventilating the coils by directing air currents through ventilating spaces in the cores and between the coils.

The use of enduring insulating materials is one of the things that distinguish a high-grade motor from a cheaply constructed one. No difference is descernible on the surface, but the one will operate for years without trouble while the other will be making frequent visits to the repair shop. So thoroughly has the subject of insulating materials and the effect of heat on them been studied that the insulation of a good modern motor can be counted on to last indefinitely under the temperatures encountered in normal service.

Theoretically, moisture, oil and dirt can be kept out of a motor, but practically they cannot; so that protection against them must be provided. This protection is secured in a modern motor by impregnating the coils with a material that forms a smooth, hard, oil-and-moisture-proof surface, which adds many years to the life of the motor.

With dirt from the outside must be included the carbon and copper dust produced by the wear of the brushes and commutator. This dust is particularly objectionable because it is a conductor of electricity and in the older motors was an important factor in the depreciation of the coils.

Vibration is an evil over which the motor manufacturer has no control, since it depends on the conditions of installation; but he has, however, accurately balanced the armature, strengthened the coils mechanically and bound them firmly in place, and supported the fields in motors for especially severe service by springs. The impregnation of the coils also helps, since it prevents the wires of a coil from rubbing against each other. The vibration encountered in normal machine-shop service with the motors properly mounted can be disregarded; but where the service is particularly racking, a shortened motor life must be expected.

Cleanliness is the first law for prolonging motor life. Protect the motor from dust, dirt and dripping oil and water. Metal chips are especially bad. Clean it frequently and blow out the dust accumulated inside by means of compressed air or a hand bellows. For very bad locations, use a motor with screen covers if large particles are liable to get into it, or an entirely inclosed motor if much dust or moisture is unavoidable.

Do not overload the motor. The temperature rise of a motor operating at its rated horsepower will not injure it; but the greater the load the higher the temperature, so that an overload means a shortened life. All good modern motors will withstand short overloads of even an extreme character, but if the motor is continually operated at a temperature of over 75 deg. F. above the temperature of the room, it is overloaded, either because there is excessive friction somewhere or because it is too small for the work. The common method of determining the temperature of a motor by placing the hand on it is not accurate enough. The actual temperature should be determined by thermometers, the bulbs of which are laid against the motor frame and windings at various points and protected from air currents by being covered with wads of waste.

ALTERNATING-CURRENT MOTORS

The case for the modern alternating-current motor is even stronger. The squirrel-cage motor, the usual type found in machine shops, has no wearing parts except the bearings. The stationary part carries a set of simple, impregnated coils, and the rotating part is practically indestructible because its windings are heavy copper bars. Given proper care as to bearings, cleanliness, overloads, etc., there seems to be no good reason why such a motor should ever wear out.

OBSOLESCENCE

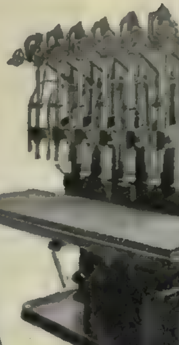
Depreciation must, however, take into consideration a factor that has nothing to do with the wearing out of the machinery—namely, the appearance of forms so much improved that it is more economical to scrap old, even though still good, machines and buy the new type than to continue to operate the old. Our readiness to do this is regarded as a characteristic American trait. With some kinds of apparatus depreciation must be based primarily on obsolescence, but this at present does not appear to be the case with motors. The efficiency of the modern motor has been raised almost to the theoretical maximum and not much improvement can be expected along this line. Mechanical design seems to be fairly well standardized.

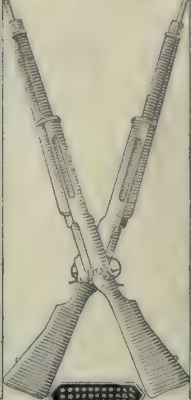
Prophecies to the effect that the end of progress has been reached have been upset too often to warrant indulgence in them, but it can be stated as a fact that there is today no reason to believe that our present motors will be superseded for some time to come.

Generally speaking, motors will outlast their control equipment. Controllers are naturally less rugged than motors and have a larger proportion of wearing parts—bearings, movable arms, contact pieces, etc. Though all these parts are protected as far as possible and are renewable, still the controller as a whole will usually depreciate more rapidly than the motor. Furthermore, controller design is in a much more rapid state of evolution than motor design. Today manually operated controllers are being largely replaced by automatic controllers, and these latter will probably be improved in time and will in turn be superseded.

For controllers, therefore, a 10 per cent. depreciation estimate can still be used, but it is by no means as conservative as in the case of motors.

The LYON FAIR





THE Lyon Sample Fair reflects the greatest credit upon its originators and apparently is on the road to make good the object of its projectors, to create a fair of samples in France, which will rival, if not supplant, the famous Leipzig Fair.

The initial fair was held in 1916, and even then, under the greatest of handicaps, it gave great promise. This year, with the obstacles multiplied, there were about three times as many exhibitors as there were in 1916.

Fostered by the French Government, which gave it recognition as the only official fair of France, it is beginning to bloom in its aspirations to be the great commercial clearing house of Europe.

This fair should attract American manufacturers, for it is a most important trade getter and is a splendid advertising medium for American-made goods. The fair is not what we generally term a fair in the United States, in the sense that it is an exhibition of goods and samples destined to attract the people generally. It is an exhibition of improvements in matters of production as well as the products themselves, and the attendance is limited to shopkeepers and people directly interested in the sale of goods.

While the fair at Lyon had a most picturesque setting, it lacked concentration and systematization. It stretched for 6 miles along the beautiful quays of the swiftly moving Rhone; and it was not an easy matter to shop over such a great area, especially if you were interested in several lines of commerce.

Next year, however, the directors will concentrate the booths at two different points with the ultimate object of housing all exhibits under one great roof, which, after the fair, will be used as a commercial museum. Here, samples brought to the fair will be permitted to remain, with the rights of substitution from time to time.

It is well to remember that Lyon, the second city of France in point of importance, is first commercially. It claims to be the greatest silk center of the world, is the most important for the tinsel industry and the automobile trade, and is important dyestuff center.

The people of Lyon are peculiar and must be studied by anyone hoping to do business with them. They are proud, shrewd and honest. Germany has long since known all the peculiarities of the merchants and has offered liberal credits, promptly filled orders in strict accordance with specifications, and has done everything to foster her trade. How well she succeeded is demonstrated by the fact that she practically controlled these markets before the war. And right here we should enforce upon our manufacturers the necessity of giving foreign orders much more careful attention than has been their wont in the past. This is especially true of the French markets, and the people with their extreme politeness look for a similar return in their correspondence with the United States. Oftentimes our manufacturers fail to answer letters; or replying, do so in a cold, matter-of-fact way that produces actual harm, not only to themselves, but to all American manufacturers.

It is positively inexcusable how lightly business men of America treat foreign trade. In one case a large dealer who is also the representative of some important American business houses placed an order for a large number of "Universal Pliers." The terms were cash against document, and when the goods arrived after many months' delay, the French merchant, who, by the way, had a large contract with the French Government for many of these tools, paid for the goods and had them released. Judge his dismay when he noted that each one of these pliers bore the mark, "Made in Germany." There might have been some excuse for this during the first year of the war, but this incident happened in 1917 in the face of Government decrees prohibiting dealing with the enemy.

There was a total of 24 American firms who exhibited at the fair this year; several more had rented booths, but because of the great menace from submarines could not, or would not, take the chance of sending valuable displays. Several important exhibits were also lost at sea. The American exhibitors reported an enormous demand for their goods, as well as important sales. From data collected by the Fair Committee it is conservatively estimated that direct sales through the medium of the fair aggregated upward of 250,000,000 francs (about $50,000,000).

A very important and interesting place was the American consular exhibit of American manufacturers' catalogs. They were carefully card indexed, and well-informed clerks attended to the crowd of inquirers. While the catalog exhibit was by no means complete, large orders resulted and a good impression was made. Every American manufacturer should see that his catalogs are on exhibition at the next fair, to be held at Lyon, France, Mar. 1 to 15, 1918.

The illustrations shown herewith were obtained through the courtesy of the Allied Machinery Co., New York City.

Terms Used in Aëronautics

SYNOPSIS — *Due to the fact that the number of airplanes being produced in this country is increasing very rapidly, the accompanying illustration and the list of terms should be of value to many manufacturers.*

THE illustration shows a typical airplane of the modern biplane, or two-wing, type, with some of it in section to show construction. The principal parts are named. It will be noticed that there is a tendency to call the various parts by a plain, descriptive American name, instead of by the French name, as was the custom only a short time ago. Some of the special names still linger and will probably continue to do so, just as "garage" is likely to remain as a part of the language.

Around the main picture are grouped several details of construction as well as small illustrations of different types of machines. It is not of course possible to show all types, but it is hoped by illustrating a few of those which are most in the public prints to familiarize our readers with the terms in general use, so as to make them understandable. In view of the vast number of airplanes which are to be built during the next year, it is more than likely that many shops of various kinds now on entirely different work will be engaged in making either complete or partial equipment for the new method of locomotion. And before this comes, it is part of the duty of every up-to-date mechanic to be informed, in a general way at least, in regard to the mechanical details of these machines.

The insignia of the United States Flying Corps, as recently published by the War and Navy Departments, is shown on the wing and on the tail of the large machine in the center. Red, white and blue are used, in the order shown, a star being the distinguishing mark on the wings and three vertical stripes on the rudder of the machine. The markings are distinctive and will, it is hoped and believed, be much in evidence in France before many months have elapsed. With the advent of a huge flying corps we may expect to see great changes in the situation on the Western front of the battle area.

The following list of aëronautical terms, adopted by the National Advisory Committee for Aëronautics, has been prepared with a view to eliminating the duplication, confusion and erroneous use of terms.

Aërofoil: A thin wing-like structure, flat or curved, designed to obtain reaction upon its surfaces from the air through which it moves.

Aëroplane: See Airplane.

Aileron: A movable auxiliary surface used for the control of rolling motion—that is, rotation about the fore and aft axis.

Aircraft: Any form of craft designed for the navigation of air—airplanes, balloons, dirigibles, helicopters, kites, kite balloons, ornithopters, gliders, etc.

Airplane: A form of aircraft heavier than air, which has wing surfaces for sustentation, with stabilizing surfaces, rudders for steering, and power plant for propulsion through the air. This term is commonly used in a more restricted sense to refer to airplanes fitted with landing gear suited to operation from the land. If the landing gear is suited to operation from the water, the term "seaplane" is used. (See definition.)

> Pusher—A type of airplane with the propeller or propellers in rear of the wings.
>
> Tractor—A type of airplane with the propeller or propellers in front of the wings.

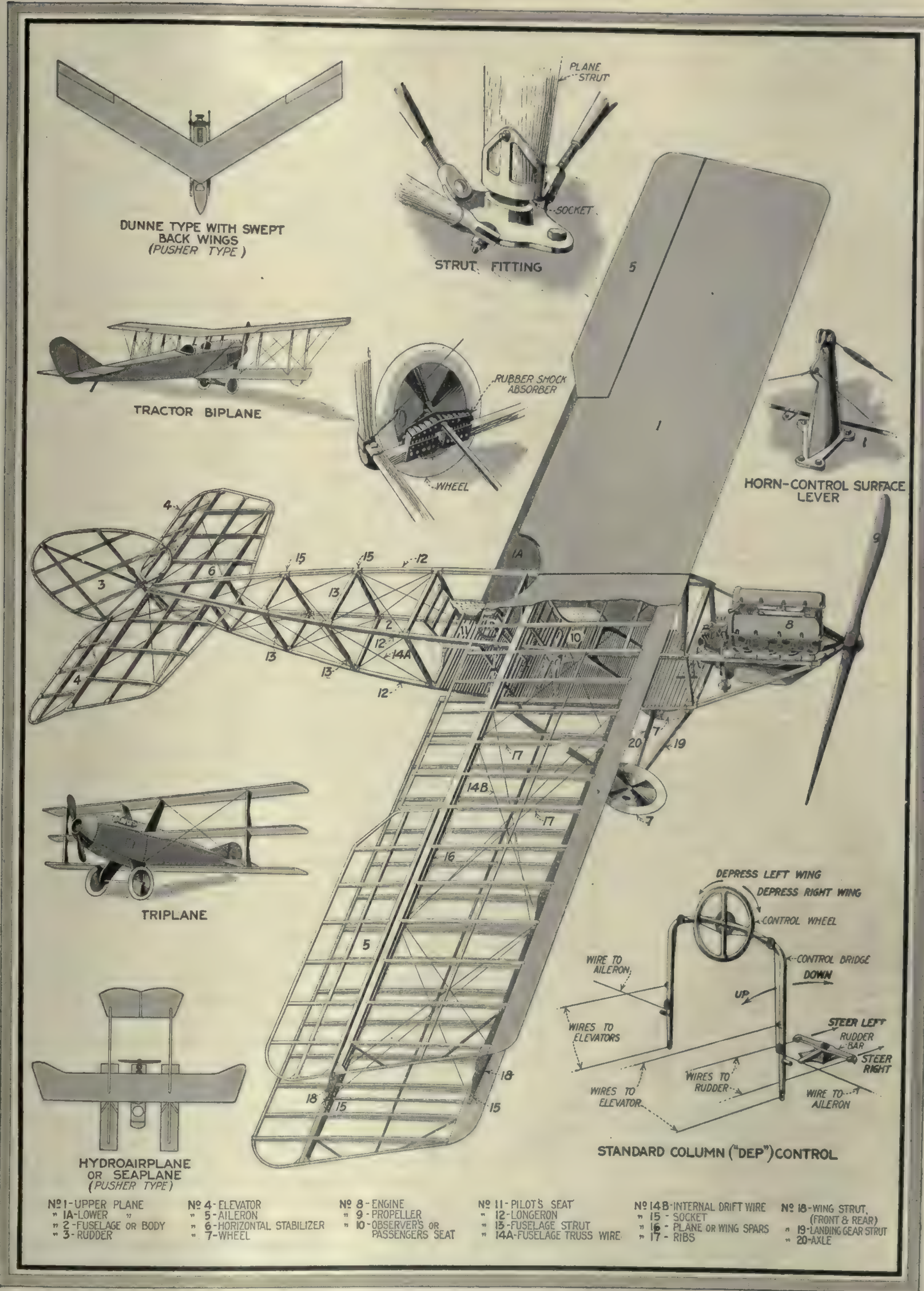
Air-speed meter: An instrument designed to measure the velocity of an aircraft with reference to the air through which it is moving.

Altimeter: An instrument mounted on an aircraft to continuously indicate its height above the surface of the earth.

Anemometer: An instrument for measuring the velocity of the wind or air currents with reference to the earth or some fixed body.

Angle:

> Of attack—The angle between the direction of the relative wind and the chord of an aërofoil, or the fore and aft axis of a body.



TYPICAL AIRPLANES AND DETAILS OF CONSTRUCTION

Critical—The angle of attack at which the lift is a maximum.

Gliding—The angle the flight path makes with the horizontal when flying in still air under the influence of gravity alone.

Aspect ratio: The ratio of spread to chord of an aërofoil.

Aviator: The operator or pilot of heavier-than-air craft. This term may be applied equally, regardless of the sex of the operator.

Axes of an aircraft: Three fixed lines of reference; usually centroidal and mutually rectangular. The principal longitudinal axis in the plane of symmetry, usually parallel to the axis of the propeller, is called the fore and aft axis (or longitudinal axis); the axis perpendicular to this in the plane of symmetry is called the vertical axis; and the third axis, perpendicular to the other two, is called the athwartship axis (or transverse or lateral axis). In mathematical discussions the first of these axes is called the X-axis, the second the Z-axis, and the third the Y-axis.

Ballonet: A small balloon within the interior of a balloon or dirigible for the purpose of controlling the ascent or descent, and for maintaining pressure on the outer envelope to prevent deformation. The ballonet is kept inflated with air at the required pressure, under the control of a blower and valves.

Balloon: A form of aircraft comprising a gas bag and a car, whose sustentation depends on the buoyancy of the contained gas, which is lighter than air.

Captive—A balloon restrained from free flight by means of a cable attaching it to the earth.

Kite—An elongated form of captive balloon, fitted with tail appendages to keep it headed into the wind, and deriving increased lift due to its axis being inclined to the wind.

Bank: To incline an airplane laterally—that is, to rotate it about the fore and aft axis. Right bank is to incline the airplane with the right wing down.

Banking rudder: See Aileron.

Barograph: An instrument used to record variations in barometric pressure. In aëronautics the charts on which the records are made are prepared to indicate altitudes directly instead of barometric pressure.

Biplane: A form of airplane in which the main supporting surface is divided into two parts, one above the other.

Body of an airplane: A structure, usually inclosed, which contains in a streamline housing the power plant, fuel, passengers, etc.

Cabré: A flying attitude in which the angle of attack is greater than normal; tail down; down by the stern—tail low.

Camber: The convexity or rise of a curve of an aërofoil from its chord, usually expressed as the ratio of the maximum departure of the curve from the chord as a fraction thereof. "Top camber" refers to the top surface of an aërofoil, and "bottom camber" to the bottom surface; "mean camber" is the mean of these two.

Capacity:

Lifting—The maximum flying load of an aircraft.

Carrying—Excess of the lifting capacity over the dead-load of an aircraft, which latter includes structure, power plant and essential accessories.

Carrying capacity: See Capacity.

Center: The point in which a set of effects is assumed to be accumulated producing the same effect as if all were concentrated at this point.

Of buoyancy—The center of gravity of the fluid displaced by the floating body.

Of pressure of an aërofoil—The point on the chord of an element of an aërofoil, prolonged if necessary, through which at any instant the line of action of the resultant air force passes.

Of pressure of a body—The point on the axis of a body, prolonged if necessary, through which at any distant the line of action of the resultant air force passes.

Chord:

Of an aërofoil section—A right line tangent to the under curve of the aërofoil section at the front and rear.

Length—The length of the chord is the length of the aërofoil section projected on the chord, extended if necessary.

Controls: A general term applying to the means provided for operating the devices used to control speed, direction of flight, and attitude of an aircraft.

Critical angle: See Angle, Critical.

Décalage: An increase in the angular setting of the chord of an upper wing of a biplane with reference to the chord of the lower wing.

Developed area of a propeller: A layout of the area of a propeller blade designed to represent the total area of the driving face, in which the elements of area are developed as if unfolded onto the plane of the drawing (necessarily an approximation on definite assumptions, as no true development of the helix can be made).

Dihedral in an airplane: The angle included at the intersection of the imaginary surfaces containing the chords of the right and left wings (continued to the plane of symmetry if necessary). This angle is measused in a plane perpendicular to that intersection. The dihedral of the upper wing may and frequently does differ from that of the lower wing in a biplane.

Dirigible: A form of balloon, the outer envelope of which is of elongated form, provided with a propelling system, car, rudders and stabilizing surfaces.

Nonrigid—A dirigible whose form is maintained by the pressure of the contained gas assisted by the car-suspension system.

Rigid—A dirigible whose form is maintained by a rigid structure contained within the envelope.

Semirigid—A dirigible whose form is maintained by means of its attachment to an exterior girder construction containing the car.

Disk area of a propeller: The total area of the disk swept by the propeller tips.

Diving rudder: See Elevator.

Dope: A general term applied to the materials used in treating the cloth surface of airplane members to increase strength, produce tautness and act as a filler to maintain air-tightness; usually of the cellulose type.

Drag: The total resistance to motion through the air of an aircraft—that is, the sum of the drift and head resistance.

Drift: The component of the resultant wind pressure and an aërofoil or wing surface parallel to the air stream attacking the surface.

Elevator: A hinged surface for controlling the longitudinal attitude of an aircraft—that is, its rotation about the athwartship axis.

Engine, right or left hand: The distinction between a right-hand and a left-hand engine depends on the rotation of the output shaft, whether this shaft rotates in the same direction as the crank or not. A right-hand engine is one in which, when viewed from the output shaft, looking toward the output end, the shaft is seen to rotate clockwise.

Entering edge: The foremost part of an aërofoil.

Fins: Small planes on aircraft to promote stability; for example, vertical tail fins, horizontal tail fins, skid fins, etc.

Flight path: The path of the center of gravity of an aircraft with reference to the air.

Float: That portion of the landing gear of an aircraft which provides buoyancy when it is resting on the surface of the water.

Fuselage: See Body.

Gap: The distance between the projections on the vertical axis of the entering edges of an upper and lower wing of a biplane.

Glide: To fly without power.

Glider: A form of aircraft similar to an airplane, but without any power plant. When utilized in variable wind it makes use of the soaring principles of flight and is sometimes called a "soaring machine."

Gliding angle: See Angle, Gliding.

Guy: A rope, chain, wire or rod attached to an object to guide or steady it, such as guys to wing, tail or landing gear.

Head resistance: The total resistance to motion through the air of all parts of an aircraft not a part of the main lifting surface. Sometimes termed "parasite resistance."

Helicopter: A form of aircraft whose support in the air is derived from the vertical thrust of propellers.

Inclinometer: An instrument for measuring the angle made by any axis of an aircraft with the horizontal.

Keel plane area: The total effective area of an aircraft which acts to prevent skidding or side slipping.

Kite: A form of aircraft without other propelling means than the towline pull, whose support is derived from the force of the wind moving past its surface.

Kite balloon: See Balloon, Kite.

Landing gear: The understructure of an aircraft designed to carry the load when resting on, or running on, the surface of the land or water.

Lateral stability: See Stability, Lateral.

Leading edge: See Entering edge.

Leeway: The angular deviation from a course over the earth, due to cross-currents of wind.

Lift: The component of the force due to the air pressure of an aërofoil, resolved perpendicular to the flight path in a vertical plane.

Lift bracing: See Stay.

Lifting capacity: See Capacity, Lifting.

Load, full: See Capacity, Lifting.
  Reserve (or useful)—See Capacity, Carrying.

Loading: See Wing loading.

Longitudinal: A fore and aft member of the framing of an airplane body, or of the floats, usually continuous across a number of points of support.

Longitudinal stability: See Stability, Longitudinal.

Metacenter: The point of intersection of a vertical line through the center of gravity of the fluid displaced by a floating body when it is tipped through a small angle from its position of equilibrium and the inclined line which was vertical through the center of gravity of the body when in equilibrium. There is, in general, a different metacenter for each type of displacement of the floating body.

Monoplane: A form of airplane whose main supporting surface is disposed as a single wing on each side of the body.

Motor: See Engine.

Nacelle: See Body.

Natural stability: See Stability.

Nose dive: A dangerously steep descent, head-on.

Ornithopter: A form of aircraft deriving its support and propelling force from flapping wings.

Pitot tube: A tube with an end open square to the fluid stream, used as a detector of an impact pressure. More usually associated with a concentric tube surrounding it having perforations normal to the axis for indicating static pressure. The velocity of the fluid can be determined from the difference between the impact pressure and the static pressure. This instrument is often used to determine the velocity through the air.

Propeller:
  Developed area of—See Developed area of a propeller.
  Disk area of—See Disk area of a propeller.
  Right-hand—One in which the helix is right-handed.

Pusher: See Airplane.

Pylon: A marker of a course.

Race of a propeller: The air stream delivered by the propeller.

Rib: See Wing.

Right (or left) hand:
  Engine—See Engine.
  Propeller—See Propeller, Right-hand.

Rigid dirigible: See Dirigible, Rigid.

Rudder: A hinged or pivoted surface, usually more or less flat or streamlined, used for the purpose of controlling the attitude of an aircraft about its vertical axis when in motion.

Seaplane: A particular form of airplane in which the landing gear is suited to operation from the water.

Side slipping: Sliding toward the center of a turn. It is due to excessive amount of bank for the turn being made, and is the opposite of skidding.

Skidding: Sliding sidewise in flight away from the center of the turn. It is usually caused by insufficient banking in a turn, and is the opposite of side slipping.

Skids: Long wooden or metal runners designed to prevent nosing of a land machine when landing or to prevent dropping into holes or ditches in rough ground. Generally designed to function should the wheels collapse or fail to act.

Slip: This term applies to propeller action and is the difference between the actual velocity of advance of an aircraft and the speed calculated from the known pitch of the propeller and its number of revolutions.

Soaring machine: See Glider.

Spread: The maximum distance laterally from tip to tip of an airplane wing.

Stability: The quality of an aircraft in flight which causes it to return to a condition of equilibrium when meeting a disturbance. (This is sometimes called "dynamical stability.")

Directional—Stability with reference to the vertical axis.

Inherent—Stability of an aircraft due to the disposition and arrangement of its fixed parts.

Lateral—Stability with reference to the longitudinal (or fore and aft) axis.

Longitudinal—Stability with reference to the lateral (or athwartship) axis.

Stabilizer: See Fins.

Mechanical—Any automatic device designed to secure stability in flight.

Stagger: The amount of advance of the entering edge of the upper wing of a biplane over that of the lower; it is considered positive when the upper surface is forward.

Stalling: A term describing the condition of an airplane which from any cause has lost relative speed necessary for steerageway and control.

Statoscope: An instrument to detect the existence of a small rate of ascent or descent, principally used in ballooning.

Stay: A wire, rope, or the like, used as a tie-piece to hold parts together or to contribute stiffness; for example, the stays of the wing and body trussing.

Step: A break in the form of the bottom of a float.

Streamline flow: A term in hydromechanics to describe the condition of continuous flow of a fluid, as distinguished from eddying flow where discontinuity takes place.

Streamline shape: A shape intended to avoid eddying or discontinuity and to preserve streamlike flow, thus keeping resistance to progress at a minimum.

Strut: A compression member of a truss frame; for instance, the vertical members of the wing truss of a biplane.

Sweep back: The horizontal angle between the lateral (athwartship) axis of an airplane and the entering edge of the main planes.

Tail: The rear portion of an aircraft, to which are usually attached rudders, elevators and fins.

Tail fins: The vertical and horizontal surfaces attached to the tail, used for stabilizing.

Thrust deduction: Due to the influence of the propellers, there is a reduction of pressure under the stern of the vessel which appreciably reduces the total propulsive effect of the propeller. This reduction is termed "thrust deduction."

Tractor: See Airplane.

Trailing edge: The rearmost portion of an aërofoil.

Triplane: A form of airplane whose main supporting surfaces are divided into three parts, superposed.

Truss: The framing by which the wing loads are transmitted to the body, comprises struts, stays and spars.

Velometer: See Air-speed meter and Anemometer.

Vol-piqué: See Nose dive.

Vol-plane: See Glide.

Wake gain: Due to the influence of skin friction, eddying, etc., a vessel in moving forward produces a certain forward movement of the fluid surrounding it. The effect of this is to reduce the effective resistance of the hull, and this effect, due to the forward movement of the wake, is termed the "wake gain." In addition to this effect the forward movement of this body of fluid reduces the actual advance of the propeller through the surrounding medium, thereby reducing the propeller horsepower.

Warp: To change the form of the wing by twisting it, usually by changing the inclination of the rear spar relative to the front spar.

Wings: The main supporting surfaces of an airplane.

Wing loading: The weight carried per unit area of supporting surface.

Wing rib: A fore-and-aft member of the wing structure used to support the covering and to give the wing section its form.

Wing spar: An athwartship member of the wing structure resisting tension and compression.

Yaw: To swing off the course about the vertical axis, owing to gusts or lack of directional stability.

Angle of—The temporary angular deviation of the fore-and-aft axis from the course.

American Electrochemical Society To Meet in Pittsburgh

The thirty-second general meeting of the American Electrochemical Society will be held in Pittsburgh, Oct. 3 to 6. A special feature of the meeting will be a series of papers and discussions on electrochemical war supplies and the part the electrochemical industry will play in the present struggle.

The committee in charge is outlining an elaborate plan of technical sessions, visits to industrial plants and entertainment features. It invites the delegates to arrive in Pittsburgh on Wednesday, Oct. 2, so as to get together informally and enjoy some recreations that have been planned for them.

On Thursday, Oct. 3, will be held a regular meeting of the society in the morning, with optional excursions to industrial plants in the afternoon. In the evening an illustrated lecture on a semi-technical subject will be given.

On Friday, Oct. 4, a symposium on electrochemical war supplies will be held in the morning, followed by excursions to industrial plants in the afternoon. A subscription dinner will be held at the William Penn Hotel in the evening, with special entertainment features. The ladies are especially invited to be present at this function.

Saturday, Oct. 5, will be devoted to an all-day excursion on a special train, with complimentary luncheon, to several industrial plants in the Pittsburgh district.

Drill-Spindle Repair

By August Unser

While overhauling a multiple drill press recently, I found 16 spindles in good condition except for the location of the spindle drive gears, which varied from 0.005 in. to 0.0010 in., owing to play on the spindles. As it was up to me to find some means to correct them, I decided to knurl the spindle, which left me about 0.0015 in. stock for grinding, to suit the holes of the gears. The repair gave satisfactory results.

Press Tools for Typewriter Ratchets and Dials

BY FRANK A. STANLEY

SYNOPSIS—*Design and use of press tools for forming the serrations on the edges of ratchets, also a drilling jig for the same pieces. Piercing and graduating tools for an indicator dial are shown in detail.*

SEVERAL ratchets of the kind used on the platen of the Noiseless typewriter are shown in the foreground of Fig. 1. They are about 1½ in. in outside diameter by ⅜ in. thick, with a long hub on one side and a ¼-in. hole bored through. The hub fits over the spindle of the rubber platen. The blanks for these ratchets are made in the automatic screw machine. The form in which they come from the machine is seen at *A* and *B*, Fig. 1, where two ratchets are shown from opposite sides. These blanks are coated with copper. A second machining operation consists in forming the serrations around the edge with the press tools shown at *A* and *B*, at the left of the group of tools in Fig. 1. Then the serrations are shaved with the tools at *C* and *D*, at the right. These tools consist of a shallow shaving die and of a punch that is adapted to act also as a nest for the blank. The pilot on this punch has a slot cut crosswise of the body with a spring projecting at either side and serving to retain the work in place when slipped over the pilot. There is at one side of the punch a locating stop *E*, which enters one of the notches in the periphery of the blank, and thus serves as a locating stop to position the blank in alignment with the grooves in the punch shown at *C*.

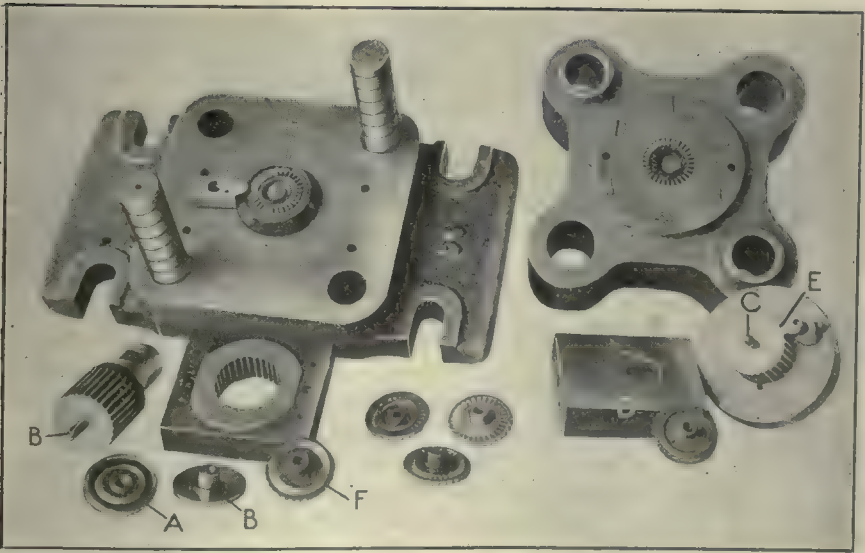


FIG. 1. PRESS TOOLS FOR NOISELESS TYPEWRITER PLATEN RATCHETS

The next operation consists in placing the blank in the handscrew machine, cutting the shallow groove around the outer face, as at *F*, to allow carbonization of the blank along this channel only. The copper surface protects the remainder of the work in the heating process.

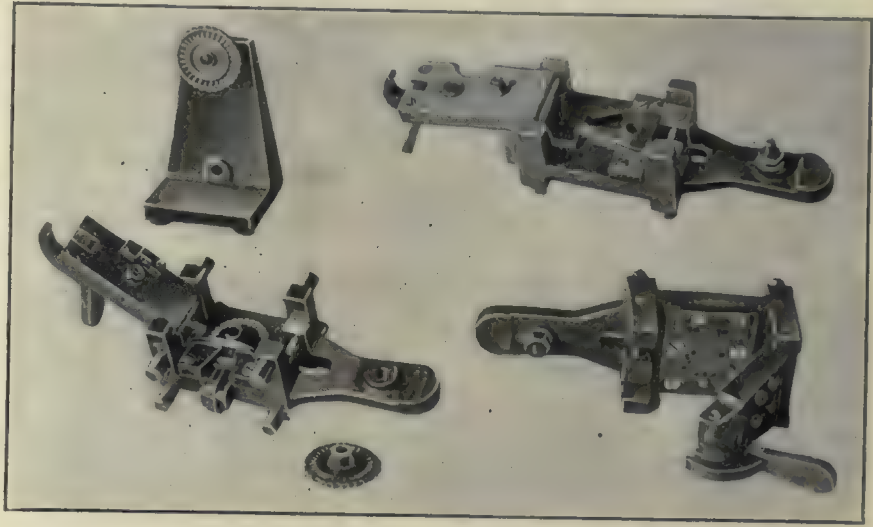
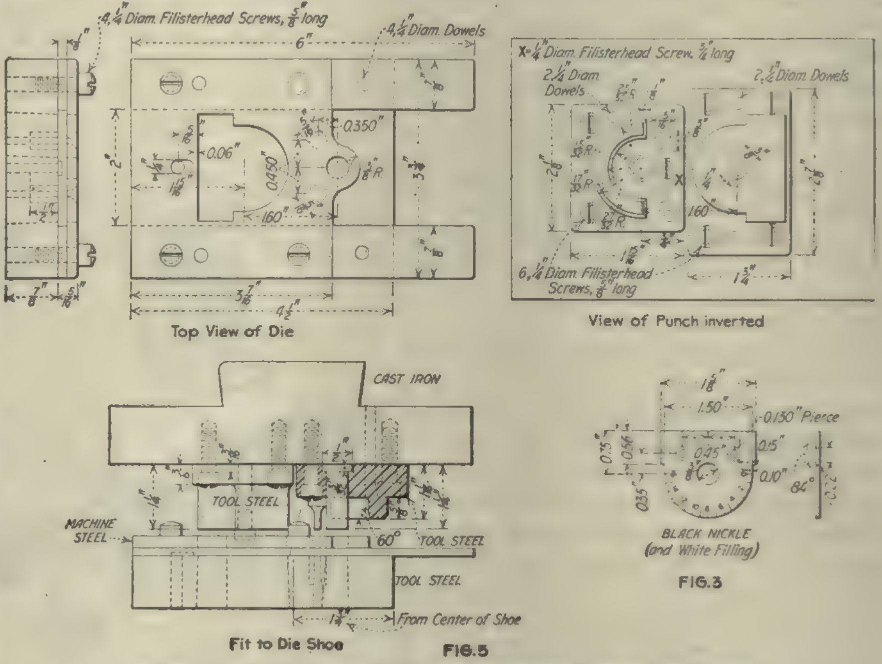


FIG. 2. DRILL AND REAMING JIGS

The next operation is performed in the press with the heavy punch and die at *G* and *H*. The lower die has at *I* a round-ended locating stop on which the blank is nested in position on this die and which locates the outer serrations correctly in relation to the die teeth below. This lower die also carries an ejector pin at the center for forcing the blank out of the die ring upon the upstroke of the press. The action of the upper die in its descent over the corner pillars is to force the ratchet-shaped teeth through the side of the groove in the blank at one stroke. The next operation is hardening the smooth surfaces, the outside serrations around the blank, the ratchet teeth outside, and inside wherever the bare metal is exposed by machining after copper-plating the piece. That is, wherever the blank is exposed by machining after coppering the piece, it hardens to prevent wear of the tooth edges. A taper hole has to be drilled crosswise of the hub to receive the taper pin. The lower jig at the left in Fig. 2 is used for this purpose. This is a snap jig with a spring plunger for locking the piece, an eccentric hook binding the handle for holding the leaf in position and a locating piece at the side to fit into one of the outside serrations. This jig is used from both sides, the hole being drilled from each way. One end of the hole is larger than the other to allow for taper-reaming. It will be noticed that one of the guide bushing holes for the drill is placed in the leaf of the jig, while the other is carried in a steel plate in the body of the jig. These two holes are of course both in line, so that the reamer will have as little work as possible to do after the drills have both been passed through their respective sides of the wall of the hub of the ratchet wheel.

For taper-reaming the work the piece is placed on the fixture shown at the top in Fig. 2. It fits freely over a stud placed crosswise of the fixture upright, this piece allowing the work to float when the reamer is run in under the sensitive drilling spindle. The fixture is merely a handy post for hanging the ratchet under the drill spindle. The floating action permits the ratchet wheel to assume readily a position in a line with the reamer. There is no tendency to cramp the latter. The hole is made true to the size of the reamer without enlargement or without elongation in either direction, as might be the case were the piece held fast and slightly out of alignment with the drill spindle. The jig at the right in Fig. 2, while not used in the form shown for this ratchet-wheel job, is in general design identical with the ratchet jig. It is therefore included in the view in order to show more clearly the construction of the leaf and the method of locking the latter tight against the base with the hooked eccentric handle. The upper jig in the same view is of similar construction, but has a pair of V-blocks in the base to locate a small crank member from the hubs at either end. The illustration also shows clearly the method of bringing the lid down against the fixed stop in the handle of the jig, and the hook designed to act as a binder.



FIGS. 3 AND 5. DETAILS OF THE DIAL AND ITS DIE
Fig. 3—Pressure indicator dial. Fig. 5—Marking, piercing and blanking die

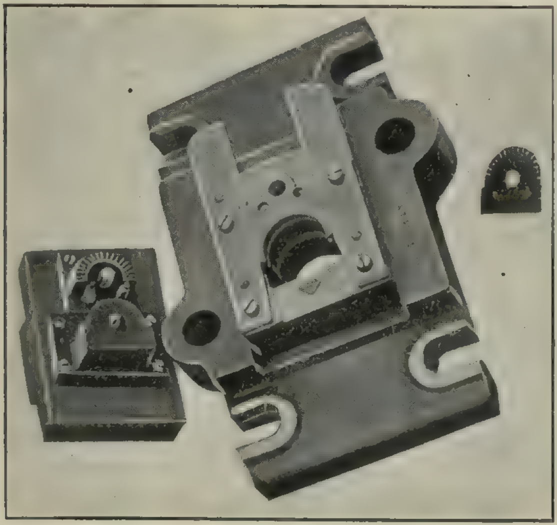


FIG. 4. PRESS TOOLS FOR INDICATOR BLANK

The small crank shown in the jig at the upper right-hand corner, Fig. 2, is used for adjusting the typewriter carriage in relation to the type, to allow for one or more thickness of paper, according to the character of the work being done on the typewriter. In the movement of this crank, it passes over the face of an indicator dial at the front of the machine. This dial is graduated in the manner indicated in Fig. 3, the numbers running from 0 to 16. There is a $\frac{3}{8}$-in. hole in the center of this plate, which passes over the neck of the adjusting screw. This plate is pierced and blanked with the tools shown in Figs. 4 and 5.

As will be seen upon examination of the illustrations, these press tools are of tandem character; that is, the three holes are pierced in the stock before the blanking is done. At the same stroke that puts the three holes in, the graduations and the numerals are struck into the face of the stock. The next advance of the strip of metal feeds the work against stop pins at the left-hand side of the die. The following downstroke of the press and blanking tools cuts the work out to the outline shown. The lower face of the blanking punch will be seen provided with a conical-pointed pilot pin that enters the $\frac{3}{8}$ hole already pierced in the work.

The small piercing punches for the two screw holes are made of $\frac{5}{16}$-in. drill rod turned down to the required size for the screws. The stripper plate is countersunk deeply around the opening for these small punches in order that the neck of the punches may pass down well into the plate and give suitable support to the ends of the small punches themselves. Owing to this liberal opening in the stripper, the punches are made with a sweeping fillet instead of being brought to anything like a sharp corner. Thus they are much more substantial in operation than is often the case where a liberal fillet of this kind is not permissible.

The plan view at the upper right-hand corner in Fig. 5, showing the base of the embossing and piercing punch as well as the blanking punch, illustrates clearly the method of attaching both punch blocks to their cast-iron carrying block. Three screws are used in the case of the graduating die, along with a pair of dowels, while four screws are applied to the holding of the blanking punch itself.

United States Munitions*

The Springfield Model 1903 Service Rifle

Operations on the Hand Guard—II

SYNOPSIS—*This article continues the description of the hand guard for the Springfield rifle, as manufactured at the Government arsenal. Some of the processes closely resemble those on the stock and, in consequence, are not so detailed.*

A MODIFIED Blanchard lathe, Figs. 2118 and 2119, is used to turn for the bands, and a similar lathe, Fig. 2085, is used to turn between the bands. The work is turned or fed by hand, by means of the large handwheel shown. The rate of feed depends on the hardness and grain of the wood.

The hand guard is cut to finish length in the duplex saw, Figs. 2086 and 2129. The piece is held down over a locating form by means of a hand lever and spring clamping piece, and then the work is fed to the saws by a lever in front, which operates the sliding carriage. Clearance for the windage screw is cut as shown in Fig. 2087, with the tool in Fig. 2136.

Again a modified Blanchard type of lathe is used to finish-turn the hand guard from the lower band to the sight base. Two pieces are placed on the mandrel and clamped by cupped collars at each end. A spring clamp is slipped over the pieces on the part not turned to prevent spring or chatter.

Following this, the field view is cut in a special wood shaper, Fig. 2141. The sanding and finishing operation is very similar to that on the stock previously described, as the workman first shaves the wood to the edges of a templet, Fig. 2144, and then scrapes and sands to a finish. After the finish-scraping, the work is dipped in boiled linseed oil, drained and dried in the air overnight.

Clips are small formed spring-steel pieces that contact with the barrel. The seats for the ends of these clips are cut in the machine shown in Fig. 2147, using the workholder, Fig. 2148. Next, the clips are slipped into place by hand and then, together with the butt end of the guard, are coated with cosmoline put on with a brush.

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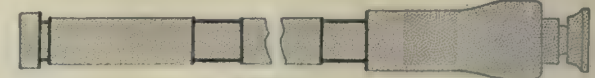


FIG. 2117

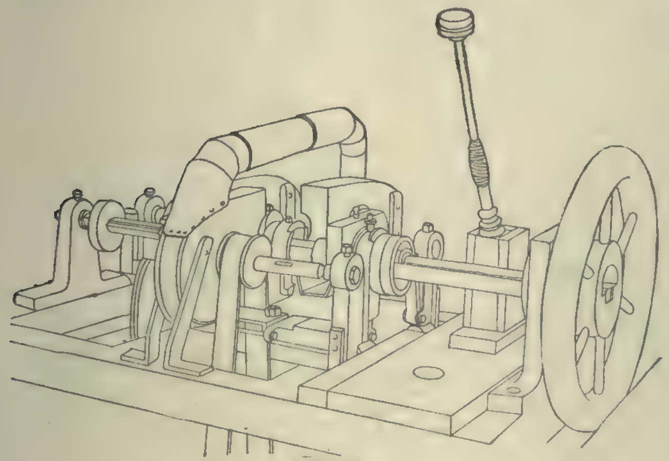
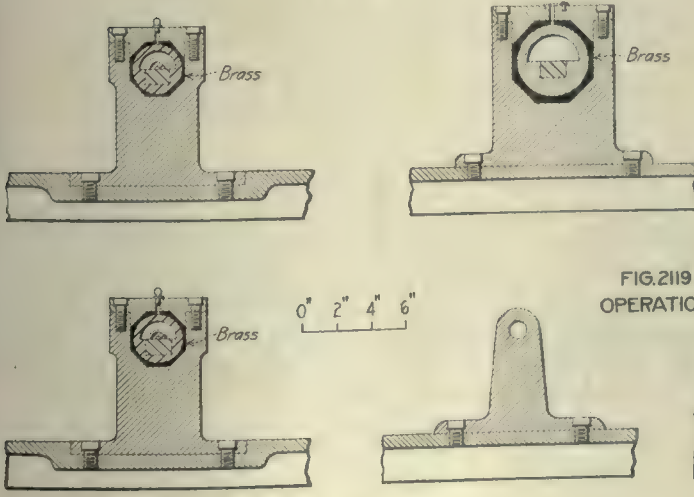


FIG. 2118



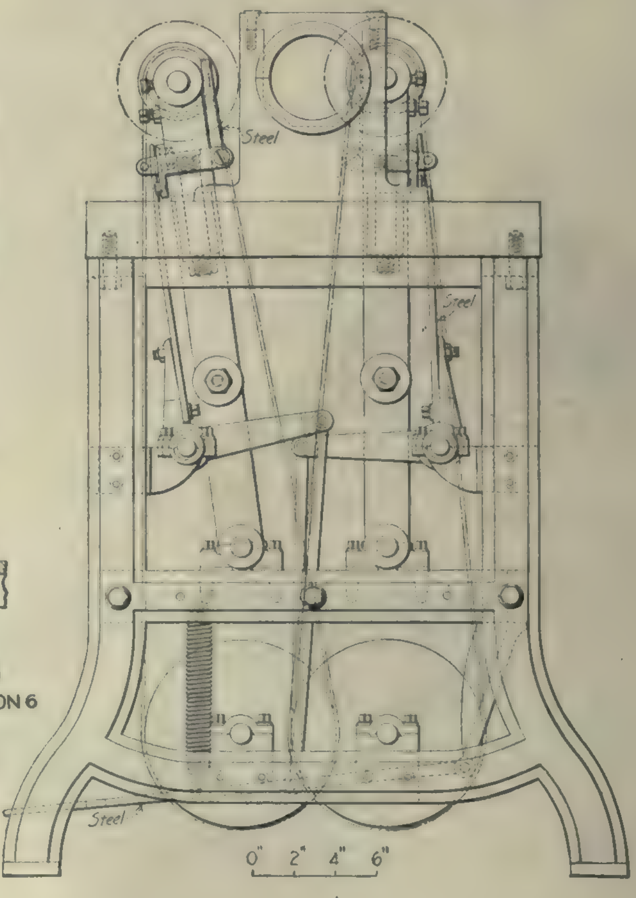


FIG. 2119
OPERATION 6

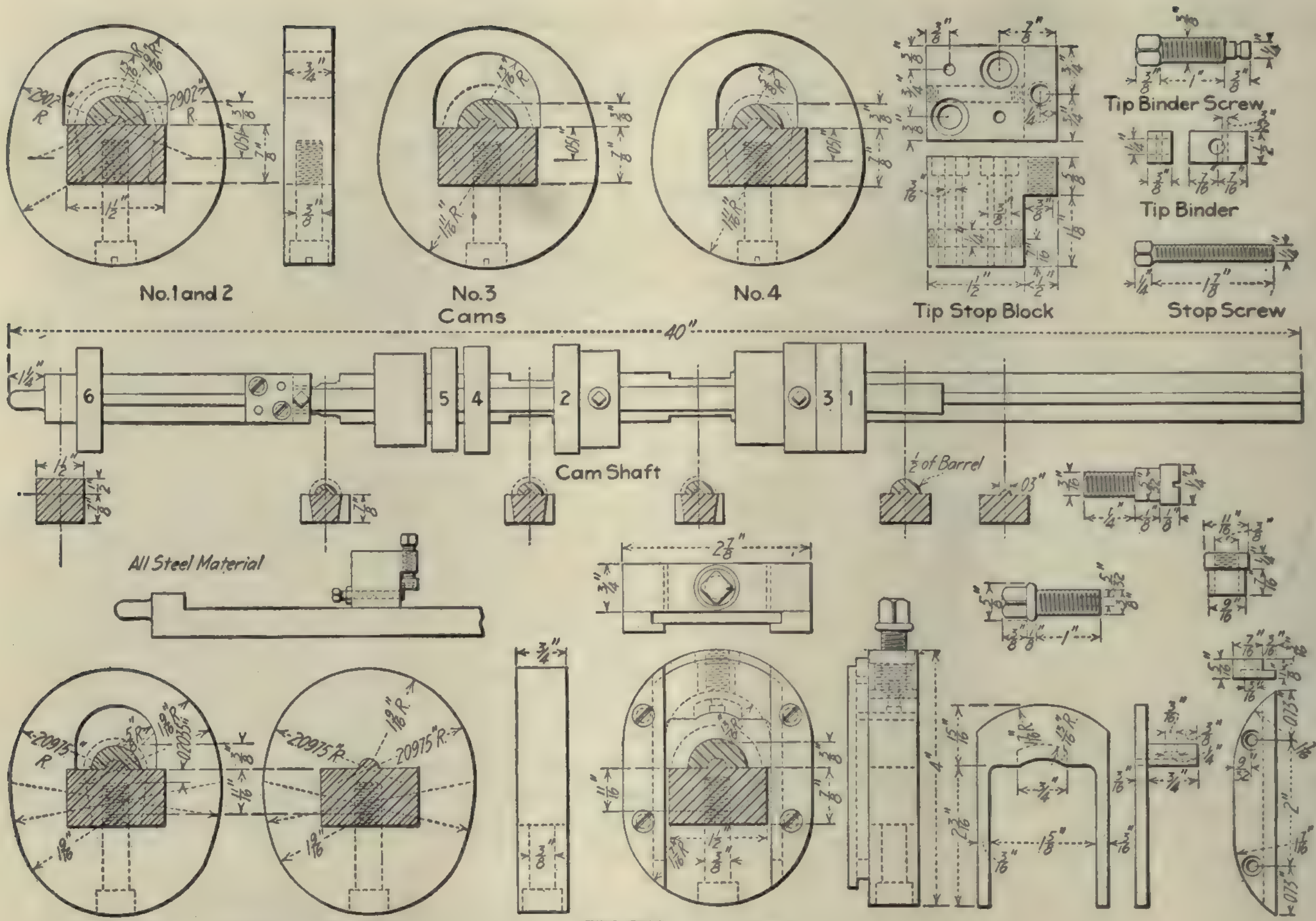


FIG. 2119
OPERATION 6

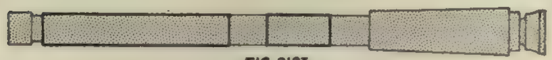


FIG. 2123

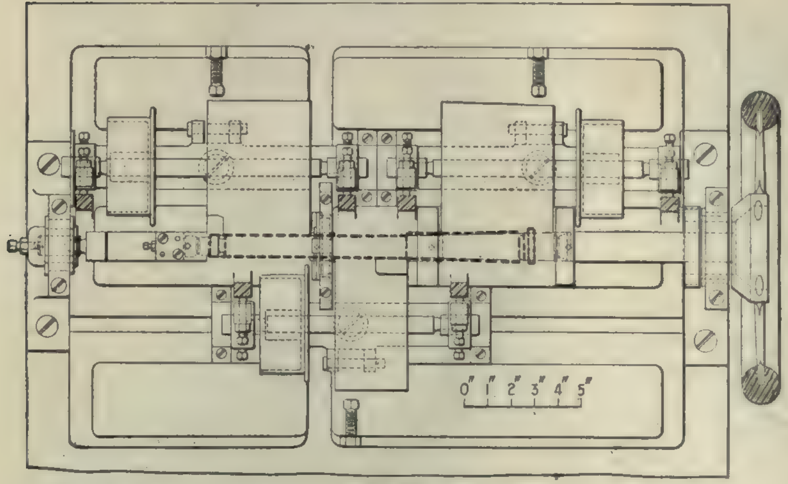


FIG. 2124

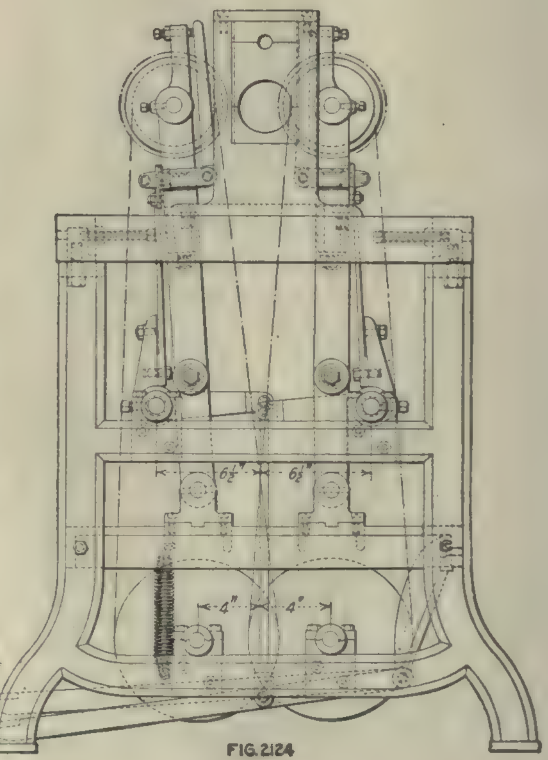


FIG. 2124

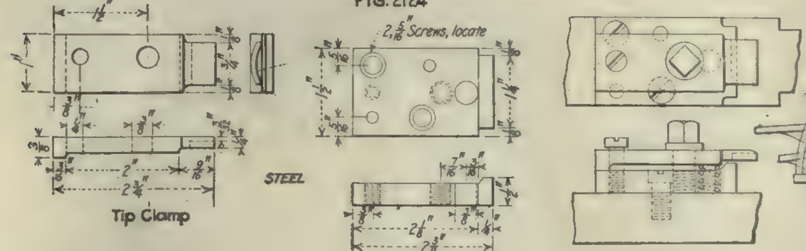


FIG. 2125
OPERATION 7

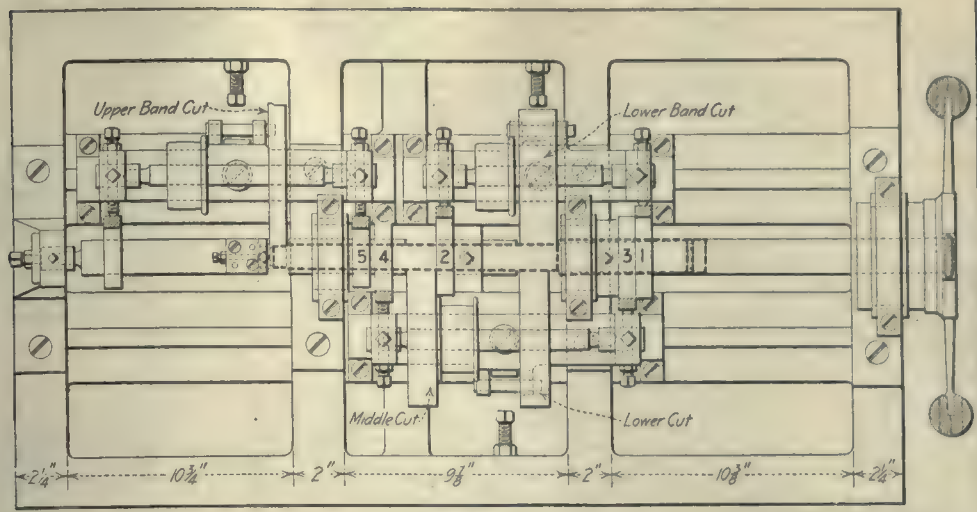


FIG. 2119

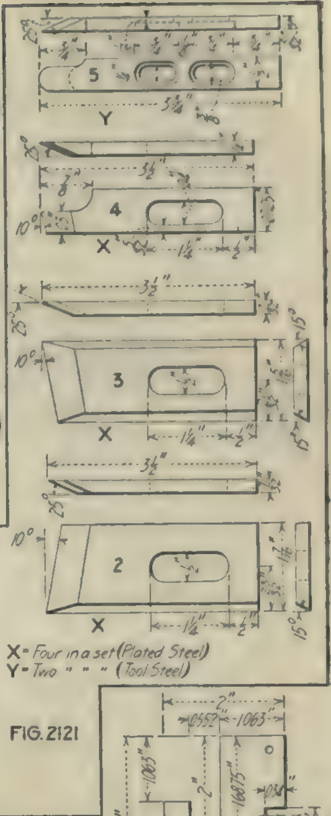


FIG. 2121

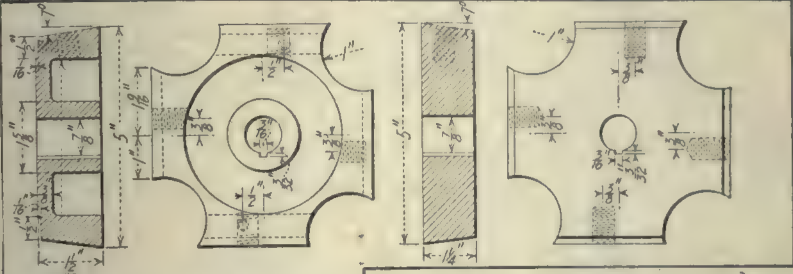
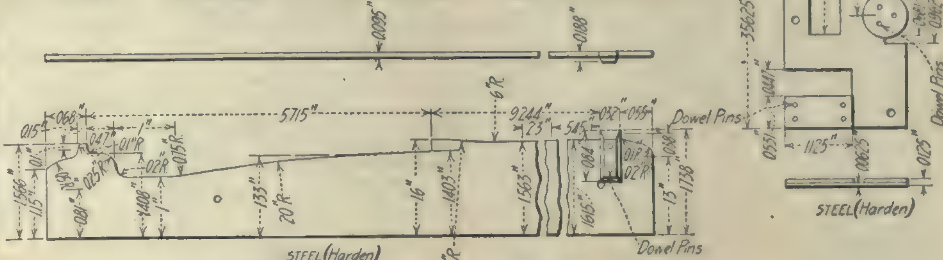


FIG. 2120



OPERATION 6

FIG. 2122

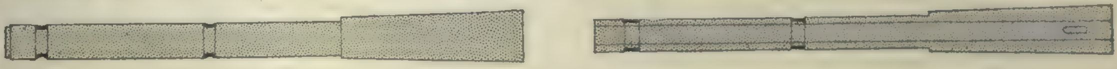


FIG. 2128

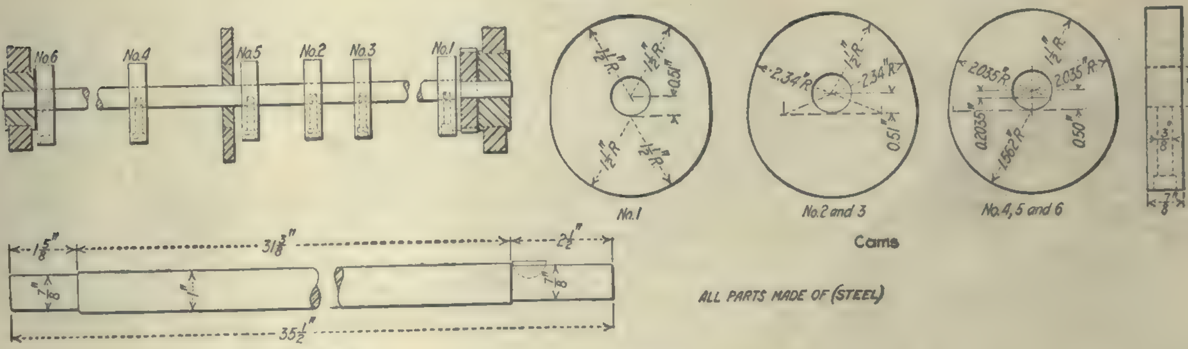


FIG. 2124

OPERATION 6. TURNING FOR BANDS

Transformation—Fig. 2117. Machine Used—Special cam lathe, Figs. 2118 and 2119. Number of Operators per Machine—One. Tool-Holding Devices—Tool heads, Fig. 2120. Cutting Tools—Fig. 2121. Gages—Fig. 2122. Production—880 per day.

OPERATION 7. TURNING BETWEEN BANDS

Transformation—Figs. 2123 and 2124. Machine Used—Special cam lathe, Fig. 2085. Number of Operators per Machine—One. Work-Holding Devices—Fig. 2125. Tool-Holding Devices—Cutter heads, Fig. 2126. Cutting Tools—Fig. 2127. Average Life of Tool Between Grindings—600 pieces. Production—880 per day. Note—Operator is careful not to turn below cuts for bands.

OPERATION 8. CUTTING TO FINISH LENGTH

Transformation—Fig. 2128. Machine Used—Special duplex saw, Figs. 2086 and 2129. Number of Operators per Machine—One. Tool-Holding Devices—Fig. 2130. Cutting Tools—Fig. 2131. Average Life of Tool Between Grindings—2000 pieces. Gages—Machine operator's gage, Fig. 2132; inspector's gage, Fig. 2133. Production—3850 per 8-hr. day.

OPERATION 9. CUTTING CLEARANCE FOR WINDAGE SCREW

Transformation—Fig. 2134. Machine Used—Special machine, Fig. 2087. Number of Operators per Machine—One. Work-Holding Devices—Fig. 2135. Cutting Tools—Fig. 2136. Average Life of Tool Between Grindings—2000 pieces. Gages—Fig. 2137. Production—4950 per 8-hr. day.

OPERATION 10. TURNING REAR END FROM LOWER BAND TO SIGHT BASE

Transformation—Fig. 2138. Machine Used—Blanchard type lathe, Fig. 2088. Number of Operators per Machine—One.

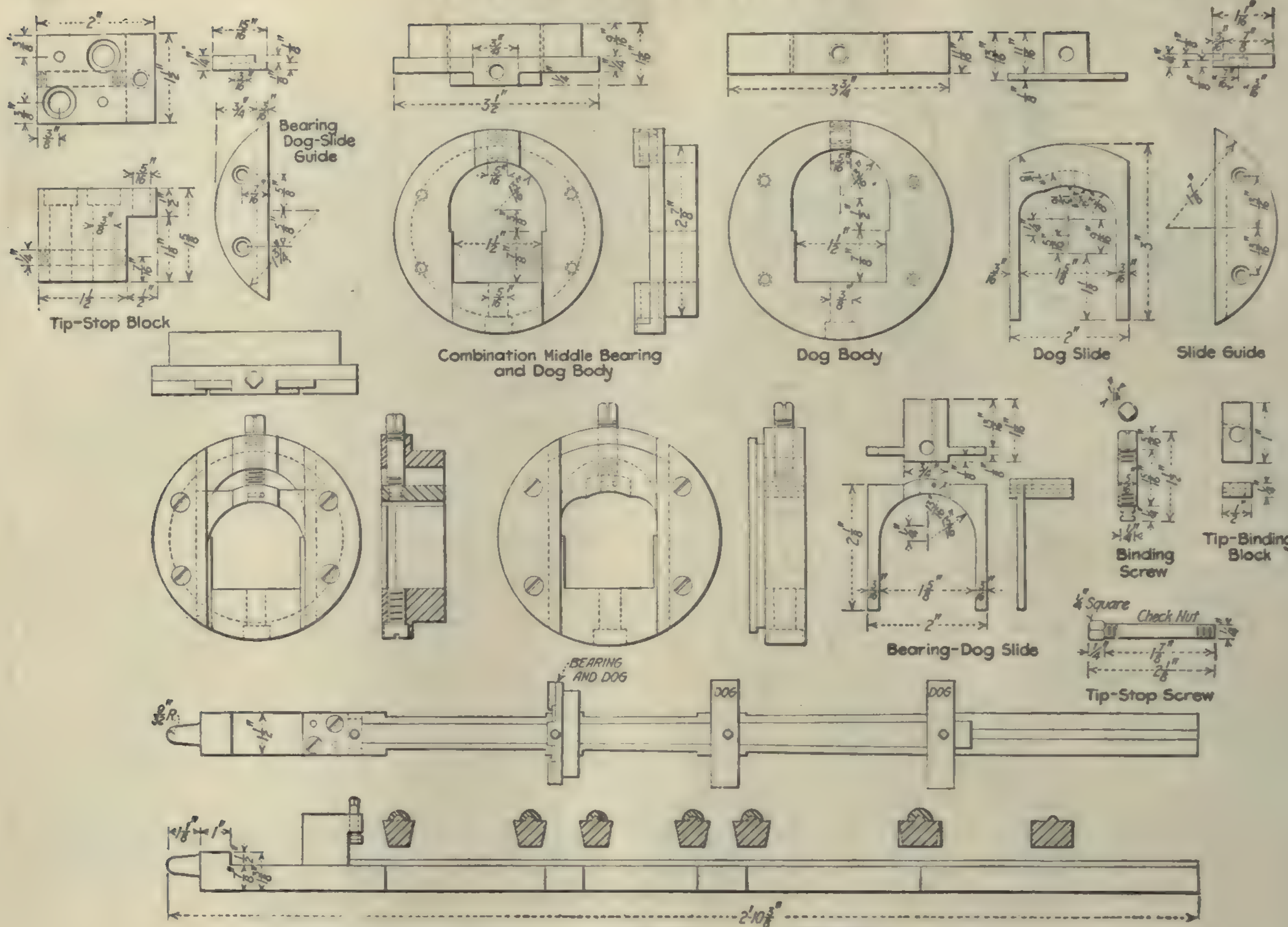


FIG. 2125 OPERATION 7

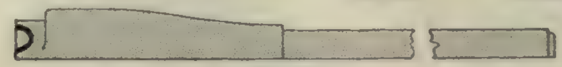
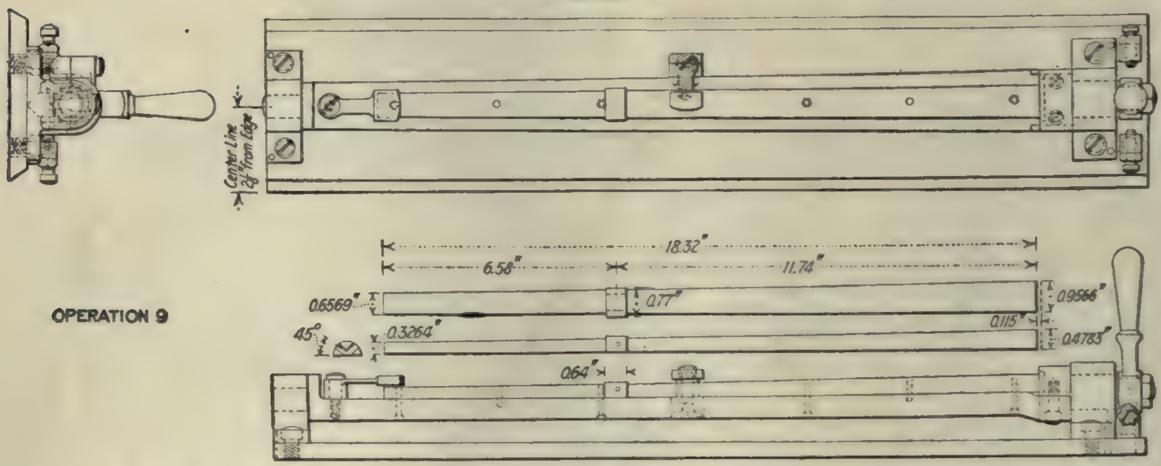


FIG. 2134



OPERATION 9

FIG. 2135

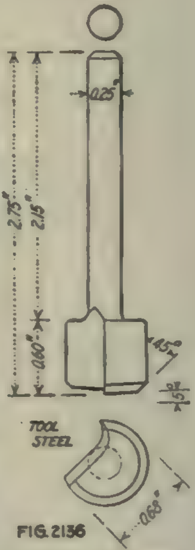


FIG. 2136

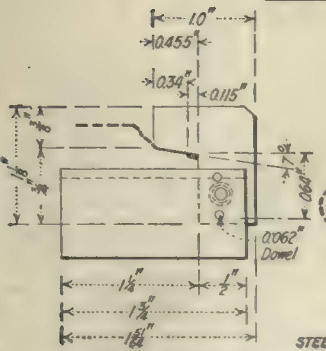


FIG. 2137 A

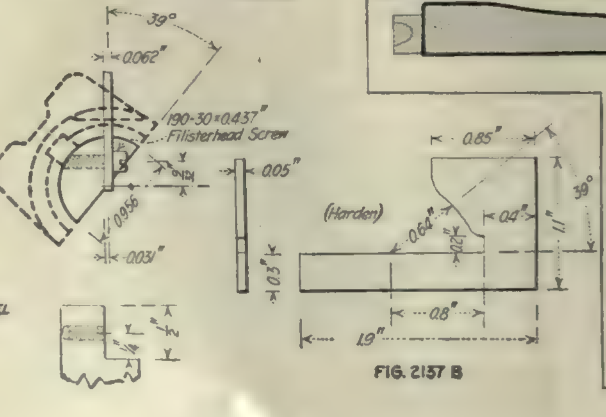


FIG. 2137 B

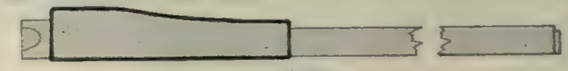


FIG. 2138

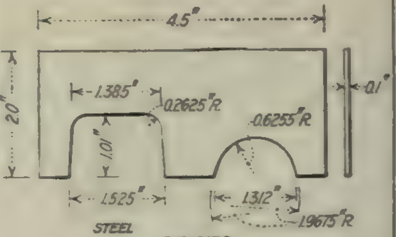
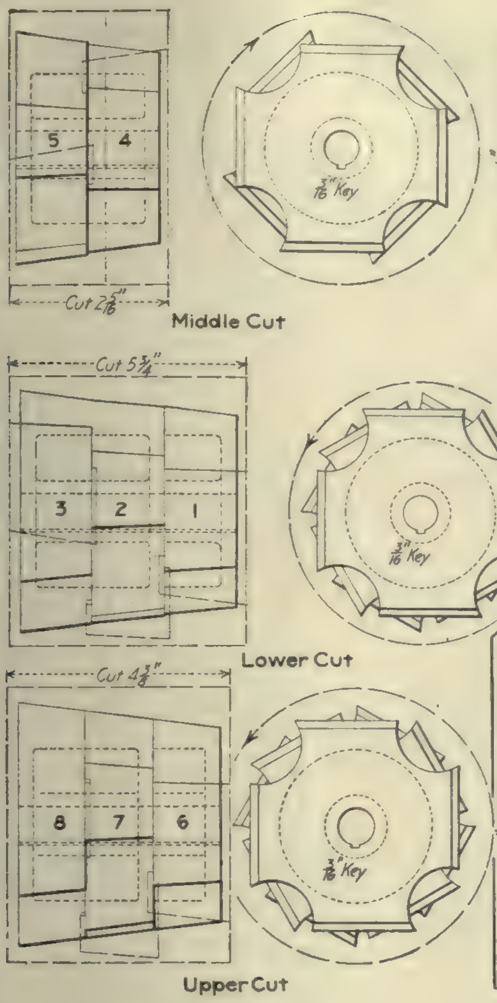


FIG. 2139 OPERATION 10

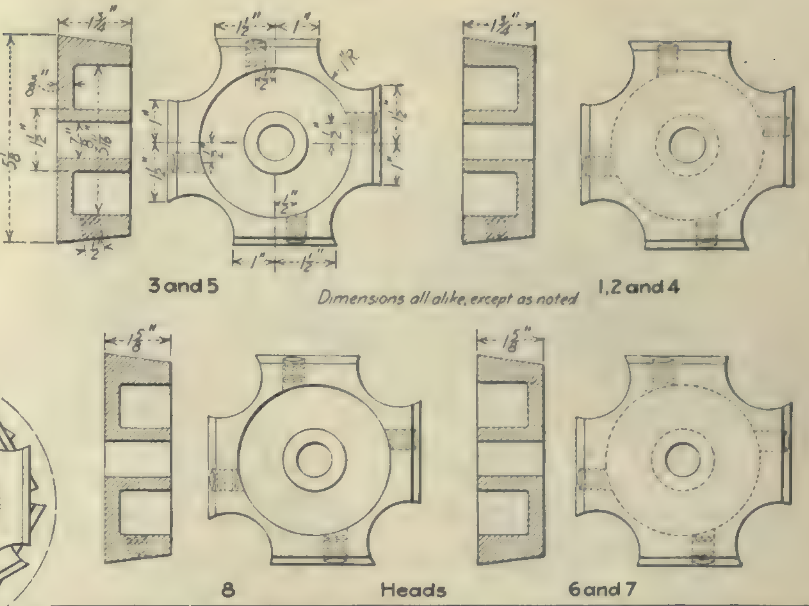


Middle Cut

Lower Cut

Upper Cut

FIG. 2126



3 and 5

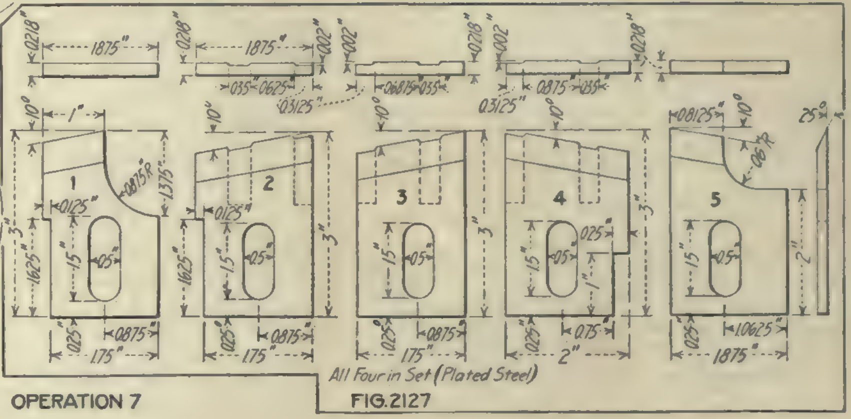
Dimensions all alike, except as noted

1, 2 and 4

8

Heads

6 and 7



OPERATION 7

FIG. 2127

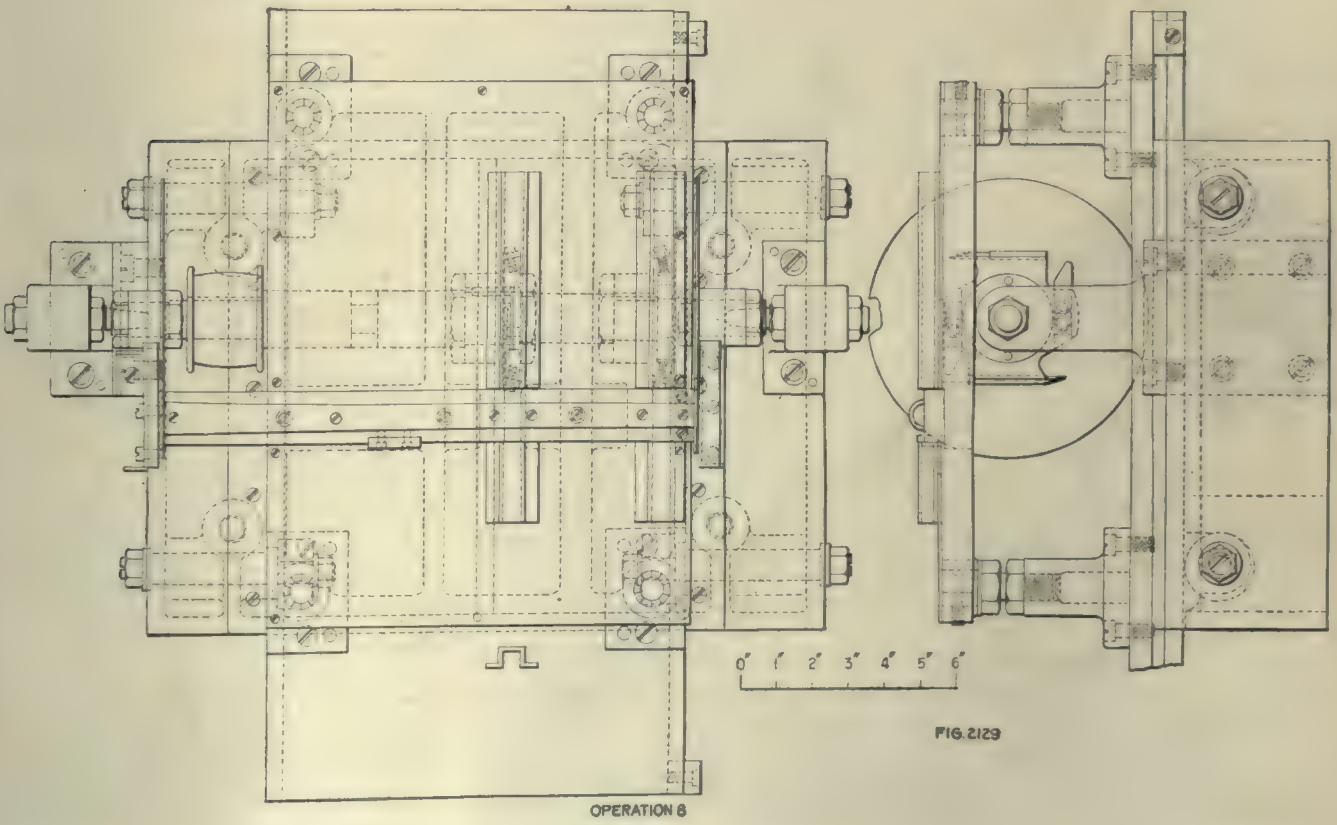
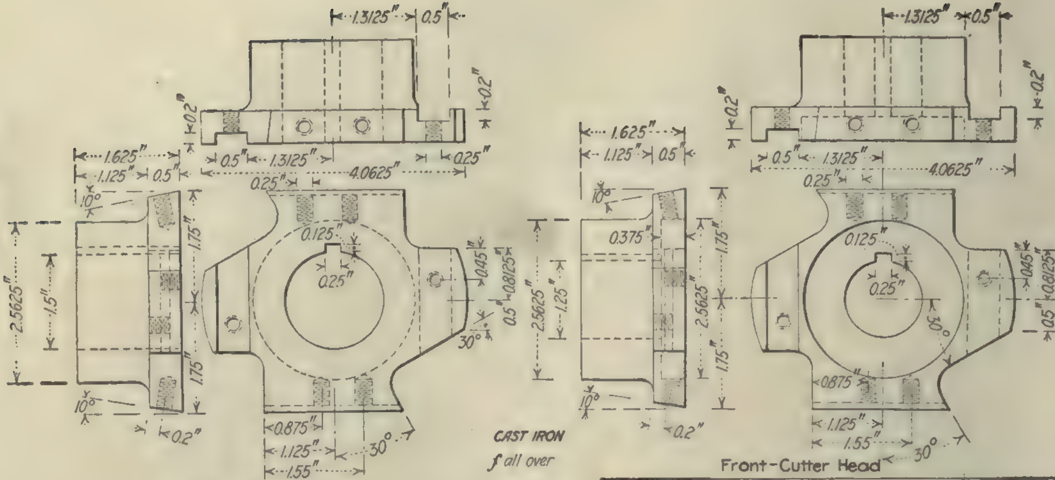


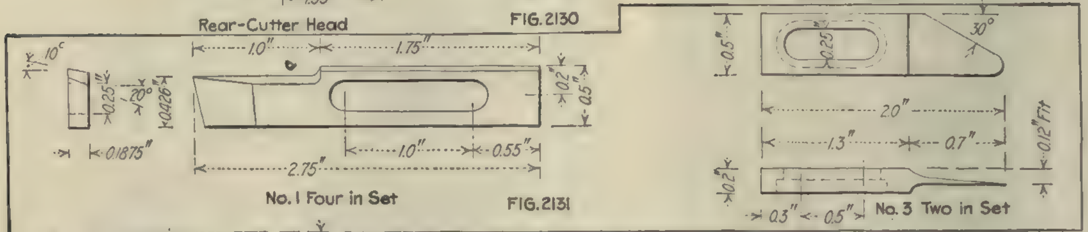
FIG. 2129

OPERATION 8



Rear-Cutter Head

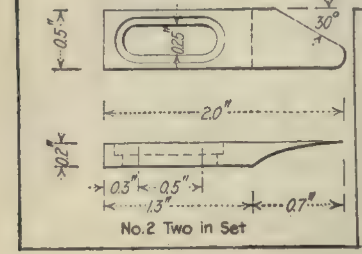
FIG. 2130



No. 1 Four in Set

FIG. 2131

No. 3 Two in Set



No. 2 Two in Set

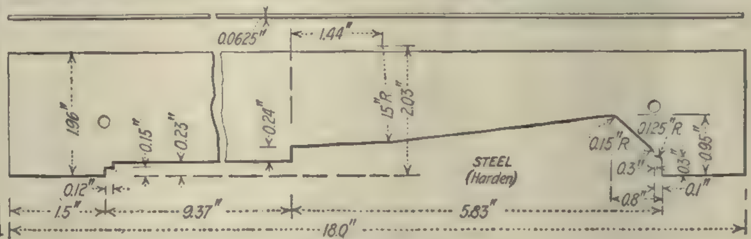


FIG. 2132

OPERATION 8

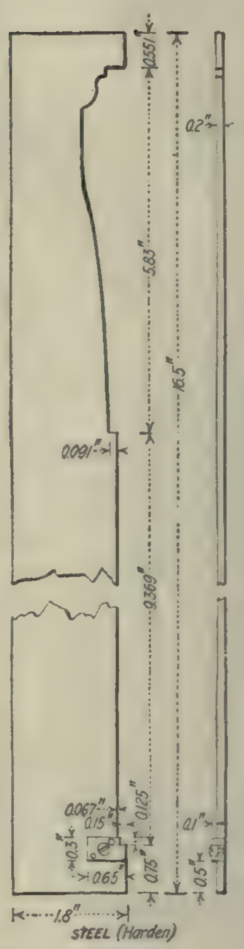


FIG. 2133

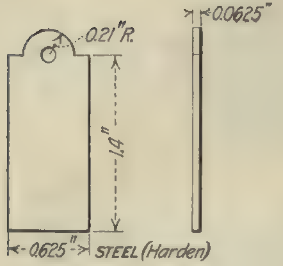
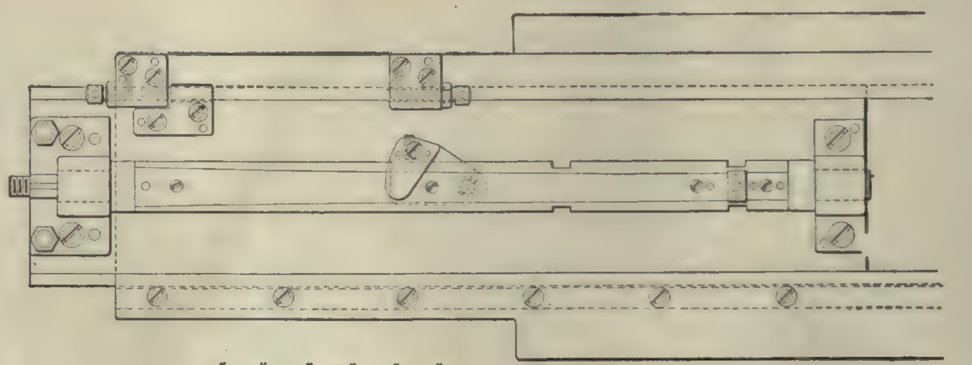


FIG. 2150



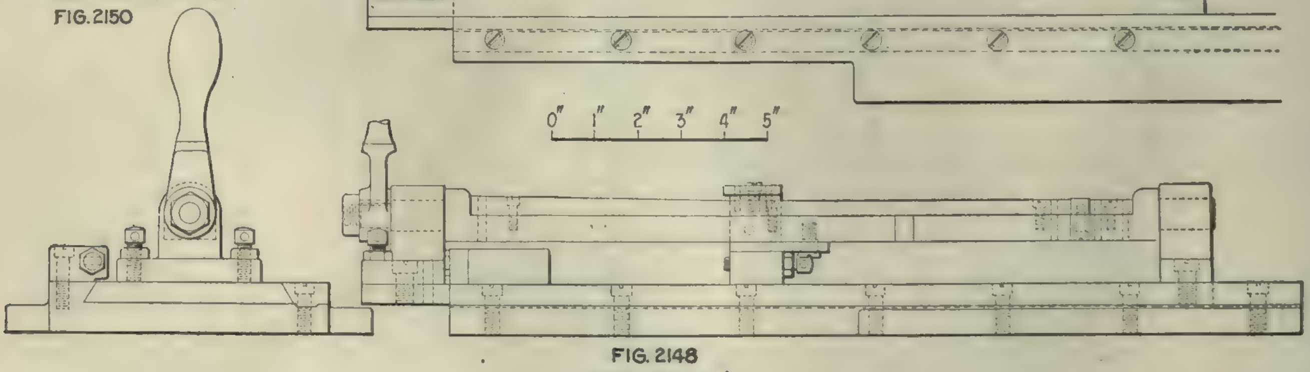


FIG. 2148

OPERATION 13½

Average Life of Tool Between Grindings—500 to 700 pieces. Gages—Fig. 2139. Production—1210 per 8-hr. day. Note—Two pieces are turned at once; clip shown on work is to prevent spring and chatter during cut.

OPERATION 11½. CUTTING FIELD VIEW

Transformation—Fig. 2140. Machine Used—Special wood shaper, Fig. 2141. Number of Operators per Machine—One. Cutting Tools—Fig. 2142. Average Life of Tool Between Grindings—1000 pieces. Gages—Fig. 2143. Production—3300 per 8-hr. day.

OPERATION 12. SANDING AND FINISHING

Number of Operators—One. Description of Operation—Operator holds work as shown in Fig. 2144 and shaves to edges of templet, then scrapes and sandpapers all over, using spoke shaver, scrapers and Nos. 1, 0, 00 and 000 sandpaper. Gages—Fig. 2145. Production—121 per 8-hr. day.

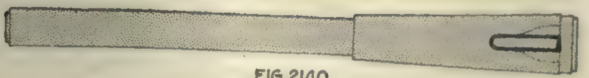


FIG. 2140

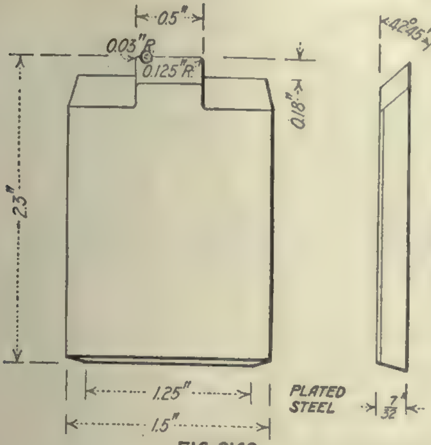


FIG. 2142

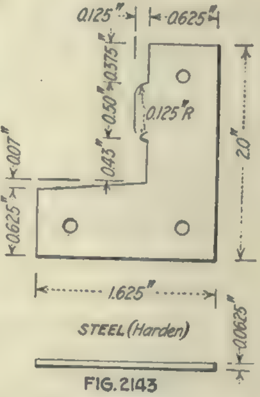


FIG. 2143

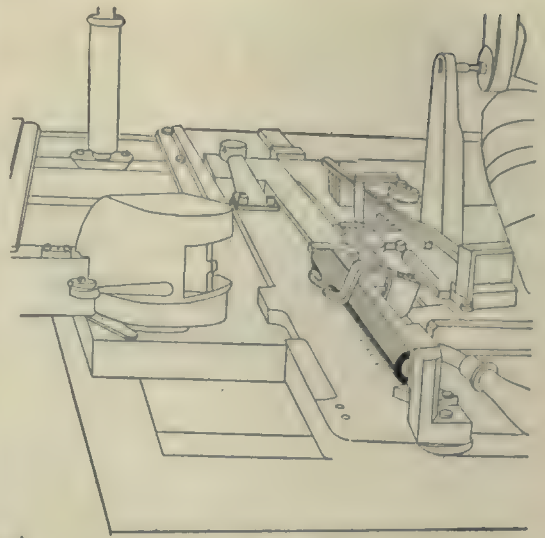


FIG. 2141

OPERATION 11½

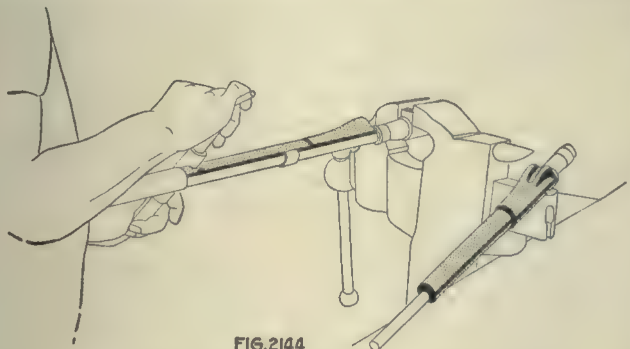
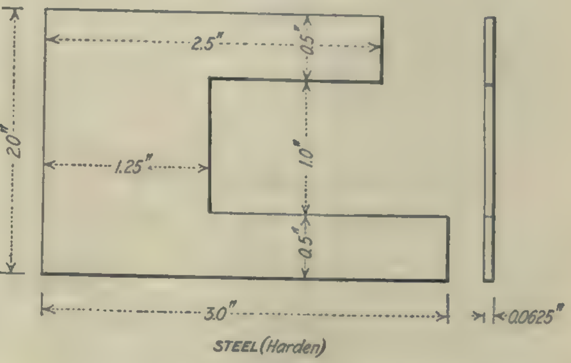


FIG. 2144



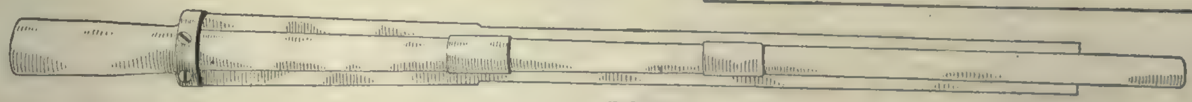


FIG. 2145

OPERATION 12

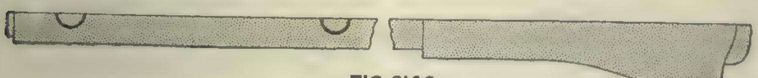


FIG. 2146

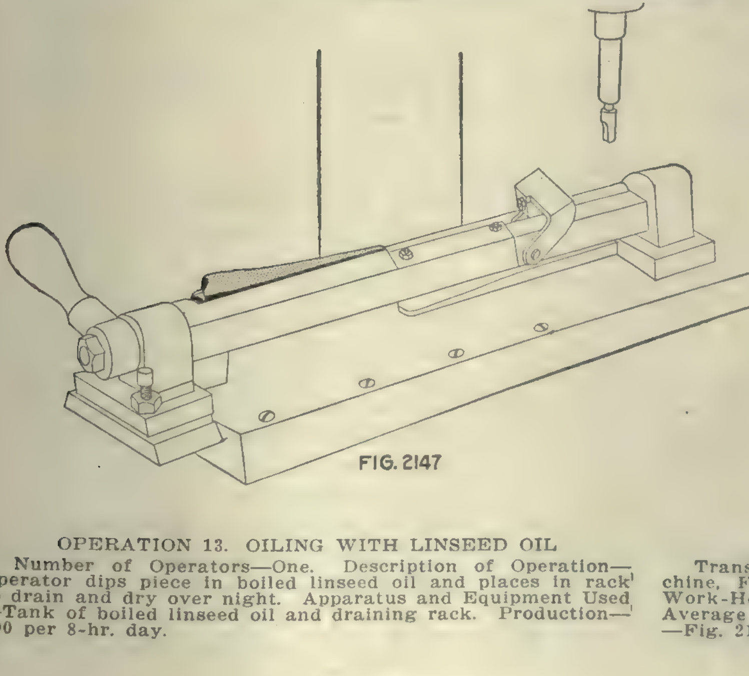


FIG. 2147

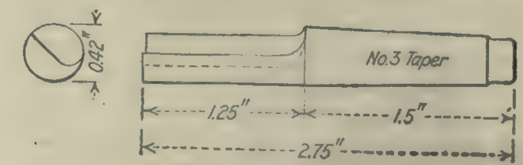


FIG. 2149

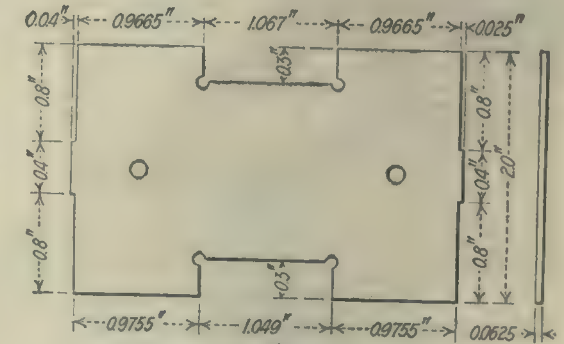


FIG. 2150

OPERATION 13. OILING WITH LINSEED OIL

Number of Operators—One. Description of Operation—Operator dips piece in boiled linseed oil and places in rack to drain and dry over night. Apparatus and Equipment Used—Tank of boiled linseed oil and draining rack. Production—990 per 8-hr. day.

OPERATION 13½. CUTTING FOR CLIPS

Transformation—Fig. 2146. Machine Used—Special machine, Fig. 2147. Number of Operators per Machine—One. Work-Holding Devices—Fig. 2148. Cutting Tools—Fig. 2149. Average Life of Tool Between Grindings—1000 pieces. Gages—Fig. 2150. Production—1232 per 8-hr. day.

OPERATION 13¾. ASSEMBLING CLIPS

Transformation—Fig. 2151. Number of Operators—One. Description of Operation—The clips are small pieces formed of sheet steel; they are slipped into place by hand, and fitted in when necessary. Production—1760 per 8-hr. day.

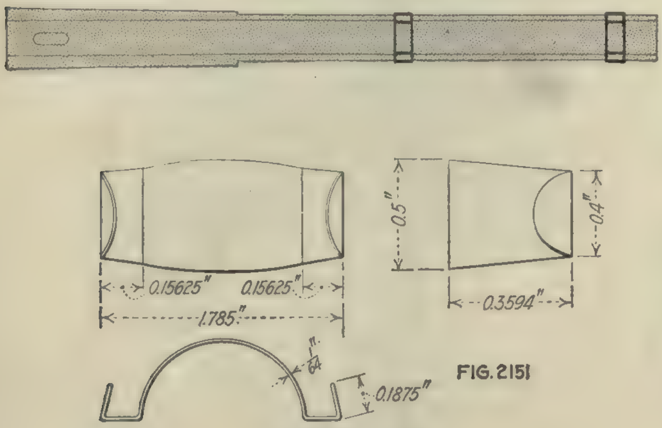


FIG. 2151

OPERATION 13¾

OPERATION 14. OILING WITH COSMOLINE

Number of Operators—One. Description of Operation—With a brush the operator coats with cosmoline the spots on the guard that touch the barrel; they are the butt end of the guard and each clip. Production—5280 per 8-hr. day.

Springfield Expositions and Export Conference

The first of an annual series of industrial expositions and export conferences was held at the Eastern States Exposition Grounds, Springfield, Mass., June 23 to 30. Thursday, June 28, was set apart as "Metal Trades Day" and the morning conference devoted to machinery and metal goods was presided over by Charles E. Hildreth, president Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., and general manager of the National Machine Tool Builders' Association.

The first paper, read by C. O. Smith, sales manager Norton Grinding Co., Worcester, was "After the War—What of Machinery Export?" "American Tools in Foreign Markets" was discussed by Oren O. Gallup, export manager Simonds Manufacturing Co., Fitchburg, Mass., and Adolph W. Gilbert, president Chapman Valve Manufacturing Co., Indian Orchard, Mass., had as his subject "Metal Fittings in Overseas Markets."

About 400 members of the National Metal Trades Association and representatives of employers' associations in New England attended the session.

Each day of the conference was set apart for specific industries, and many of the speakers at the various sessions were recognized leaders in their respective industries. Monday was "Paper Day"; Tuesday, "Textile and Financial Day"; Wednesday, "Leather and Rubber Goods Day"; Thursday, "Metals Day"; Friday, "Office Appliance Day"; and Saturday, "Chemical Day."

The chairman of the general committee of the conference was Frank H. Page, president of the National Equipment Co., Springfield, and a number of men well known in the steel and machinery field were on the Advisory Council, among them the following: Walter H. Fish, manager General Electric Co., Lynn, Mass.; Louis A. Collidge, treasurer United Shoe Machinery Corporation, Boston; E. M. Herr, president Westinghouse Electric and Manufacturing Co., New York; W. W. Nichols, Allis-Chalmers Manufacturing Co., New York; Maurice Coster, managing director Westinghouse Electric Export Co., New York; Charles M. Muchnic, vice president American Locomotive Sales Corporation, New York; A. L. Humphrey, president Westinghouse Air Brake Co., Pittsburgh; Winchester Bennett, president Winchester Repeating Arms Co., New Haven, Conn.; F. J. Kingsbury, Bridgeport Brass Co., Bridgeport, Conn.; and Charles Glover, Corbin Screw Corporation, New Britain, Connecticut.

New Freight-Handling System

Plans that will shortly be put into operation will effect a complete change in the methods of receiving, loading and forwarding less than carload freight, of all descriptions, upon all portions of the Pennsylvania R.R. lines east of Pittsburgh and make the most far-reaching improvement that has ever been attempted on a large scale in freight-transportation practices. The present custom of receiving less than carload freight indiscriminately at all stations at any time of the day, for all destinations, which has been followed since the early days of railroading, will be abolished. In its place there will be substituted a carefully devised plan whereby the acceptance and loading of freight in less than carload lots will be conducted according to a regularly established system, and such freight will be automatically concentrated into full loads at the point of shipment.

This plan will include the inauguration of shipping days—or substantially "sailing dates" on which cars will depart from various points of origin to specified destinations; freight will be accepted on the proper shipping days only, and the cars will "sail" as specified.

Particular stations will be designated at which freight will be exclusively received for specified destinations; freight for such points will be accepted at the stations named only.

This system is to eliminate the delay incident to the rehandling of freight under the present methods of consolidating small shipments into full carloads at transfer stations and will give the shipper quicker service than is possible under the old method. It will also conserve the car supply by effecting better average loading than is possible under the transfer system; this will increase the cars available for commercial freight, as well as Government supplies.

Dies for Piercing Single Radial Holes in Shells—A Correction

By Charles Doescher

I believe a correction should be made as regards my article on page 163, Vol. 46, for the reason that *D* shows a square bushing inserted in a die holder. This is a mistake for which I am not to blame, as the sketch which I sent in not only showed a solid die, but also contained the brief wording, "solid or one-piece die."

Inserting a square bushing in a die or die holder of this type, as shown in the illustration referred to, is diemaking practice for which I do not wish to be credited.

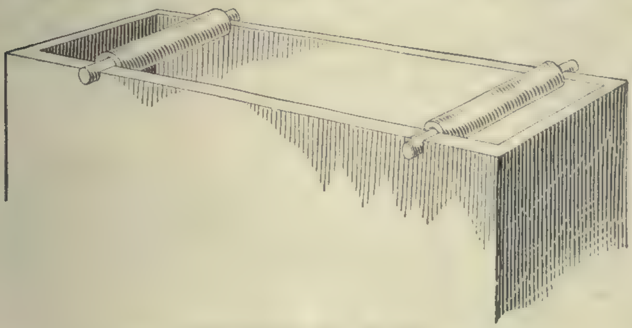
[The error noted is "on us." However, the essential part of this drawing is the "trapdoor" and not the die itself.—Editor.]

IDEAS FROM PRACTICAL MEN

Saving Trucking Cost in a Large Plant

By E. G. Bagger

The illustration shows a stand, fitted with two rollers, which is to be placed alongside each producing machine, sometimes one on each side of the workman. When the work comes to the machine the truck is backed up against this stand and the whole stack of full cases is pulled on top of the rollers, not lifted one by one. As the work is machined the workman places one case after another on top of the rollers on the other side of him. The finished work is removed in a similar manner. This saves handling each case twice.



THE ROLLER STAND

The rollers are simple to make, being of gas or water pipe with a bar of steel serving as a shaft. The stand, which should be about the same height as the truck, is equally simple to make.

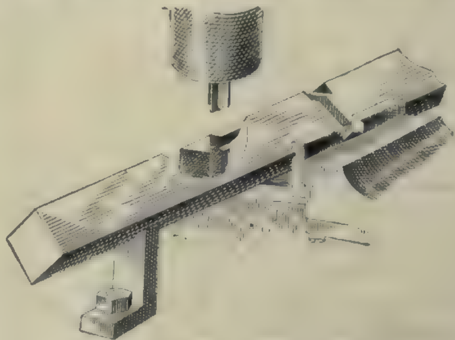
Gripping Square Stock by the Corners

By B. F. Clark

Mr. Holaday, on page 604, Vol. 46, shows a gage for setting square rods while milling off a section of one corner. In the hands of a skilled mechanic this gage will undoubtedly do the work in a fairly satisfactory manner, but used by an unskilled man, on a production of several hundred pieces, it would lead to errors that would affect the accuracy of the finished work. I assume that Mr. Holaday used an ordinary miller vise. While he gives no dimensions, his illustration shows that the corners of the square rods come slightly below the top of the vise jaws, which would allow the use of properly made V-blocks.

Some time ago we had a similar job, except that the squares were so large that they could not be gripped in the vise at all. Nearly all miller vises are made of a good grade of cast iron, and the jaws are faced with steel wearing plates held in place by screws. As shown in the illustration, we planed up a piece of steel twice the length of the vise jaws and planed a V in the right position to hold the work. This strip was then cut in two, and in the center on one of the V's a hole was drilled and a piece of ¼-in. drill rod driven in to form a stop, so that two pieces could be milled at one chucking, as shown. We used an end mill in the vertical attachment and set up the vise so that the cross-feed could be used, as our rods were too long to clear the column when the vise was set the other way. The pieces were put in, one from each side, up against the stop and the vise tightened. The other ends of the rods were supported on V-blocks made by bending up some ¼ x 2-in. steel and cutting a V in the top to act as a guide.

These V-plates and rests could be made as quickly as the gage in question and entirely eliminate the necessity of handling a gage every time the work is placed in the vise. We also thought it best to let the V's carry all the load and so located them that the work would clear the bottom of the vise slightly when tightened up. Using this rig the pieces came all alike, and once properly set up there was no gaging necessary for the operator to bother with.



THE SPECIAL VISE JAWS

Drafting Room Versus Shop

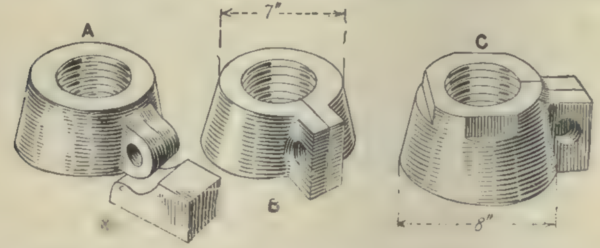
By Joseph R. Sheppard

I have read with interest the article and discussions on the strife between the drawing room and the shop; and I think that my experience may help to settle this important matter, as I have had very little trouble along this line during my 10 years' experience as draftsman.

I believe that this is mainly due to the fact that I have spent some years in the shop as a mechanic, hence, I can size up a job not only from the point of design and appearance, but also from the shop man's point of view. With this in mind, I have made it a habit to spend some time in the shop daily—usually a part of my own lunch hour—following my work personally through the pattern shop, foundry, machine shop and erecting shop and, in some instances, the final operation of the machine in the customer's plant.

In opening a conversation with the mechanic, if he happens to be a patternmaker, I show some tact and confess my lack of knowledge of patternmaking in general. I usually become pretty well acquainted before many days pass and ask for any suggestions he may like to make. I try to make him feel that his suggestions are valuable, which in many cases they are. In a few months I am conversing intelligently with him, and arguing, good naturedly of course, as to the manner of molding such a piece and which part of the pattern is to be in the cope and which part in the drag, also the method of making core boxes and certain changes that would save hours in his time on the patterns. These matters we thrash out together.

In displaying this attitude I am amply repaid; for if I make any mistake and fail to see it myself, which often happens, during my daily excursion through the shop the error is called to my attention personally and in almost every case caught and altered before the pattern is made.



EXAMPLE OF SHOP AND DRAWING-ROOM COÖPERATION

This same policy I carry out in the foundry, smith, boiler and machine shops. In every case I make all the friends I can and assume a sort of inquisitive manner instead of a know-it-all attitude.

I might mention how I got around our boss blacksmith, who is a gruff old fellow and gave very short answers until I mentioned the fact that my father was a boss blacksmith and that I used to visit the shop as a boy. This seemed to break the ice, and he began to ask me questions about my father and his work; soon we were exchanging experiences.

Now, being a machinist, I make it very plain that I served my time in the shop, but also mention the fact that I left the shop as a young fellow and do not pretend to know the trade from beginning to end. No one ever does accomplish that, even if he spends a lifetime in the shop. I ask for suggestions, or sometimes make a suggestion myself in this manner: "Say, Bill, I never saw this tried and don't know whether it would work; but I know you have been running a lathe for years, and I would like to know what you think of such and such a scheme." Do you know, it usually happens that he tries it out that same day.

Let us look at a simple illustration of what I am trying to set forth. We had a clamp nut that was always made as shown at *A* in the illustration, with a core on the drag side. This was criticized during one of our shop talks, and as a result the pattern was changed as shown at *B*. The new way permits the pattern to draw free, as can be plainly seen. In going through the machine shop I saw a machinist trying to hold a similar nut in his chuck prior to facing, boring and threading, which was some job, due to the tapering side of the nut. I saw his difficulty, and now we make our rough castings as at *C*, which gives four flat straight surfaces to grip on.

I could go on and cite many other instances of just such a nature, but I think I have shown the matter clearly. It is this attitude that I have tried to exemplify throughout my daily experience with my fellow shopmates (as we all should be), working with one goal in view—to get out as good a job as possible with the least work and discomfort possible.

I have had positions where the shop men would come and ask me to help them out with their troubles, because I would not fuss and fume, but usually from my contact with the shop would find some simple way out of the difficulty. They would invariably reciprocate and do the same for me. And, do you know, the knowledge that I acquire in this manner is worth more than any study or reading that I do, and I do considerable of both, reading every technical paper that comes to my hand.

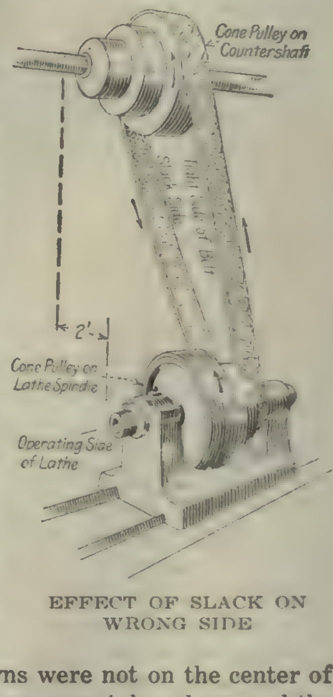
I think this is the spirit of coöperation referred to in the latter part of the letter by F. G. Higbee, on page 519, Vol. 46, and I have found that it always works to the satisfaction of both parties.

A Countershaft Drive Problem

By J. Limbrunner

In reply to the request for a solution of the problem presented by H. D. Martindale, on page 484, Vol. 46, I submit the following as the probable cause of the belt climbing from one step to another.

As indicated in the illustration, the slack side of the belt is on the operator's side; that is, the belt is sagging away from the pulley. When taking a heavy cut, the tight side of the belt will be in great tension suddenly, thus causing the slack side to sag, or drop, away from the pulley more than before; and the belt, therefore, would have a tendency to climb the next step. This condition may be aggravated by the edges of the different steps on the pulleys being worn. Another matter which is of importance is that the crown should be absolutely on the center of each step. At one time we had considerable trouble with a belt climbing on a cone pulley. Upon investigating, we found that the crowns were not on the center of the various steps. The pulleys were taken down and the crowns re-turned so that they were central on each step, after which the pulleys were put back on the shafts—and the trouble was over.



EFFECT OF SLACK ON WRONG SIDE

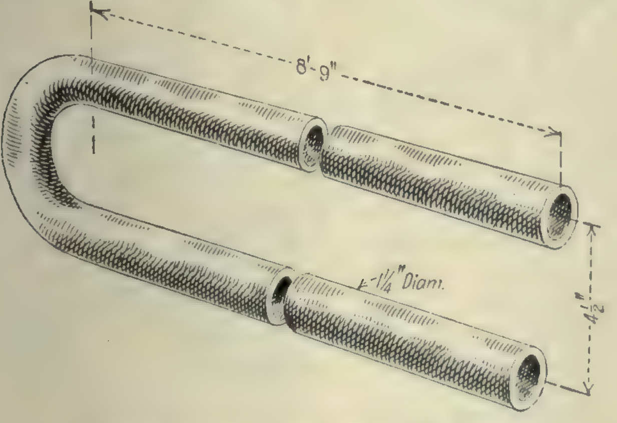
While the drive as installed by Mr. Martindale is perhaps theoretically correct, it is by no means the ideal drive. To make the most efficient drive, the slack side of the belt should always be on top; for then, instead of the arc of contact being decreased by the belt sagging away from the pulley, it will rather be increased, because the belt will hug the pulley around a greater part of its circumference. The greater the distance between the centers of the pulleys and the wider the belt, the heavier it will be; and the worse the condition will be if the belt is running so that its slack side is on the under side, as shown in the illustration.

How Would You Do This Job?

By F. P. Terry

We have a good number of tubes to bend as shown in the accompanying sketch. They are used for high-pressure tubular heaters and, when expanded into the header, must stand a test pressure of 300 lb. per sq.in. The tubes are 1¼ in. in diameter and about $\frac{1}{16}$ in. thick. They are good-quality seamless tubes, the double length varying from 5 ft. 6 in. to 8 ft. 9 in. long.

Can this operation be done without heating the tubes? If not, is more than one heat necessary? Is it necessary to fill the tube before heating? If so, what should be used? And perhaps what is most important, what is the best appliance to use?



HOW WOULD YOU DO THIS JOB?

We are doing this job, but not in a satisfactory manner. I am convinced that there is a better method. What is it?

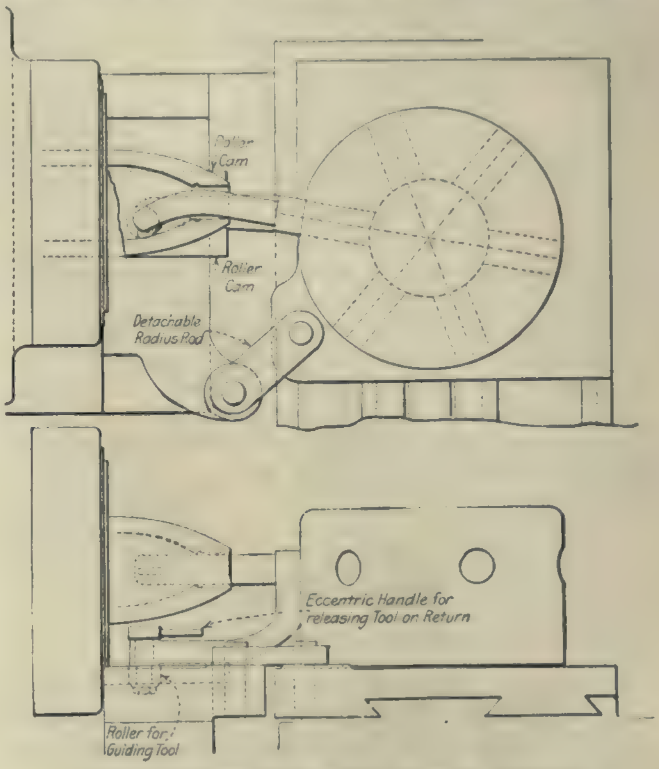
Form Boring the Nose of 6-In. Shells

By G. M. Strombeck

After heating and closing in the nose on a 6-in. shell it is necessary to refinish the inside. A method for doing this accurately is shown in the accompanying illustration. The outside of the straight part of the shell is first turned to be exactly concentric and true with the inside before the nose is closed in. This affords a surface for chucking the shell so that the inside will run true.

To refinish the inside of the shell, mount a bent boring bar in a turret. This bar carries an arm that extends below the shell and carries a roller directly below the tool. It is essential that this roller be exactly below the tool and that the cutting edge of the tool be of the same radius as the roller. With these conditions it is easy to check up the relative positions of both by squaring up from the roller.

The tool is guided by a cam groove in which the roller fits. In doing the work, put just enough tension on the turret clamp to permit the turret to turn without shake. Swing the bar around so that the tool will enter the hole and the roller enter the open end of the cam groove, after which the form of the inside must of course conform to the cam. The only point that now needs watching is that the bar does not rub against the outer edge of the hole. This is taken care of by the detachable radius rod or link, which is dropped onto a pin on the saddle cross-slide and another on the lathe bed. The path of the center of the turret is thus definitely determined and interference avoided.



FORM BORING THE NOSE OF 6-IN. SHELLS

When the cut has been completed, the tool is removed from the finished surface by throwing forward the eccentric pin on which the roller runs, which permits the rapid withdrawal of the tool.

Keys Through Thin Bushings

By H. E. McCray

Probably most of the readers of the *American Machinist* have been up against the proposition of keying a wheel on a bushed shaft where the bushing is too thin to permit its being keywayed inside and outside, and two keys used. We have a rather heavy drive of this sort on some automatic gear cutters, where we sometimes find it necessary to use cutters with 1½-in. hole on a 1¼-in. arbor. The feed is heavy and the cut intermittent when feeding in, until the cut reaches the width of the flute in the cutter.

The way this is ordinarily done, and the first we tried, is shown in Fig. 1, using a deep key and split bushing. Even with a close fit on the key and bushing the key would roll and pound out in two or three hours, resulting usually in a broken milling cutter and scored arbor.

The foreman of the gear department wanted some bushings with solid keys made up, similar to Fig. 2. This is a rather expensive proposition to make accurately with ordinary equipment. After some debate, we made up bushings and keys as shown in Fig. 3. The rings are turned up and split, and the keys shaped out and sawed to width from a bar of tool steel. The projecting edge about ⅛ in. on each side of the key prevents any tendency to roll, and the keys stand up well under the drive. Can some one suggest a better way of doing this? The method shown in Fig. 3 can hardly be called an inexpensive way, although it is considerably cheaper than the bushing shown in Fig. 2.

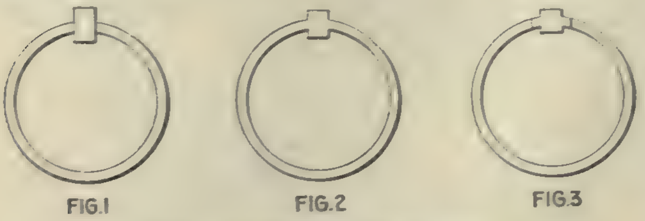


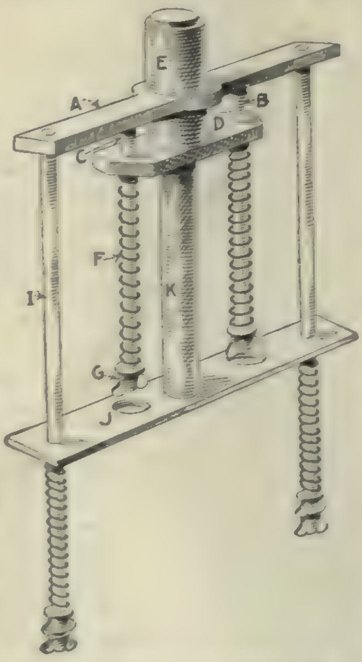
FIG.1 FIG.2 FIG.3

THE DIFFERENT KEYS USED

Adjustable Buffer and Ejector for Press Work

By Burnett Menkin

The illustration shows a device I have recently made for use in single- and double-acting dies for drawing through shells. These shells are from ¾ to ⅞ in. in diameter and up to ¾ in. deep. They are made of soft iron stock from 0.007 to 0.025 in. thick. The plate *A* is secured under the press and has a hole in it for the pipe *E*, fastened to the plate *D*, which slides on the rods *B* and *C* and is supported by the springs *F*. The tension of the springs is varied by the nuts *G*. The rods *I* are screwed into the plate *A* and carry the plate *J*, supported by springs and nuts in the same way as the plate *D*. A pipe *K* fits the pipe *E* and serves the same purpose. For drawing shells, the tension necessary to make a smooth draw can be obtained either with *E* or *K*, or for heavier draws by the two combined. The adjustment of the springs gives great flexibility.



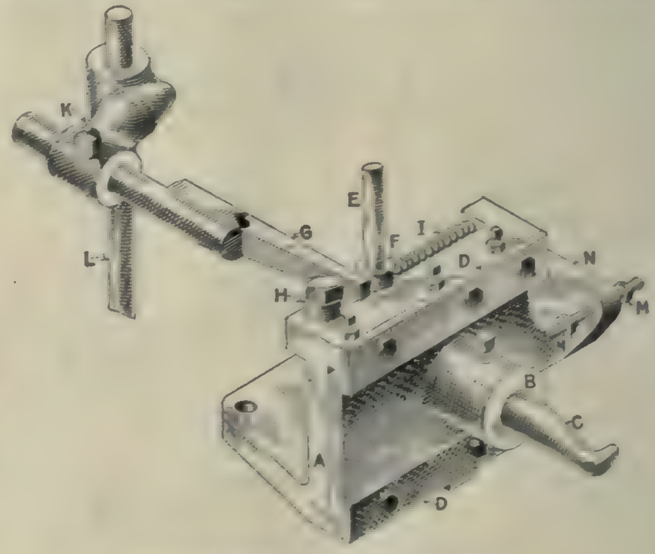
BUFFER AND EJECTOR

Taper-Boring Attachment for Turret Lathe

By C. C. Blood

In the manufacture of universal joints for automobiles and motor trucks, many of the yoke hubs have taper holes bored in them. For several years we have machined these yokes on turret lathes. The need of a more suitable taper-boring attachment than that furnished by the makers of the lathes induced the writer to devise the one shown. Two of these attachments have been in almost constant use with splendid results for six years.

The base *A* is bolted on the turret in the place of one of the regular toolholders. A wedge *G* controls the sliding piece *B*, in which the boring tool *C* is fastened. The slide *B* is held in place by the gibs *D*. The lever *E* is flat in section below the roller *F*, and its lower extremity is fulcrumed on the upright web of the base *A* by a shoulder screw. Midway between the fulcrum and the roller *F* it is pivotally connected to a boss on *B*, which projects through a suitable slot in the upright web of *A*. Through this construction, by pulling the lever *E* back and forth, *B* is caused to slide across the face of *A*. This movement is controlled by the wedge *G*, which bears against the stationary roller *H* and the roller *F* mounted on the lever *E*. All slack between the rollers and the wedge is taken up by the spring *I*. The member *G* is bolted to the rod, the rear end of which is fastened to the swivel joint *K*. The part *K* is attached to an upright rod *L*, which in turn is attached to the rear end of the lathe. It is evident from the construction that the wedge *G* must be made just twice the taper of the hole that is to be bored.



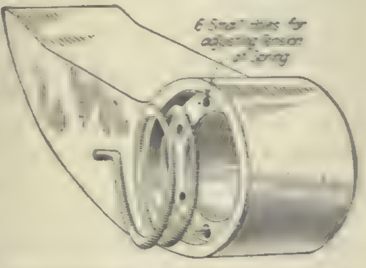
TAPER-BORING ATTACHMENT

The operation is as follows: When the turret brings the boring attachment around to its working position, the rod, which when not in use is hung on a hook out of the way, is placed between the rollers *H* and *F*. To do this the operator pulls the end of the lever *E* toward him, which separates the rollers sufficiently to allow the wedge to drop into place. Then as the carriage feeds forward, the rollers gradually approach the thinner portion of the wedge, allowing the tool to travel inward across the face of *A*, thus boring the hole to a taper corresponding to one-half of the taper of the wedge. If it is desired to use the tool for straight boring, the wedge is not used and the nuts *M* are tightened on the lug *N* to bring the tool to the desired position.

Concealed Spring for Use on a Ratchet Pawl

By George Wood

The sketch shows a spiral spring that can be inclosed in a ratchet pawl. This arrangement is designed to supplant the ordinary method of allowing the pressure of a flat spring to actuate the pawl. As can be seen, the stud hole is counterbored the same diameter as the spring, and six small holes are drilled equidistant in the circumference of the bottom of the counterbored hole. By inserting the end of the spring in the different holes, it is possible to regulate the liveliness of the pawl to any desired degree.



CONCEALED RATCHET PAWL SPRING

In addition to its neatness this method has much to commend its use wherever such a pawl is needed.

Right-Angle Triangles

By Frank Metzler

A short time ago the writer was pleased to see a solution of angles arranged in very convenient form, as submitted herewith. In some sections this method obtains quite generally in the shops, while in others the process of tediously extracting the square root, with its attending chances of error, is almost exclusively in vogue.

While the subject is one that has gone "through the mill" repeatedly, its appearance in the form shown was exceedingly pleasing to quite a number of us, and we thought it worthy of presentation. Employed at the bench, one does not have frequent occasion to extract either square or cube root; and it frequently follows that, when forced to its use, one questions the accuracy and considerable time is lost working out its proof.

Problem 1. To find the angle 375 ÷ 0.750 = 0.5. Refer to a table of natural sines, and you will find 0.5 = 0.30°.

Problems 2 and 3 are similarly secured; 375 ÷ 0.6495 = 577. Referring to a table of natural tangents, we find 0.577 = 0.30°; 0.6495 ÷ 750 = 0.866. Referring to a table of cosines, we find 0.866 = 30°. The remaining problems are pure multiplication and division without reference to tables.

The process that generally obtains is illustrated for problem 4, as follows:

$$\begin{array}{rr} 750^2 = & 5625 \\ 375^3 = & 1406 \\ \hline & 0.4219 \end{array}$$

$$6 \times 6 = 36$$
$$6 \times 20 = 120 + 4 \times 4 = 496$$
$$64 \times 20 = 1280 + 9 \times 9 = 11{,}601$$
$$649 \times 20 = 12980 + 5 \times 5 = 64{,}925$$

$$\begin{array}{r} 0.6494 \\ \sqrt{4220.0000} \\ 36 \\ \hline 620 \\ 496 \\ \hline 12400 \\ 11601 \\ \hline 79900 \\ 64925 \\ \hline \end{array}$$

Contrasted with this process, the submitted chart should be a relief to those who infrequently work out problems involving the use of the right-angle solution.

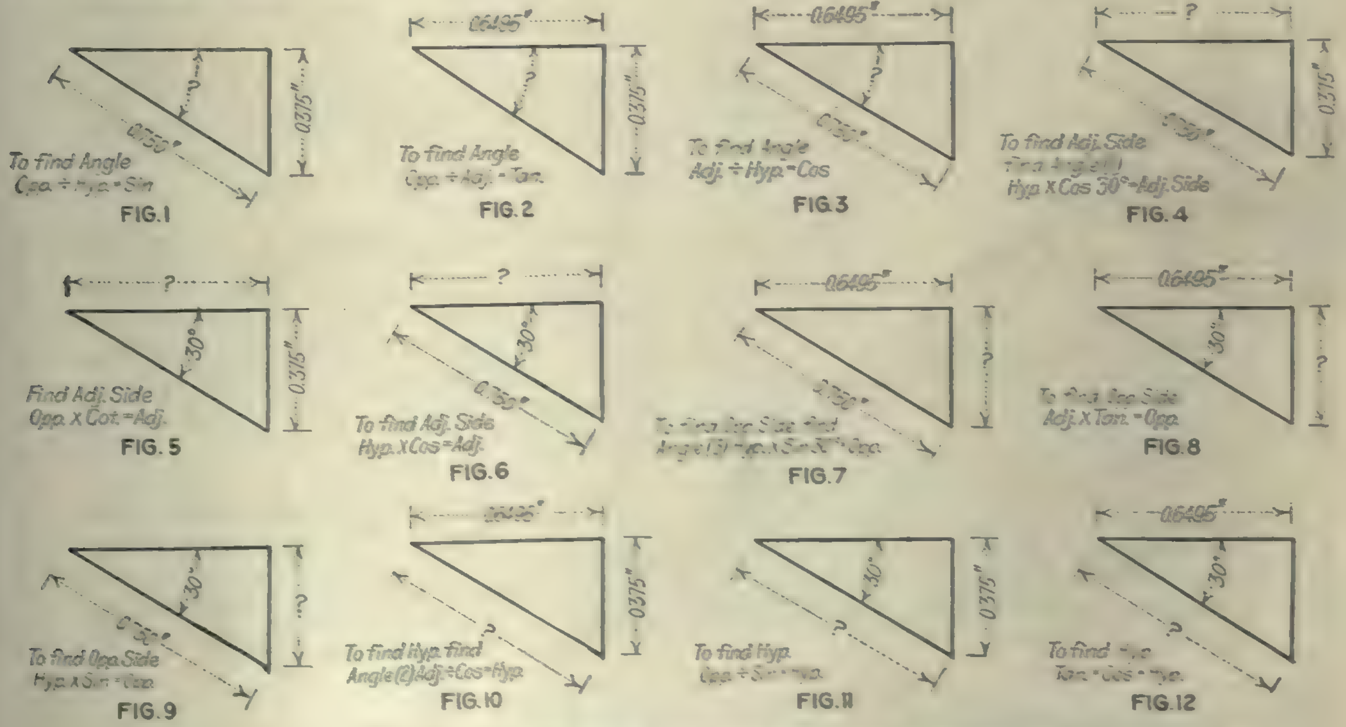


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6 FIG. 7 FIG. 8 FIG. 9 FIG. 10 FIG. 11 FIG. 12

FIGS. 1 TO 12. A NUMBER OF PROBLEMS INVOLVING THE SOLUTION OF RIGHT-ANGLED TRIANGLES

Congress and the Advisory Commission

An Editorial

A MAN may have a library and yet be illiterate; a workman may own fine tools and yet be unskilled; Congress recognizes an Advisory Commission and yet is unadvised. The good that comes from books or tools or men depends entirely upon the intelligence displayed in using them.

□ □

You manufacturers and shop owners know the market value of expert advice. It comes high. Imagine that to solve a complicated manufacturing problem you were able to call as consulting engineers Thomas A. Edison, Daniel Willard, Howard Coffin, Frank Scott, J. E. Otterson, Samuel Vauclain and Julius Rosenwald. Irrespective of the size of the bill that you would have to pay these gentlemen for their services (and it would be a big one, for they are big men), you would value their advice because of their success and practical experience.

No private corporation on earth, however great its resources, could get together the array of advisory talent exemplified by the Advisory Commission of our Council of National Defense. These gentlemen, including those mentioned above, and numbering several hundred others of equal prominence and capability, have been asked to advise our Government on subjects with which they are intimately familiar.

All these men work at the request of the President. They work without compensation, and nearly all of them have let go of every personal activity in order to devote their time entirely to serving their country. They have given up home, amusements, social and family life, and buckled down to the hardest grind that any body of men ever attempted. They rise early and retire late, and the interim is packed full of strenuous and wearing activity. Many of these men are actually shortening their lives—burning the candle at both ends—something that the hope of material gain could not induce them to do for a moment.

For the privilege of doing their bit, these men have paid their own traveling expenses, hired their own offices, employed and paid the wages of their own clerks. For while these men came to Washington at Presidential invitation, seconded by Congress, no provision was made to defray the expense of their work in any way; and yet you have still to hear the first protest on this subject from any one of them.

These men do not have their speeches and deliberations franked broadcast over the country so that people may admire their oratory and accomplishments. Their work is quietly and efficiently done in spite of the fact that they are limited to an advisory capacity only and have no power to carry out their own recommendations. But because they are business men they accomplish results without grandstand plays or fireworks. Here are some of the things they have done since March 1, 1917:

They have mobilized the 262,000 miles of railroad of this country for the Government defense.

They have knit together the organizations of the telephone and telegraph companies to insure the Government the most rapid and efficient wire communication.

They have procured for the United States Army and Navy 45,000,000 pounds of copper at less than one-half the current market price—saving the Government thereby nearly $10,000,000.

They have made similar savings in steel, zinc and aluminum.

They have completed an inventory for military purposes of 27,000 American manufacturing plants.

They have saved the Government millions of dollars by the proper coördination of purchases through the agency of the General Munitions Board of the Council of National Defense.

□ □

Handicapped as they have been through lack of authority, these men have through diplomacy, tact and ability taken the first step toward putting America's war power above the level of a joke.

□ □

Germany laughed to see our arsenals, shackled by the short-sightedness of Congress, unable up to within the last six months to turn out over one hundred rifles a day. It was no longer a joke, however, when the Advisory Commission of the Council of National Defense found means through private manufacturers to furnish all the rifles that will be needed.

□ □

Germany laughed at our arsenal capacity of a few machine guns per week, due to absurdly insufficient appropriations by Congress, but Germany has stopped laughing since the Ordnance Department, through the efforts of the Advisory Commission, provided means through private manufacturers for an unlimited supply of these essential weapons.

□ □

Germany laughed when Congress passed a bill prohibiting the timing of operations in Government arsenals, crippling thereby the power of arsenal management and encouraging inefficiency.

□ □

Germany laughed when Congress only recently threw out the appropriation requested for the inspection and care of gages—declaring that gages did not concern the conduct of war! This in spite of the fact that for over a year Canada has had an official gage-inspection department at Ottawa, having found the need of one through costly experience.

□ □

Germany laughed when Congress, failing to realize the national importance of the development of the airplane, an American invention, neglected to protect and encourage it by Government subsidy. It was no longer a joke, however, when the Aircraft Production Board, a subcommittee of the Advisory Commission, formed the aircraft manufacturers of the United States into an association, brought together the Wright-Martin Air Craft Corporation and the Curtiss Aëroplane Company under a satisfactory patent agreement, evolved the training plan for aviators, started six schools for the preliminary training of aviator students, canvassed the airplane-production facilities of the United States, arranged for the standardization of training types of machines and promulgated the demand for 100,000 American airplanes to swoop down on Germany from the sky.

□ □

And now comes a move that will occasion Germany great merriment and consolation. Certain members of Congress who cannot conceive it possible for men to serve their country without attempting to exploit it, have during the past few weeks been scheming to do away with the Advisory Commission of the Council of National Defense. Instead of coming out squarely with their opinions like men, these politicians have quietly introduced into the Food Control Bill a paragraph that will prohibit "any person connected with the Government" from selling to it anything in which he has an interest. The members of the council are held to be "connected with the Government" and, representing as they do the great producers of the materials needed to win a war, the passage of this measure means either their resignation from the Council of National Defense or that the companies with which they are connected must refrain from accepting Government orders.

Can any one conceive a move that would do more to strengthen our enemies than this latest example of Congressional imbecility?

Either we must do away with the services of those men who, judging by their success and achievements, are best qualified to insure our own success and safety, or else we must strictly refrain from making use of nine-tenths of the productive capacity of the United States—for fully nine-tenths of our industries are represented in the wonderful organization in the Council of National Defense.

□ □

An attempt by certain Congressmen threatening the complete destruction of this elaborately organized machinery—and without the slightest suggestion of replacing it, to say nothing of bettering it—looks suspiciously like a deliberate attempt to cripple America and aid Germany.

□ □

To introduce this move in such a measure as the Food Bill is a flagrant insult to American intelligence and an attempt to stab Uncle Sam in the back. It is bound to hurt us. If it passes, it will injure us beyond repair; if it does not pass, it will injure us anyway, because it will delay the Food Control Bill and give food speculators a new lease of life. The Kaiser, Von Bethmann-Hollweg and Dr. Dernberg could not themselves have concocted a better scheme!

□ □

Do these members of Congress who advocate the elimination of intelligent watchfulness over Uncle Sam's pocketbook wish to go back to Spanish War days of embalmed beef, defective supplies, camp cripples and country-wide scandals?

□ □

Is it a studied attempt on the part of paid employees of the people who average questionably in their attendance on public duties to impugn the patriotism and honesty of men who, without pay, work for America from 18 to 20 hours a day?

□ □

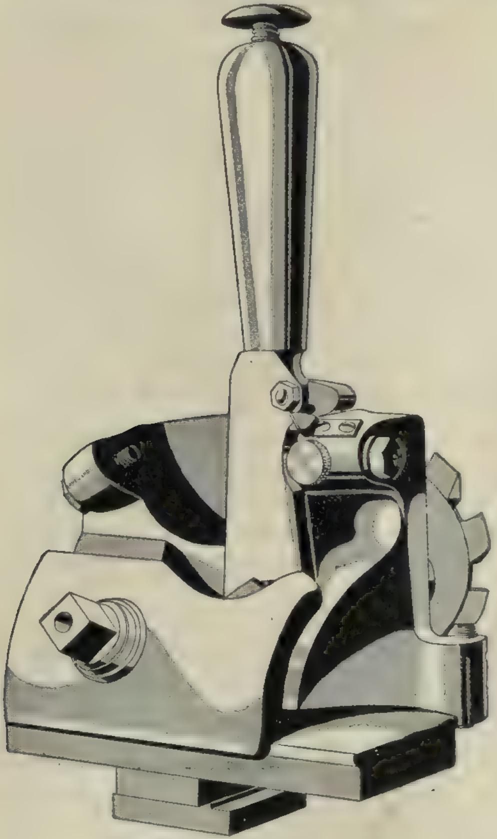
It is quite conceivable that from a politician's point of view it is not convenient to have business men who know their business advise and keep track of the expenditure of the billions in Uncle Sam's safe. It is conceivable that politicians resent the growing activity in national affairs of men who are beyond the reach of petty graft or political patronage. But it is not conceivable that the American people can have in Washington a majority of legislators short-sighted enough to permit the successful furtherance of this intrigue. The Council of National Defense, its Advisory Commission and subcommittees represent the brains of industrial America. Use them, but don't abuse them.

Shop Equipment News

Threading Tool

The Rivett Lathe and Grinder Co., Brighton, Boston, Mass., is now marketing the improved threading tool shown in the illustration. The device consists of a sub-base, base, eccentric cutter arbor, operating lever, clamping plate, micrometer stop, and other adjusting and operating details.

The sub-base is mounted on the tool block of the lathe and secured by means of a hollow-head capscrew with a T-nut. A second clamping bolt is used to secure the base to the sub-base. The cutter arbor is of hardened tool steel, ground and lapped into position, and is conical in shape to allow for adjustment. The arbor is fitted to an adjustable steel bearing in the base. The latter has a micrometer stop, engaging a locking pawl on the operating lever, allowing readings of 0.0005 in. A square-head setscrew at the front of the base supports the operating tooth of the cutter and permits adjustment when the size is reduced by grinding.



THREAD-CUTTING TOOL

The operating lever is fitted to a squared portion of the cutter arbor and is held in position by a locking nut. A locking pawl, controlled by means of a compression spring, push rod and thumb pad, is fitted to this lever. The clamping plate is groove milled to coincide with a rib on the sub-base, the upper portion of which bears against the side of the base.

Sandblast Room

The illustrations show the "Humane" sandblast room being marketed by the American Foundry Equipment Co., 52 Vanderbilt Ave., New York City. When using this piece of apparatus the operator stands outside of the room, operating the hose nozzle through a slit, covered with rubber flaps, at the front of the machine, as indicated in Fig. 1.

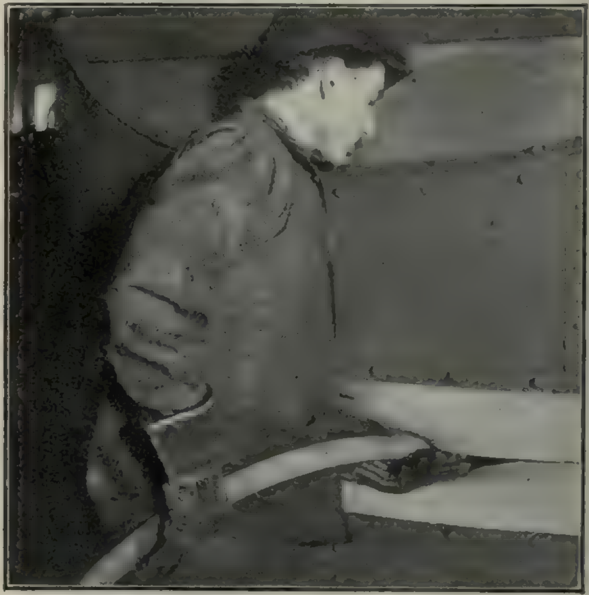


FIG. 1. OPERATING THE "HUMANE" SANDBLAST ROOM

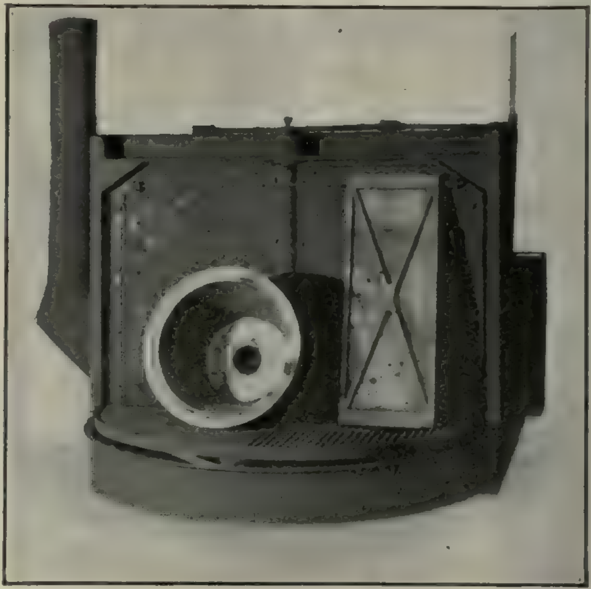


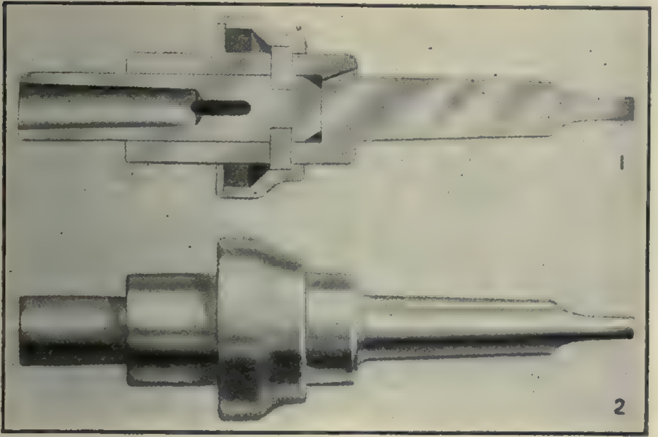
FIG. 2. REAR VIEW OF THE SANDBLAST ROOM, SHOWING ROTARY TABLE

The work may be seen at all times through the fine brass screen installed in the sloping portion of the top. Fig. 2 is the rear view, showing the rotary table. It will be noticed that the parts to be sandblasted may be loaded onto the rear part of the table while the operator is working on the castings on the front part. On completion of the sanding operation the table may again be rotated through 180 deg., bringing the new work in position to be operated upon and the finished work in a position for unloading. The machine is made with any size of table from 5 to 12 ft. in diameter and is made up singly or in multiple units, as desired. The pressure tank is located beneath the flooring, and electric lights placed on the ceiling provide illumination.

Quick-Action Chuck

The quick-action chuck illustrated is for use where a number of drilling, reaming or tapping operations are performed on one machine and where the ability to change from one tool to another with little waste of time is an advantage. The mechanism is the product of the Quick Action Chuck Co., Grand Rapids, Mich.

Only five pieces are used in the complete assembly; and the merit claimed for it is that, should a tool become set in the material being worked, all torque stress may be removed by raising the engaging collar of the chuck, which will immediately relieve the driving jaws and eliminate chance of tool breakage. The interchangeable collets are removed or placed by simply raising the collar. All parts of the chuck are machined of crucible steel, and the body is equipped with a standard taper shank.



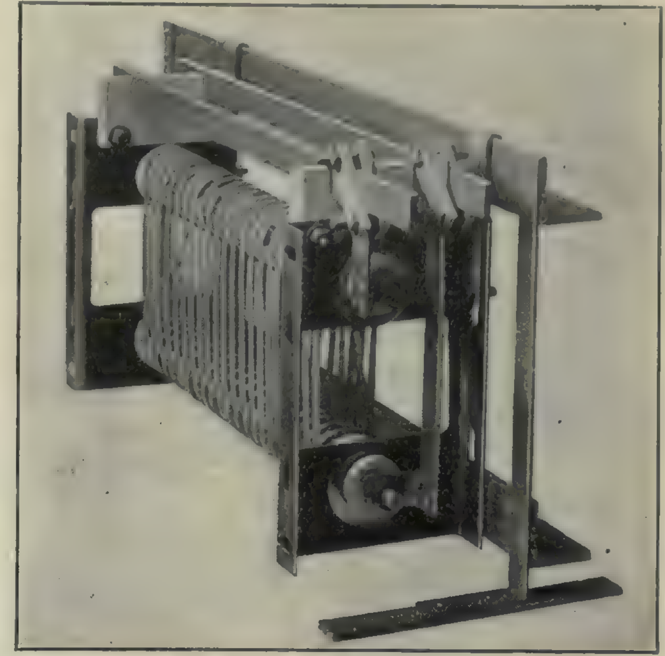
CROSS-SECTION AND EXTERIOR VIEWS OF THE QUICK-ACTION CHUCK

Westinghouse Oven Heater

The Westinghouse Type C oven heater, made by the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., is designed especially for use in enameling or japanning ovens, but may be used in a large variety of applications where ovens are employed for a baking or drying process.

The heating element consists of a ribbon wound on a number of fireclay bushings assembled on two steel tie-rods, between two pressed-steel end plates. The ends of the ribbon are secured to drop-forged steel terminals that are clamped to the steel tie-rods, the rods therefore becoming the terminals for the heaters. These rods are insulated from the end frames where they pass through the frames, and the ends are threaded for bolting on the connectors.

Connectors are made of ¼ x 1-in. cold-rolled steel. A large number are made standard and may be supplied directly from stock along with the heater. Special connectors are furnished to meet the requirements. Cold-rolled steel busbars are recommended and may be mounted directly above the heater on insulators bolted directly to the end frames. Connectors are secured to busbars by steel clamps.

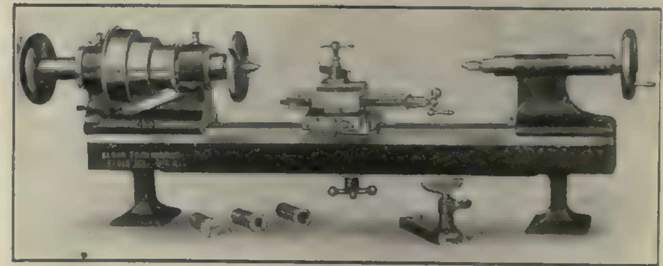


WESTINGHOUSE OVEN HEATER

Hooks bolted to the flanged end plates are used for hanging the heaters on the usual supporting steelwork, which may be flat iron, angle or channel iron or pipework. Protecting screens may be attached directly to the flanged end plates, without any other means of support.

Elgin Precision Bench Lathe

The precision bench lathe here illustrated has been placed on the market by the Elgin Tool Works, Elgin, Ill. The lathe is very similar to the company's No. 4, except that the construction is considerably heavier.



PRECISION BENCH LATHE

The head and tailstocks fit the No. 4 bed and give a swing of 7½ in. The collet capacity is ¾ in., and the hole through the draw spindle will accommodate work of this size. The spindle and front bearings, which are made of tool steel, are hardened, ground and lapped, and the rear bearing is of bronze. Sixty holes are bored in the rear flange of the pulley, which facilitates the indexing of work. Four larger holes are bored in the front flange to provide for locking the spindle while tightening or loosening collets, thus overcoming the liability of the indexing feature being used as a stop. The tail spindle accommodates a No. 5 B. & S. taper. The attachments for the No. 4 lathe, such as slide rest, grinders, planers, milling attachments, etc., are adaptable to this lathe.

"Automatic" Threading Lathes

Two new types of threading lathes have recently been produced by the Automatic Machine Co., Bridgeport, Conn. The belt-drive type is illustrated in Figs. 1 and 2. This machine is recommended for threading screws, worms and nuts with either single or multiple threads on diameters up to 1¾ in. and with pitches of three threads per inch or finer. It is fitted with a friction drive, which automatically controls the backshaft, enabling the cutting tools to withdraw from the work without relief if this feature is required. Relief, however, is recommended. Either forged tools or circular formed cutters may be used, as desired. The machine will handle either right- or left-hand threads. The 13-in. all-geared-head type is illustrated in Figs. 3, 4 and 5. The spindle of this machine is reversed at each end of the carriage or tool stroke by means of a positive-acting mechanism. Four changes of speed and reverse are provided. Fig. 4 illustrates the construction of the carriage and tool slides, while Fig. 5 shows the steady and follow rests supplied on lathes 16 ft. in length. This machine is adapted for either internal or external threading operations. Right- or left-hand threads may be cut with equal facility and the change from one style to the other may be quickly made.

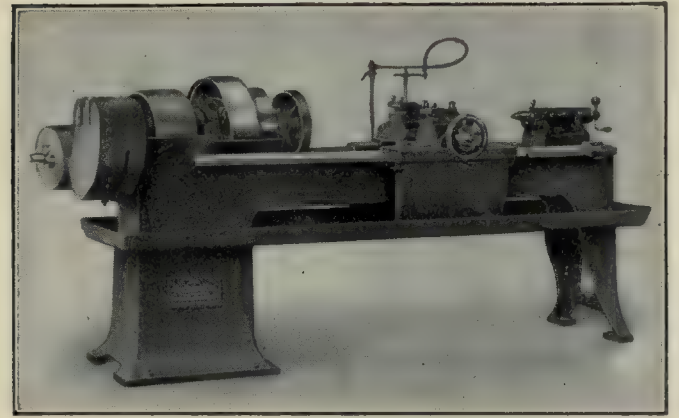


FIG. 1. FRONT VIEW OF BELT-DRIVEN THREADING LATHE

Swing over shears, 15 in.; swing over carriage, 6¼ in.; diameter of spindle cones, 9 and 12 in.; hole through spindle, 1½ in.; front spindle bearing, tapered, 2⅜ to 3 in. by 4 7/16 in.; rear spindle bearing, 2⅛ x 3½; diameter of tailstock spindle, 2 in.; spindle centers, No. 4 Morse taper; spindle nose threaded 2¾ x 6; lengths of bed, 6, 8, 12 and 16 ft.; respective distance between centers, 30, 54, 102 and 150 inches

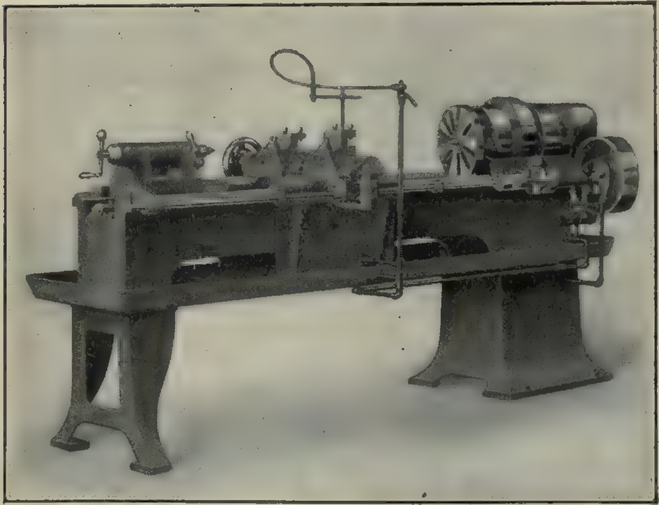


FIG. 2. REAR VIEW OF BELT-DRIVEN THREADING LATHE

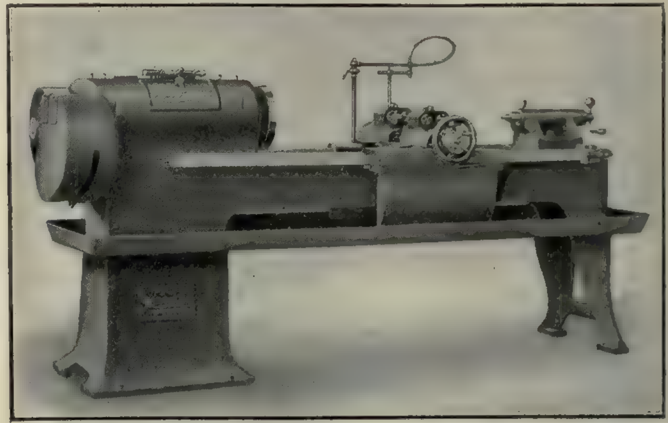


FIG. 3. INCLOSED HEAD 13-INCH THREADING LATHE

Swing over shears, 13 in.; swing over carriage, 4¼ in.; driving pulley, 14 x 4¼ in.; hole through spindle, 1½ in.; front spindle bearing, 3¼ x 5 in.; rear spindle bearing, 2 9/16 x 4½ in.; diameter of tailstock spindle, 2 in.; centers, Morse taper No. 4; spindle nose threaded 2¾ x 6; lengths of bed, 6, 8, 12 and 16 ft.; respective distance between centers, 24, 48, 96 and 144 inches

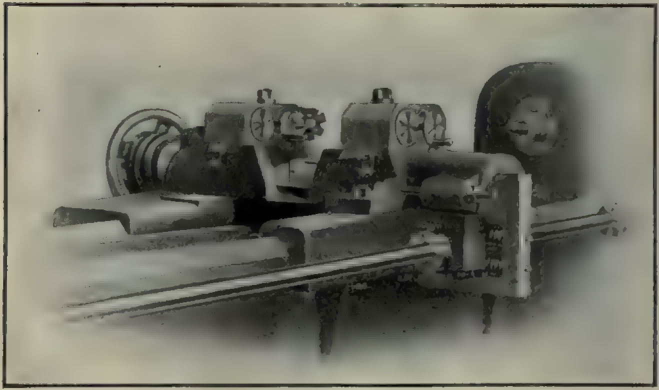


FIG. 4. CARRIAGE AND TOOL SLIDES

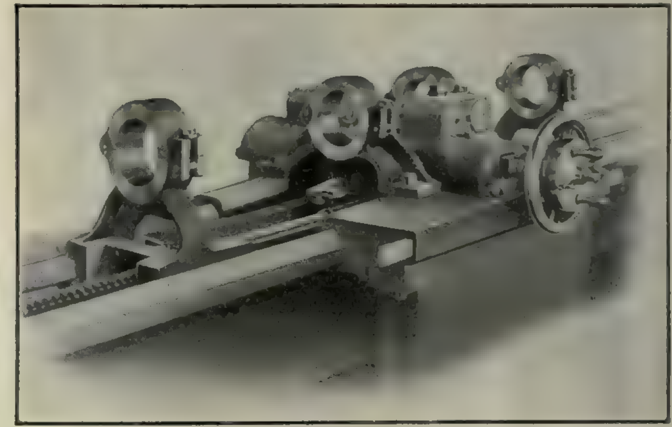
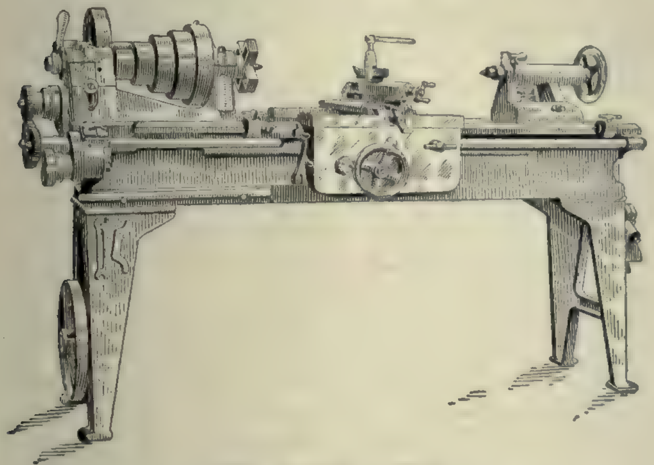


FIG. 5. STEADY AND FOLLOW RESTS FOR 16-FT. LATHES

Gem 14-Inch Latne

The Gem 14-in. engine lathe is now being manufactured by Richard H. Kiddle, Kinsman, Ohio. The bed is of the customary box-type construction and is built in sizes of from 4 to 10 ft., varying by steps of a foot. The headstock is ribbed under the cone and is provided with gear covers to insure safety. The tailstock is undercut to allow the compound top slide to be operated when swiveled, and a lever binder is used.

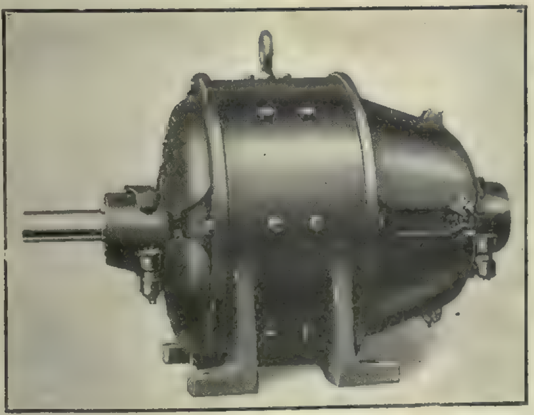


GEM 14-INCH LATHE

Swing over carriage, 8¾ in.; cone diameters, 3½ to 8 1/32 in.; belt, 2 in. wide; hole through spindle, 1 1/32 in.; front babbitt bearing, 1⅞ x 3¾ in.; rear babbitt bearing, 1 9/16 x 3 in.; tail-spindle diameter, 1⅞ in.; tapers, Morse No. 4; lead-screw diameter, 1 1/16 in.; weight, 1200 pounds

The feed rack pinion may be freed by pushing a knob in the apron when screw-cutting work is being done, but may be left intact when so desired, as a locking device prevents the lead-screw nut and the lateral feed being engaged at the same time. Regular equipment includes steadyrest, large and small faceplates, screw gears and countershafts.

Reliance Direct-Current Motors



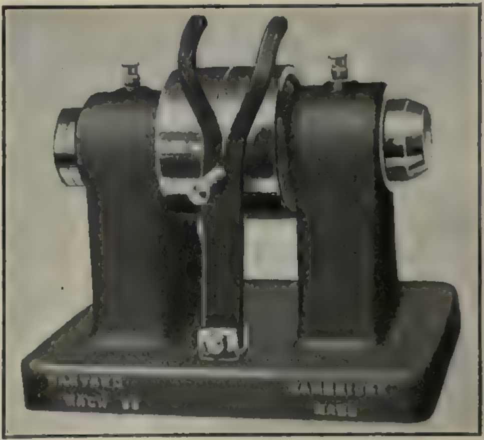
FULLY INCLOSED RELIANCE DIRECT-CURRENT MOTOR

The Reliance Electric Engineering Co., 1044 Ivanhoe Road, Cleveland, Ohio, is now marketing a new line of heavy-duty electric motors for direct current. These machines the company designates as type T motors, and they are made in the open, semi-inclosed and fully inclosed types, the latter form being shown in the illustration. The motors can be supplied for either constant or adjustable speed and with or without slide rails. The frame is of cast steel, and substantial ribs protect the machined feet from breakage. The four poles are laminated and fastened to the frame by capscrews, while the commutating poles are of soft openhearth steel fastened in place by the same method. The field coils are wound on a form, taped with linen and muslin, dipped in insulating varnish, baked, and assembled with pressboard spools. Commutating coils are of double cotton-covered wire. Babbitted cast-iron shells are used for bearings, and lubrication is secured by means of oil rings dipping into oil pockets. If desired, a split bearing can be furnished on the pulley end.

The commutator is mounted on an extension of the armature spider, being forced on and held from rotating by a key. The capscrew method is employed for holding the commutation segments, the screw heads being accessible from the outside. The brushes are of graphitized carbon and of such size that the current density does not exceed 35 amp. per sq.in. The brush holders may be removed without taking the motor apart and can be moved in radially to compensate for commutator wear. The leads are brought out through an asbestos board between the frame and the end bracket, permitting the bracket to be readily removed. Starters of the panel, drum or automatic type are used.

Harvard Polishing Machine

The polishing and lapping machine here shown is built in two styles—with a No. 2 Morse taper in the spindle end as illustrated, or with spring chucks accommodating work up to ½ in. in diameter. The machines, which can also be furnished with any special equipment required, are intended especially for toolroom use, the lapping of bushings and plug gages and other similar work. The Harvard Machine Co., Harvard Square, Cambridge, Mass., is the manufacturer.



POLISHING AND LAPPING MACHINE

Change in the Firm of Lodge & Shipley

Murray Shipley, whose biography appears in this week's "Who's Who," has sold his interest in the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, to the Lodge heirs. It is understood that the active management of the concern will remain practically unchanged.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Though things are beginning to move in many directions, it is not permissible to say much about some of them at the present time. Work is under way in several branches of munitions manufacture, and rifles, cannon and ammunition are already being made "somewhere in America." Aircraft work is also under way. Inspectors are on the job in several factories, and we shall begin to have a flock of training machines coming along almost before we know it. Real quantity production has not yet started, but it is materializing as surely as our vast quantity of automobiles come out of their respective factories every day.

The motor question is being pretty well threshed out, and the whole matter of complete planes will be solved in good time. It is to be regretted that we could not have been further prepared at the outset, but we are making up for lost time as rapidly as possible. As fast as we can train pilots we shall be able to send machines across to aid in putting out the eyes of the enemy. Some aviators have already reached the front, and while this is only a drop in the bucket it is at least a beginning; and all things have to start in a small way.

STANDARD DESIGNS OF AIRPLANES

In a short time we shall have standard designs for airplanes, and as there are more parts to them than appear on the surface, so to speak, it is quite possible that some of our smaller shops can make parts and so help to swell the grand total we must produce. While there are many parts made of wood, there are also a number of metal elements such as wing-strut sockets, braces, etc., not to mention such accessories as compasses, drift indicators, inclinometers and the like.

The question of struts and other wooden parts brings up the ever-present problem of dry rot and similar defects that are hidden in wood. A defective strut, which appeared to be perfectly good from all outward examination, is said to have been responsible for Victor Carlstrom's death not long ago. A strut gave way so that the wing crumpled up when he was straightening out after a dive, and left him practically helpless 2000 ft. in the air. And yet he kept his presence of mind and fought for control all the way down, never shutting off his motor until he was within 50 ft. of the ground, when he saw that all his efforts were in vain. By his death we lost the best high-speed pilot we have yet produced, and the lack of pilots of this kind is one thing that has delayed the development of the high-speed machines. Of course, they will be developed—must be developed—and when they are we shall find that we can build machines that will be as fast as any that sail the air today. No nation has a monopoly of brains or mechanics, and another year will see more history made in air navigation than we dream of at this time.

We shall also see the development of many new construction features in the various parts of the machine. There is talk of hollow struts of laminated materials to prevent hidden defects, of the fuselage or body built in the same way as it is now being made in some cases, and of propellers made of different materials than at present. The scarcity of linen for wing covering is driving many to experiment with cotton, with very good results, and paper has even been suggested by those who are familiar with airplane requirements and know what can be done with strong papers.

INCREASED PAY FOR NAVY

Uncle Samuel has often been accused of being niggardly to his many employees. While this may be true in some cases, he is almost extravagantly generous when we compare the pay received by men in the United States army and navy with that of the soldiers and sailors of other nations. Not that any amount of money can ever pay a man for risking his life as a fighting man must do, but in comparison with other armies and navies our men are considerably better off.

And now comes a new list of ratings for men in the navy that Secretary Daniels strongly urges for adoption. His recommendations are a further and much needed recognition of the mechanic as a factor in the making of modern war, and while the pay does not compare with some of the sums made in munition factories during the past two years, it is along the right line, and includes "keep," as we used to say in the old apprentice days.

	First Class, per Month	Second Class per Month
Enginemen	$45	$40
Blacksmiths	65	50
Coppersmiths	65	50
Pattern makers	65	50
Molders	65	50
Chief special mechanic	127	...
Special mechanic	80	...
Machinists' mates	45	...
Water tenders	45	...

Yeomen receive an extra $10 per month for efficiency.

TRAINING ENGINEERS FOR MERCHANT SHIPS

One of the difficulties of the shipping board will be to find competent engineers for merchant ships, as no less than 5000 additional engineers will be required within the next 18 months. The board will establish marine-engineering schools for training men who have an engineering foundation but who are not now qualified to pass the necessary examinations for receiving papers. The terms will begin on July 20 at the Massachusetts Institute of Technology, Cambridge, Mass.; Stevens Institute, Hoboken, N. J.; Case School of Applied Science, Cleveland, Ohio; Armour Institute of Technology, Chicago, Ill.; Washington University, Seattle, Wash., and Tulane University, New Orleans, La. Each term will last one month, and the cost of tuition will be paid by the shipping board. The Massachusetts Institute of Technology can put through classes of 150 students, while each of the others can handle about 35 in each class. Marine engineers of all grades, oilers and water tenders are eligible for these classes. After passing their examinations, the engineer students will be given an opportunity for further training under service conditions, until needed on the ships of the new merchant marine.

Along somewhat similar lines work has been begun on a new training station for naval reserves at Cape May, N. J., which will accommodate 2500 men in all. This is on a farm owned by Henry Ford, who has leased the ground to the Government for $1. There will be twenty large barracks and dormitories as well as officers' quarters, power plant, laundry and hospital.

The navy is also taking over the grounds and buildings at Gulfport, Miss., originally built for the Mississippi Centennial Exposition, which was postponed on account of the war. The area was tendered by the city as temporary training quarters, in a commendable spirit of helpfulness rather than in an attempt to hold up the country for a high price in time of need, as has been evidenced in certain instances.

While statistics are always open to suspicion, they are about the only method we have of comparison, and so I may be permitted to give a few that were recently authorized by the National Advisory Committee on Aëronautics in regard to the risk of aviation. These deal with the mortality in the U. S. Army Service during the past nine years and refer to peace times entirely. Incidentally the data show how very slowly we have increased our flying corps, even in the face of tremendous increases by foreign countries. The figures given are only those in which officers and enlisted men of the regular army were involved, the mortality per cent. for each year being figured on the basis of the number exposed to risk. These figures represent only those engaged continuously in flying and do not take into account the flights of passengers.

STATEMENT OF MORTALITY IN U. S. ARMY AIR SERVICE FROM 1908 TO APRIL 28, 1917

Year	No. Exposed to Risk	No. of Flights	Total Hours in Air	Total Miles Flown	Casualties	Mortality, per Cent.
1908	3	.....	.....	....	1	33.33
1909	2	.....	.....	....	....	.....
1910	1	.....	.....	....	....	.....
1911	9	731	129	....	1	11.11
1912	20	1,498	225	....	3	15.00
1913	39	3,355	739	39,337	7	17.94
1914	21	2,680	824	49,440	2	9.52
1915	45	4,388	1,814	126,980	1	2.22
1916	96	11,084	5,337	400,200	...	.....
1917 to Apr. 28	110	9,306	4,716	353,700	...	.....

The table not only shows that the occupation of flying is much safer than is usually supposed, but it also gives an idea of the number of flights, the average duration of each flight and the total distance flown, as well as the speed necessary to attain these figures. It will be noticed that the rate of mortality steadily increased up to 1913 (with the exception of the year 1908, when the work was entirely new), though it has since decreased at a much more rapid rate

FRED H. COLVIN.

Business Items

The Link-Belt Co., Chicago, Ill., is now represented in Alabama by McCrossin & Darrah, American Trust Bldg., Birmingham.

Homer Strong, on page 43, was erroneously stated to have removed his office from 301 State St., Rochester, N. Y., to 818 University Block, Syracuse, N. Y. The business will be continued in Rochester, and an additional office will be established in Syracuse. A third office will also be established at 380 Ellicott Square, Buffalo, N. Y.

Personals

J. L. Roche has resigned from the Remington Arms Co., Chester, Penn.

L. A. Larson has been appointed assistant comptroller of the American Locomotive Company.

C. W. Tounsley has been appointed advertising manager of the Vulcan Steel Products Co., New York City.

E. P. Brown has been elected president of the United Shoe Machinery Co., Boston, Mass., to succeed the late S. W. Winslow.

J. F. Cahill and **R. M. Baer,** formerly with the Modern Tool, Die and Machine Co., have formed a new company under the name of the Franklin Die and Tool Co., Columbus, Ohio.

Perry L. Haynes, chief of tool design for the Locomobile Co. of America, resigned on June 30, having received a lieutenant's commission in the coast artillery corps of the Connecticut National Guard.

S. L. Nicholson, sales manager of the Westinghouse Electric and Manufacturing Co. since 1909, has been promoted to the position of assistant to the vice president, with headquarters at East Pittsburgh.

Charles H. Purdy has resigned as superintendent of the Dalton Machine Co., New York City, and will engage in the designing and building of special machinery, with offices at 103 East 125th St., New York City.

F. H. Tackaberry, general agent of the American Steel Export Co., sailed from New York on July 7 for South America. Mr. Tackaberry will collaborate with the companies' various agents throughout South America.

B. M. W. Hanson, vice president and works manager of the Pratt & Whitney Co., Hartford, Conn., has resigned to become vice president and works manager of the Colt's Patent Fire Arms Manufacturing Co., of the same city.

G. Mattman, formerly foreign sales representative of the Cincinnati Milling Machine Co. and other Cincinnati manufacturers, and Thomas L. Bratten have bought out Mr. Willard and changed the name of the Willard Machine and Tool Co. to the Willard Machine Tool Co. G. Mattman is president and T. L. Bratten secretary and treasurer.

Forthcoming Meetings

The twelfth annual exhibit of foundry and machine-shop equipment and supplies will be held under the auspices of the American Foundrymen's Association in the Mechanics Building, Boston, Mass., from Sept. 25 to 28, 1917. The officers of the exhibit committee are: President, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; vice president, Benjamin D. Fuller, Westinghouse Electric and Manufacturing Co., Cleveland, Ohio; secretary and treasurer, A. O. Backert, 12th and Chestnut Sts., Cleveland, Ohio; manager of the department of exhibits, C. E. Hoyt, 123 West Madison St., Chicago, Illinois.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

The American and Canadian engineers and architects of Norwegian birth and descent will hold an informal congress and reunion at the Chicago Norske Klub, Logan Square, Chicago, Ill., Sept. 27 to 29, 1917.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North Philadelphia, Penn.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Qutations were current as follows at the points and dates indicated:

	July 13, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$47.00	$40.00	$14.50
No. 2X Northern Foundry, Buffalo.....	55.00	47.00	19.75
No. 2 Northern Foundry, Chicago......	55.00	50.00	19.00
Bessemer, Pittsburgh	57.95	55.95	21.95
Basic, Pittsburgh	53.00	50.00	18.95
No. 2X, Philadelphia................	54.00	46.75	19.75
No. 2, Valley.......................	52.00	50.00	19.25
No. 2, Southern Cincinnati...........	49.90	42.90	16.90
Basic, Eastern Pennsylvania.........	53.00	42.50	19.00
Gray forge, Pittsburgh..............	47.95	47.95	18.70

STEEL SHAPES—The following base prices in cents per pound are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	July 13, 1917	One Month Ago	One Year Ago	July 13, 1917	One Year Ago	July 13, 1917	One Year Ago
Structural shapes ...	5.25	5.00	3.25	4.50	3.25	5.00	3.10
Soft steel bars......	5.00	4.75	3.30	5.00	3.25	4.50	3.10
Soft steel bar shapes.	5.00	4.75	3.25	4.50	3.25	4.50	3.10
Plates	9.00	8.00	4.00	8.00	3.65	8.00	3.50

BAR IRON—Prices in cents per pound at the places named are as follows:

	July 13, 1917	One Year Ago
Pittsburgh, mill	4.75	2.50
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		July 13, 1917	One Month Ago	One Year Ago	July 13, 1917	One Year Ago	July 13, 1917	One Year Ago
*No. 28 black......	8.75	10.50	9.50	3.65	9.50	3.20	9.50	3.20
*No. 26 black......	8.65	10.40	9.40	3.55	9.40	3.10	9.40	3.10
*Nos. 22 and 24 black	8.60	10.35	9.35	3.50	9.35	3.05	9.35	3.05
Nos. 18 and 20 black	8.55	10.30	9.30	3.45	9.30	3.00	9.30	3.00
No. 16 blue annealed.	9.10	10.20	9.20	4.45	9.70	3.70	9.70	3.60
No. 14 blue annealed.	8.85	10.10	9.10	4.35	9.60	3.60	9.60	3.50
No. 12 blue annealed.	8.65	10.05	9.05	4.30	9.55	3.55	9.55	3.45
No. 10 blue annealed.	8.25	10.00	9.05	4.25	9.50	3.50	9.50	3.40
*No. 28 galvanized..	10.75	13.00	12.00	5.40	11.00	5.20	11.00	5.10
*No. 26 galvanized..	10.45	12.70	11.70	5.10	10.70	4.90	10.70	4.80
*No. 24 galvanized..	10.30	12.55	11.55	4.95	10.55	4.75	10.55	4.65

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring fair-sized lots, the following quotations hold:

	July 13, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	40%	45%
Cleveland	40%	45%
Chicago	45%	50%

SWEDISH (NORWAY) IRON—This material per 100 lb. sells as follows:

	July 13, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	12.30	6.30
Chicago	12.00	5.25

In coils an advance of 50c. usually is charged.
Note—Stock scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire*	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16 ..	
No. 18	
No. 20	

*Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long........	16.00
¼ by 19 in. long........	14.00
⅜ by 19 in long........	12.00
½ by 21 in. long........	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York July 13, 1917	Cleveland July 13, 1917	Chicago July 13, 1917
Tire	5.00	5.00	4.50
Toe calk	5.00	5.50	4.75
Openhearth spring steel...	7.00	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Ordinary carbon tool steel, base price	14.00	13.00	15.00
Special base cast steel....	18.00	20.00	....

*In bars.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh basing card in effect May 1, 1917:

BUTT WELD

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
⅛, ¼ and ⅜..	42%	15½%	¾ to 1½.....	38%	22%
½	46%	31½%			

LAP WELD

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
2	42%	27½%	1¼	23%	8%
2½ to 6......	45%	35½%	1½	30%	16%
			2	31%	17%
			2½ to 4......	33%	20%
			4½ to 6......	33%	20%

BUTT WELD, EXTRA STRONG PLAIN ENDS

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
⅛, ¼ and ⅜..	38%	20½%	¾ to 1½.....	38%	23%
½	43%	30½%			
¾ to 1½.....	47%	34½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
2	40%	28½%	1¼	24%	8%
2½ to 4......	43%	31½%	1½	30%	16%
4½ to 6......	42%	30½%	2	32%	19%
			2¼ to 4......	34%	22%
			4½ to 6......	33%	21%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	29%	15%	38.8%	24.8%
3½ to 6 in. steel lap welded	28%	10%	36%	21%	42.8%	27.8%

Malleable fittings, Class B and C, from New York stock sell at 5% from list price. Cast iron, standard sizes, 27 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound:

	July 13, 1917	One Month Ago	One Year Ago
Copper, electrolytic (carload lots).....	30.50	31.00	27.00
Tin	63.00	61.00	38.75
Lead	11.00	12.00	6.50
Spelter	9.00	9.25	9.00

*Third-quarter copper: for spot copper the market price is 29c.

ST. LOUIS			
Lead	10.75	12.00	6.37½
Spelter	8.75	9.25	8.50

At the places named, the following prices in cents per, pound prevail:

	New York			Cleveland		Chicago	
	July 13, 1917	One Month Ago	One Year Ago	July 13, 1917	One Year Ago	July 13, 1917	One Year Ago
Copper sheets, base.	42.00	42.00	37.50	42.00	37.50	42.00	37.50
Copper wire (carload							
Brass pipe, base...	47.50	47.50	46.50	46.00	45.00	47.00	45.00
Brass sheets	45.00	45.00	44.50	38.00	42.00	43.00	38.00
(case lots)	39.125	45.00	24.12½	39.50	27.00	39.00	25.50
Solder ½ and ½ lots	39.50	39.50	37.50	39.00	33.00	39.00	38.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	July 13, 1917	One Month Ago	Six Months Ago
Mill	$42.00	$42.00	....
New York	45.50	45.50	$44.50
Cleveland	38.00	38.00	38.00
Chicago	42.50	42.50	40.00

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.................................. 19.00

	In Casks		Broken Lots	
	July 13, 1917	One Year Ago	July 13, 1917	One Year Ago
New York	21.00	21.50	21.50	22.00
Cleveland	23.00	22.75	23.25	23.25
Chicago	22.50	20.00	23.50	21.00

ANTIMONY—Chinese and Japanese brands in cents per pound for spot delivery, duty paid:

	July 13, 1917	One Year Ago
New York	17.00	14.00
Cleveland	21.00	19.00
Chicago	19.50	20.25

Cooperation of Machine Builders with Woodworkers

By John B. Woods

THE business of converting forest trees into the countless wood products that play so great a part in the drama of human progress affords a wonderfully clearcut example of coöperation. On the one hand is that vast army of men who work with wood: Sawmill operators, wooden-goods manufacturers whose products range from toothpicks to period furniture, byproducts enthusiasts who turn out excelsior or bond paper as their particular conditions may dictate, and the scientists who blaze new trails for the others to travel toward wider usefulness—all these with their innumerable unmentioned associates are enlisted in the forest-conquering ranks.

Standing solidly behind them, with its own far-reaching and many-sided organization of experimenters, builders and demonstrators, is the army of those who build machinery. In fact, the machine people often step out ahead of these others to point new methods, always with the equipment tried and in readiness. This is coöperation with a point to it, and the destinies of woodworkers are so mingled with and dependent upon those of the machine builders that one may well ask whether the latter are not chiefly responsible for the recent remarkable development of the woodworking industry as a whole.

THE OLD-TIME PROCESS OF CUTTING TIMBER AND WORKING IT TO SHAPE

Time was when your New England farmer, desiring to build a new front porch, hooked his horses to a sled and with the hired man drove through the snow to his back pasture, where the timber was plentiful. Hewing down enough trees for his needs, he hauled them to town and rolled the logs upon the ice of the mill-pond, to await spring. Later the millman turned his attention from grinding grist, switched his water-driven belt to the little circular-saw rig and worked the logs into slabs and boards, taking his toll from the latter. Finally, the farmer came for his lumber, hauled it home, and the transaction was done. Townspeople appropriated some of the slabs for fuel; the balance went into the river along with all the sawdust to dam the water and kill the trout.

But times have changed until even the slabs and much of the sawdust are cherished as valuable. It is not that we love the trout more, but that our love of waste has diminished; for the timber supply has waned in the old settled portions of our country until we are obliged to look to other regions for lumber, and coördinately with this reduction of raw material has come the realization that our waste has been prodigious.

THE CARE OF DETAILS

There seems to be a definite law governing human activities in the business world, which simmers down to the principle that the greater a business becomes the more searching becomes its regard for the little things. Take the packing industry: There is a working out of this principle down to the point of making butter and toilet soap from the remains of cattle and hogs. In the same way the lumberman who installs one of the great modern plants must bend all his energies toward meeting the burden of miscellaneous overhead expenses by realizing upon items that his old-time predecessor would never have considered. And there is another controlling factor—the farther away our lumber supply is found the greater must be our transportation charges; so if we are to afford ourselves the benefits of using lumber, the manufacturers must reduce their actual costs to the lowest marks. Of course, the sawmill is but one step in the ultimate destiny of wood products, but it presents the machinery builder with a wonderfully fertile field and so is worthy of more than passing attention.

Disregarding for the present any possibilities of aërial freight traffic, we may state that there are but four routes open to logs on their journey to the mill—roads of dirt or rock or snow; railways; gravity devices, such as sluiceways and chutes; and watercourses. The two last mentioned are dependent upon peculiar conditions, such as exceedingly steep hills and favorable stretches of open water. Sluiceways and slides are very costly and of limited usefulness, while the floating of logs loose or in booms is wasteful and calls for manual labor rather than machines. Many of our timber trees are too heavy to float when green, and really a great number of the lighter softwoods will go to the bottom when water soaked. But road traffic lies well within the machine man's domain.

The trend of logging practice is toward the railroad, because the timber forever is receding into the far places where no wagon roads have been. Given good earth roads or such snow-packed highways as the North woodsman knows, there is room for every motive power from ox to gasoline tractor; even the electric motor has been used on the West Coast. In Maine they have used steam tractors mounted upon spiked drivers, with sled runners forward, to haul long trains of log sleighs over the snow and ice trails. In Arkansas there are several steam tractors hauling logs over dirt roads for distances of several miles. Gasoline trucks are in wide use in California. But these few instances are almost negligible when compared with the staggering mileage of steel and wood railways that penetrate the forbidding hill and flat-land haunts of timber trees. No doubt, road traffic will increase as we evolve a system of forest conservation; therein lies a field for the traction expert.

Between the railroad and the timber is a gap that machinery can span, is spanning now wherever the trees stand thick enough to justify the expense of installation and operation. Donkey engines reach out slender cables to pull great logs to track, rooting up earth and tearing away all young growth as they come. Tall masts, firmly guyed to stumps, and other masts formed from strong trees on distant slopes are united by aërial cableways over which steel bicycles trundle at the call of hauling lines, carrying clusters of logs across deep valleys to drop them within reach of steam loading machines that stand upon the tracks. Heavy self-propelling cars with outstretching booms at both ends roll from place to place along the tracks, hauling in logs and running the lines back to timber by means of anchored sheaves that lead the cables around endless courses. Down in Louisiana, where rails must stop for the swamps, there are engines mounted upon scows, reaching out their relentless steel sinews to tow cypress and hardwoods through the water to the waiting loaders.

The goal is cost reduction to the minimum; and as time goes on, human genius will devise machines that can operate in scattering stands of timber as economically as they now handle the close-standing trees. Perhaps someone will invent a mechanical tree-felling device that will further cut the cutting costs. Several have been tried already, but their greatest drawbacks so far have been that they do not work!

A WORD FOR THE LUMBERMAN

All the arguments and horrible examples to the contrary considered, the lumberman is not a waster by choice. In the past he has left trees in the woods simply because he could not afford to haul them out. He has left knotty top-logs and high stumps. He had no use for the one and could not afford to pay the price of having the others lowered. Sawyers often refuse to bend their backs enough to cut low stumps unless they are paid for the additional drudgery. But of late the byproducts scouts have found profitable outlets for knotty logs, and the stumps have been lowered. So now the millmen bring in everything that will hold together, and give the refuse to the byproducts people.

TWO KINDS OF "HOGS"

There are hogs and hogs. One kind operates upon cut-over timberland manufacturing pork, while another variety may be found in every well-regulated sawmill converting odds and ends of wood waste into shavings. The latter type belongs to the machine world and contributes largely toward full utilization of wood. Experimenters have found that paper can be made from practically every softwood, while naval stores, dyes and sundry chemical products have their own producers among the timber species. Even where there is no inclination toward these highly technical processes the hog is valuable, for he makes fuel from coarse waste and thereby saves coal bills and gives the millman opportunity to use this additional fuel for the production of salable power such as electricity. Add to the evolution of such equipment the development of machines that fashion short lengths of boards into products such as barbed-wire spools, boxes, door scrolls, wooden novelties and the like. It matters not whether these things are finished in the sawmills or by the woodworkers who buy the material in the rough—the saving is real and the field is wide for the future.

A MOTTO WORTH WHILE

Beyond the lowered costs of wood goods in the rough and beyond the fuller utilization of all of every log, there is a goal that can well be expressed by quoting a machinery advertisement recently placed in a lumber journal. "Increase the ratio of productive time." There are many people working with wood, fashioning it into human utilities, who never saw the inside of a modern sawmill. Their problems are vital and common to all of us who buy and hire and produce, so perhaps it is well to venture into that broad realm of woodworkers in general. The cost of labor mounts week by week, or seems to do so at least. And because selling prices are prone to lag behind costs, this element of expensive labor must be met by increased output. One of the solutions is high-speed machinery.

Take the matter of nailing baskets, a simple process and capable of being managed by hand with startling rapidity. In fact, a skilled man can nail or staple fifty 4-qt. baskets in an hour. But here is a machine that can turn, hoop and staple 225 in the same length of time. The operator lays the stock upon a frame and merely watches the performance. Moldings and picture frames are common objects of everyday life and should be very easy affairs to shape, considering the rapidity with which other more elaborate forms of wood products are produced. But actually, moldings have been bad items to handle, because one piece requires the undivided attention of a great machine and cannot be hurried without ruining its glossy finish. At least, that has been the case until a recent development brought forth a machine that can turn them out at the rate of 100 lin.ft. per min. Speed is the requirement under modern conditions; and as expenses go up, its importance will increase.

But of course, speed must be subservient to quality, and one of the surest ways of keeping quality along with speed is to remove the chances of human error. Automatic feeds do this; for when machines are made to handle their own materials, the danger of lagging wits is removed. Consider match machines, or even the humble maker of cabbage crates. Here is a device that feeds itself with crate strips and stitches them with wire at the rate of 15,000 in 10 hours. Thereby is labor reduced, and with it the cost.

But such machines require great power, and here enters another phase of the question, which calls for electricity. In a large plant requiring numerous machines for different processes or various products there will be great power waste unless the supply is flexible. Main-drive shafts eat up energy even when they turn over without load, and the difference between the consumption under half and full loads is not so great as mathematics would indicate. The solution appears to be in the installation of individual motors that take current only when the machines are in use. There are other advantages, such as cleanliness and safety.

Loss of time and loss of power are about the most difficult to detect of all the manufacturer's enemies, and their conquest should go hand in hand. All in all, the machine-building fraternity should find its work abundant and decidedly worth while as soon as the present universal tangle becomes once more a many-stranded line of forward progress. The outlook is that wood will have its great day as soon as destruction gives way to reconstruction; and although we expect to find wonderful markets abroad, we shall find also seriously inclined individuals associated together for the express purpose of beating us to those promising fields.

There is much talk of a war after the war, and that brings us to the theme of this article, a sort of text coming at the wrong end of the preachment. The war after the present conflict will mean two things to this country: First, that we must go out after everything we desire and get it on our own merits; and more important, that we must put our own house in order by eliminating waste, speeding up production to take care of increased costs, removing obsolete methods and coöperating all along the line.

Device for Measuring Thread Gages

By A. W. Roberts

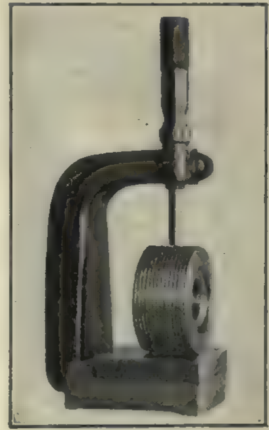
What manufacturer of threads has not been annoyed by the old, slow and somewhat inaccurate method of measuring thread gages with three wires? I certainly was much worried by the diversity of measurements taken in this manner by different inspectors on the same gage. After considerable thought, the rather simple device illustrated herewith was evolved. It was comparatively inexpensive and has proved to be very useful for the operations for which it was made.

It is made of a simple casting with a split hole bored in the top. A commercial micrometer head is set in the hole and held by a binding screw. A hardened, ground and lapped steel block is set into the base, the face of the block being set parallel to the face of the micrometer spindle.

Two of the wires are laid on the face of the block, and on top of these the gage is placed. The third wire is placed between the top of the gage and the spindle of the micrometer. By slowly rolling the gage through this contact, a very good "feel" can be obtained. Experience has shown that various inspectors will obtain the same reading, within very close limits, from the same gage.

Measurements can be checked by using standard blocks or plugs (without the wires). A further check as to the accuracy of the wires can be made by using a standard plug between the wires.

The greatest care should be taken to see that the wires are uniform in size, perfectly round and exact to a known diameter, since any error in the size of the wires is multiplied by three in the result. The easiest way to get accurate wires is to buy commercial sewing needles, lap them round and to a known size in sets of three, and cut off the tapered ends. To prove the accuracy of a gage it is advisable to use two or three sizes of three wires. The formula to be employed can be found in any good machinists' handbook. The device gives a range of measurements from 0 to 3 in. The one illustrated measures from 2 to 3 in., while by using a 1-in. block on top of the base measurements can be had from 1 to 2 in., and with a 2-in. block from 0 to 1 inch.



THE MEASURING DEVICE

Since writing the above, it has occurred to me that two lapped prisms of a known height and of a suitable angle for the thread under inspection could be used in conjunction with the wires. It would also be necessary to have a flat lapped block the same thickness as the prisms are high. With these one could measure the outside diameter and single depth of thread of the gage.

Welding a Large Cast-Iron Spider

By J. D. Cumming

SYNOPSIS — *The size and shape of this spider made the repair work slow and difficult, on account of the strains set up in the parts welded. The way the various troubles were overcome is described clearly and with definite data.*

An interesting application of the oxyacetylene-welding process to the repair of a large cast-iron spider has recently been completed at the works of a large copper-nickel mining and smelting company in Ontario. The job was somewhat larger than the ordinary and showed curious results from the original strains in the casting and the new strains imposed by the welding process.

The spider was made up of two large semicircular castings weighing about four tons each. Bolted together, they formed the support for the central shaft of a Wedge roasting furnace. This spider supporting the central shaft, which weighed about 25 tons, ran on six beveled tread rollers and was driven by a beveled pinion driving a large segmental master gear bolted to the periphery of the spider. The exact cause of the failure of this casting is a mystery, but it was probably a slight overload, a little more heat than usual and the strains in the casting, which will be referred to later.

On one-half of the spider all five arms were broken, leaving the rim entirely free, and on the other half the two end arms were cracked through. On this half of the casting the outer rim spread from the two broken arms about ½ in. and bent upward.

In Fig. 1 it will be noticed that the lower surface of the outer rim was machined to take the segmental tread plates and the master gear, and this machining caused a heavy strain to remain in the casting, due to the removal of the surface skin on one side only, and accounted for the warping of the outer rim when the two end arms broke.

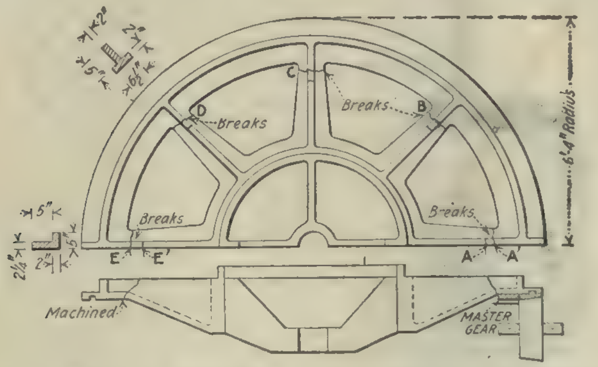


FIG. 1. DETAILS OF SPIDER AND POSITION OF BREAKS

On the half of the spider on which all five arms were broken, it was difficult to tell without a lot of checking up just what strains were released when the casting broke; but on the completion of the welding operation it was found that there had been a heavy bowing tendency producing a warped surface on the machined seat of the tread ring and master gear. It was decided to weld the arm *C* of the casting that had all the arms broken, then *B*, *A*, *D* and *E* in that order.

A furnace about 2 ft. square, of firebrick, was completed by piling bricks loosely together and putting in some grates. This furnace was filled with charcoal, and compressed air furnished the draft. About 2 ft. of the rim and 1 ft. of the arm were heated about the brick to a good red heat. At first, the rim opened away from the arm, but on applying more heat to the outside of the rim it expanded back to a fairly close fit. This procedure was carried out with all seven breaks, and a proper expansion and a good fit were secured by judgment in the application of the heat. Contrary to common practice, no chipping was done. The sides of the break were melted away by the heat of the torch forming a big V not quite through to the bottom of the break. The reason for this was to make sure that the casting was in its proper position at the completion of the heating, a point it would be difficult to be certain of if the large amount of chipping required had been done previously.

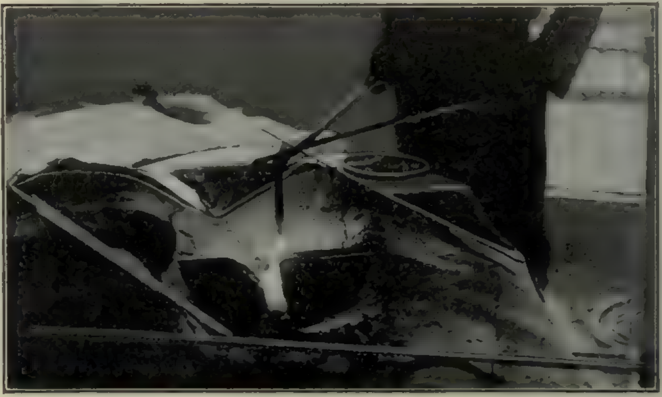


FIG. 2. ASBESTOS SHEETS PLACED TO PROTECT OPERATOR

In addition, the welding torch brought the casting to a good working heat. While this was going on, the charcoal fire was dampered and sheets of asbestos were placed over the whole of the furnace to protect the operator, as shown in Fig. 2. The heating with the charcoal fire took 2 to 3 hours for each arm, and the melting away of the sides of the break, before welding, took another 1½ hours, as a rule.

Equipment Used

The oxygen was provided in steel bottles containing 125 cu.ft., purchased from the manufacturers. The torch used was a 28-in. Oxweld welding torch with a No. 12 tip, which is next to the largest made by the Oxweld Acetylene Co. for ordinary commercial welding. The acetylene was produced by six Garrow portable acetylene flare lights, Fig. 3, connected to a manifold leading to a hydraulic back-pressure trap from which the gas was conducted to the torch by a hose. Three of these lamps would have been sufficient; but in order to be assured of an ample supply of gas, six were used. This made a flexible arrangement, allowing one or more lamps to be recharged while the others were supplying the gas, making any stoppage unnecessary after the work was begun.

Each lamp holds about 9 lb. of carbide and produces 40 to 45 cu.ft. of acetylene. Three recharges were necessary during each shift, but as this takes only about 2 min. per lamp, the helper was easily able to attend to it. In addition, a powerful light was available from one or more of the lamps fitted with reflectors when required. Cast-iron welding sticks, $\frac{3}{8}$ in. round, were used, and on account of the intense heat of the torch the sticks were welded in pairs and the pairs welded together at the ends, making a long double welding stick.

For flux, Oxweld ferro-flux was used, the end of the welding stick being dipped in it occasionally. From time to time a little common salt was thrown on the hot bath of molten iron.

The welding was performed in the usual way by a careful building up of molten metal from the welding sticks to the required form of the original casting, to which considerable extra metal was added for reinforcing. Care was taken to remove all impurities and slag that formed during the welding process. A helper scraped off this matter while it was still molten, using a welding stick or bar of flat iron. An average of about 6 hours was taken up in the welding proper. When the welding was completed, all the heated metal was carefully covered over with charcoal, which was fired and allowed to smolder after being covered up closely with asbestos. This fire burned out in about 12 hours, and another 12 hours was allowed for thorough cooling at as slow a rate as possible. Great care was taken in the cooling to prevent chilling and the danger of cracking.

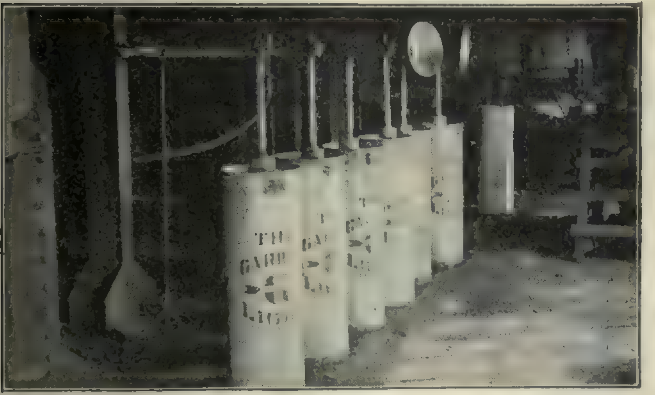


FIG. 3. BATTERY OF SIX FLARE LIGHTS

One arm was welded each day; and when the job was completed and the two spiders assembled, it was found that the half with the two broken arms was perfect, except for the warping mentioned previously, which could not be controlled. In the other half of the casting, warping took place and it was out of true, not being quite circular. This was due to the fact that all the arms were broken and to the consequent deformation resulting from the release of the internal strains. As both the rim and the hub with the arms had altered their shape considerably, there was no guide as to the original exact dimensions. It was decided to weld it up as well as could be done and take care of these deformations by shimming, etc., rather than to try springing these heavy castings back to their original shape. The time and material consumed on each weld are shown in the table.

In replacing the tread rings and master gear, it was found on leveling up that the machine seat was very much warped, being as much as $\frac{21}{32}$ in. out at one point, and quite irregular, being up and down. The amount out of true was marked at different points around the circle; and the master gear and tread rings were put in place and bolted down with small shims, after which a mixture of zinc and tin was poured in, making a solid bearing for these parts. This method proved quite satisfactory and has saved the machining of this seat, which was out of the question on account of the size and location of the casting The time taken for the preparation and welding proper was 10 days. Since a new casting would have cost $1600 and entailed a delay of at least 10 weeks, the saving is evident.

WELDING TIME ON EACH ARM AND AMOUNT OF MATERIAL USED

Arm No.	Time				Lb. of Carbide	Equivalent in Cu.Ft. of Acetylene	Cu.Ft. of Oxygen	Lb. of Welding Stick
	Preparing		Welding					
	Hr.	Min.	Hr.	Min.				
A′	3	..	6	10	150	675	525	65
E′	2	..	7	30	150	675	525	65
C	3	15	4	25	100	450	350	42
B	1	50	7	40	125	562	475	55
A	2	15	5	25	100	450	375	38
D	5	..	6	..	150	675	425	50
E	4	..	4	..	125	563	325	35
Totals,	21	20	41	10	900	4,050	3,000	350

The cost of the job was as follows:

Labor, welder and helper		$91.99
Supplies:		
24 tanks oxygen @ $3.04	$72.96	
900 lb. carbide @ $1.55 per cwt	13.95	
350 lb. welding stick @ $11.85 per cwt	41.48	
Miscellaneous, flux, asbestos, charcoal, etc	65.50	193.89
Total		$285.88

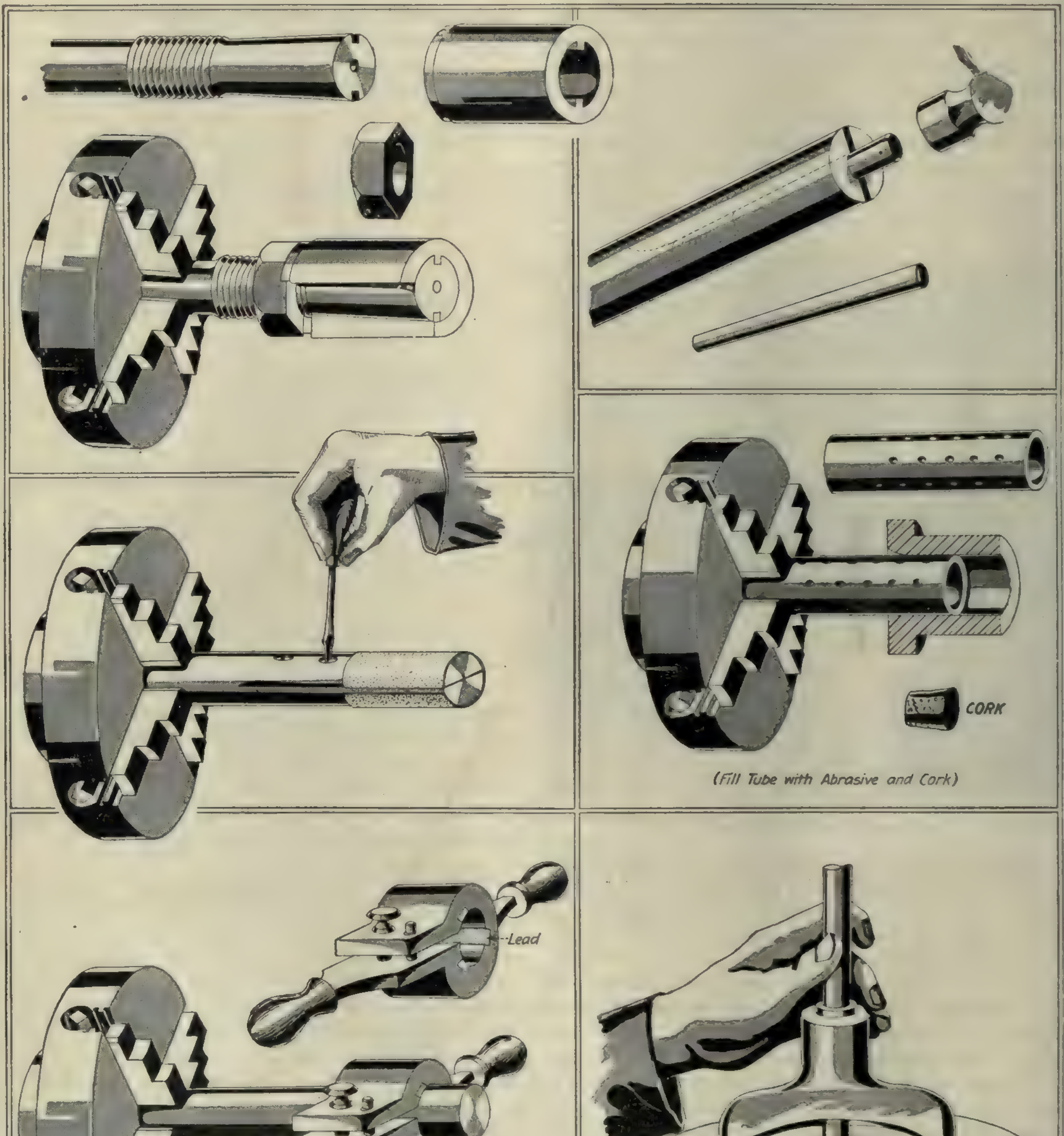
There were a few interesting points in connection with this job, one of which was the considerable saving effected by generating the acetylene in the portable Garrow lights. It will be noticed that somewhat more acetylene was used than would have been the case with the compressed gas, owing to the fact that the lights consumed some gas, and some carbide was wasted by being only partly consumed at the end of each shift. Assuming 4½ cu.ft. of gas per pound of carbide, there was 4050 cu.ft. used, which cost to generate $14.40—that is, 900 lb. of carbide at $1.55 per cwt. This same quantity of compressed gas would have cost $105.30, not including handling of the bottles, or a saving of $90.90 on this basis. Estimating that a minimum of 2900 cu.ft. would have been required if compressed gas had been used, the saving still figures out at $59.55, or 21 per cent. of the total cost of the job.

These lamps are being largely selected for this purpose, and one lamp will carry a No. 8 Oxweld tip, two lamps a No. 10 Oxweld tip. As the gas can be generated as long as the carbide holds out, there is none of the usual vexatious delay due to the fact that compressed acetylene cannot be shipped "express"; and with present freight shipments the delays in waiting for compressed gas to come from the manufacturers often proves a very costly and annoying circumstance.

The strength of the welds appears quite satisfactory, and they should be stronger than the original casting, owing to the amount of metal added for reinforcing. The amount of metal welded on was 350 lb., and the amount of oxygen 3000 cu.ft. or 8.57 cu.ft. per lb. of metal. This is somewhat higher than the allowance on the ordinary job and was due to the large amount of heat conducted away by the heavy casting. Each break averaged about 22 sq.in. in section and required about 2.3 lb. of added metal per square inch of section, on account of the reinforcing metal added to the weld.

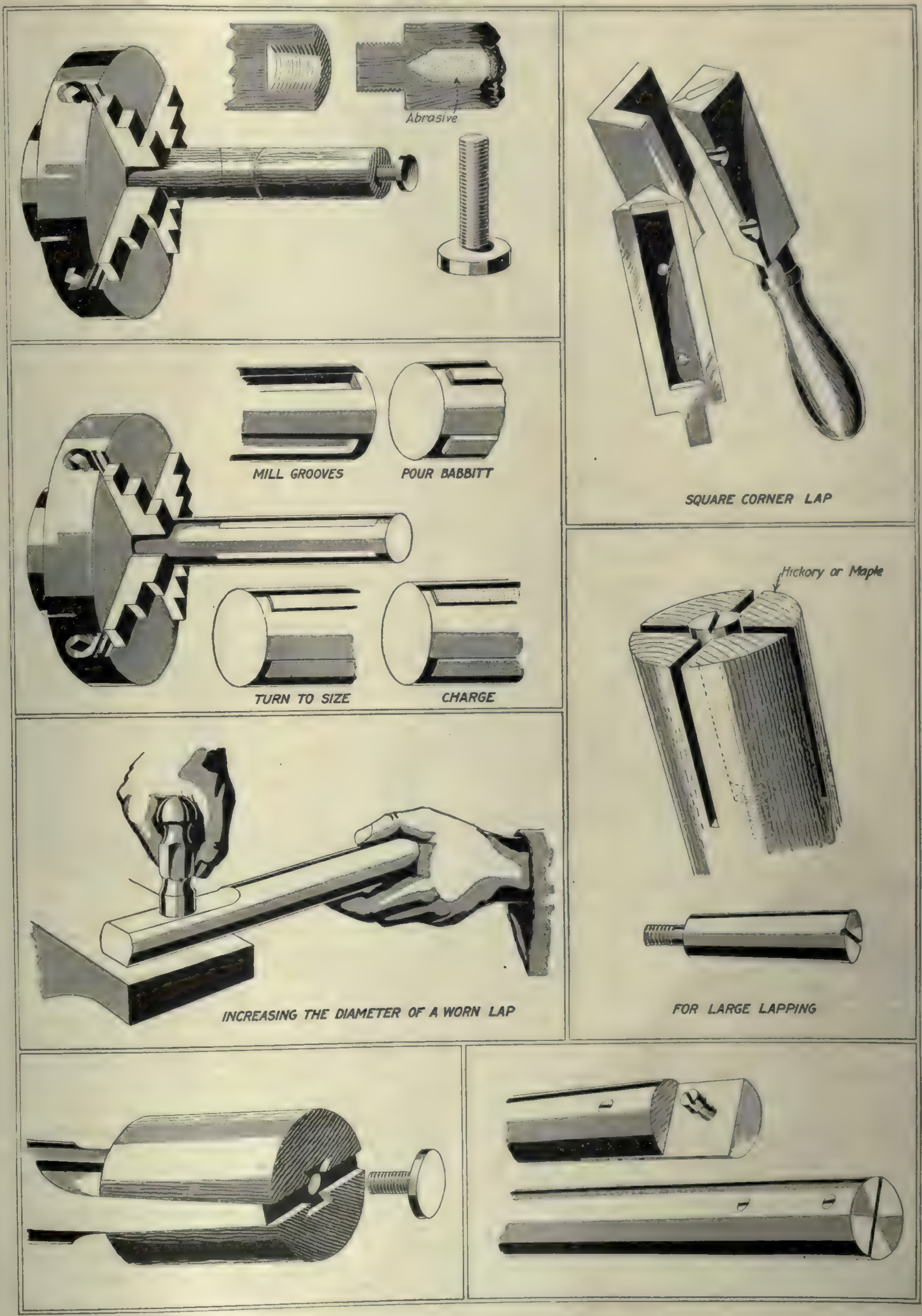
From a Small-Shop Notebook

By J. A. LUCAS



(Fill Tube with Abrasive and Cork)

INTERNAL, EXTERNAL AND END LAPPING DEVICES



ROUGH INTERNAL LAPPING DEVICES

How To Appoint Agents for Belgium After the War

BY O. KNOWLTON

SYNOPSIS — *Particulars are here given regarding the former practice of German, English, American and other manufacturers in transacting business in Belgium, and definite suggestions are made in regard to future connection for handling machine tools in that country.*

THE question of agencies in Belgium after the war is a subject that should be closely studied by machine-tool manufacturers. It is my idea to give in this article some hints about placing such agencies. However, before coming to this point I wish to outline briefly the general situation in Belgium before the war, as regards the agencies of foreign manufacturers of machine tools.

The largest import of machine tools into Belgium came from Germany. The greater number of the firms intrusted their exclusive right of sale for Belgium to dealers who paid for the goods outright and bore the responsibility of credits, etc., themselves; they also did the translation of catalogs and all the introductory work. Their profit ranged from 10 to 25 per cent., according to the difficulty they had in selling the machines or the risk involved. The selling part was left completely in the hands of the dealers. This system was very satisfactory all round, because it safeguarded the manufacturers so long as they were dealing with reliable firms; and as the dealers usually knew their market well and how to deal with the customers, the bulk of the business was transacted in this way. The German manufacturers were usually paid within 30 days from the end of the month of invoice, no longer credits being necessary, except in a few special cases.

GERMAN METHODS

Some German manufacturers were represented by commercial agents. The goods were invoiced direct to the customer, and the agent received a commission, the latter having no responsibility whatever. The commercial agents were mostly Germans with no particular knowledge of the machines they sold. The reputation of the firms usually brought about the business, and only where large orders were involved did the factory send out a practical man to help the agent to secure the business. An operator was also sent in case of trouble. Hardly any pioneer or introductory efforts were made. The manufacturers issued catalogs printed in French, and they were usually well prepared, giving every possible detail of the machines. Altogether, the task was made pretty easy for the agents. This practice, however, was not general and applied only to a limited number of firms.

Certain transactions were made direct between the Belgian consumers and the German manufacturers, but they were quite in the minority except in the case of heavy machines.

The American manufacturers, who came second in importance in the sale of machine tools in Belgium, dealt exclusively with dealers. The great mistake that most of the American firms made was intrusting their agencies to firms foreign to Belgium, whether German, Dutch, French or English. In consequence of this policy prices were considerably inflated on account of several establishments having to be kept up; firstly, the expenses of the head office had to be subscribed to and then those of the branches.

English manufacturers also adopted this method to a large extent and were mostly represented by German dealers. A few orders for very heavy machines were dealt with direct or through agents established in Paris. As I have already pointed out in a previous article, Vol. 44, page 679, it will be necessary for the English and American manufacturers to appoint native agents in Belgium. As a confirmation of what I have said before on this subject, I will mention that recently an association of French importers of machine tools has been formed in Paris, and the first step taken was to request the French government not to place any order for foreign machine tools except through French importers. This is exactly what has been expected for some time and should be well considered by any American or English manufacturers who wish to do business in France after the war. The same course will be adopted in other countries.

DEFINITE SUGGESTIONS

I would suggest that the following lines be followed in appointing an agent for work in Belgium after the war:

It will be very difficult for the foreign manufacturers to know exactly what is the financial condition of the consumers in Belgium. It is quite likely that consumers who had a sound financial reputation previous to the war may not be in the same position after hostilities have ceased. If for this reason alone, it therefore would seem that agencies should most certainly be given to a firm of merchants. While a machine-tool maker might receive every kind of information from a commission agent whom he had appointed, it must not be forgotten that such an agent takes no responsibility whatever. All his communications, while bona fide, incur responsibility upon the principals, who, not being in touch with the prospective customers, must rely entirely on the judgment of their agent. This makes it imperative that the machine-tool makers should give their agency to a firm of dealers who are of sound financial standing, and also natives of the country.

In negotiating with the dealer the first point the manufacturers should consider is whether the dealer was established in Belgium in the machine-tool business before the war. What was his reputation? What machines did he sell? What firms did he represent? Did he have showrooms and keep machines in stock? These are the the most important factors to be studied.

The second point is, Did the principals of the firm have a thorough knowledge of machine tools or did they employ salesmen with technical and practical knowledge? It is not essential for the principals of the firm to be practical men, so long as they know the business technically and are sound business men.

The third consideration is that of financial backing. It should be ascertained whether the firm soliciting the agency is financially strong and can meet all emergencies. The agent should be able to take the burden of financial responsibility from the principals. This question will be of great importance after the war, when the conditions are bound to be quite different from what they were before.

PREVIOUS CONNECTIONS

It should also be ascertained whether the prospective agent specialized in machine tools before the war, or whether he handled any article in the engineering line. It stands to reason that firms selling supplies, transmission articles, belting, oil, engines, agricultural machines, hardware, etc., cannot give all their attention to machine tools.

HE'S ALL RIGHT, SAM, HE'S A NATIVE SON

Furthermore, it is preferable that the agent should be established in Brussels, which is the most central part of Belgium and also the seat of the metal exchange. This metal exchange is a gathering once a week of all the leading manufacturers of metal products in the country. It is patronized by the syndicate of Belgian metal manufacturers and is rather exclusive. Up till a few years before the war no foreigners were allowed to attend the metal exchange, and it is absolutely certain that after the war this condition will be resumed at once. The right to attend the metal exchange has always been considered in the trade as a great advantage; and if important orders in machine tools were not always placed direct at the exchange, it was a wonderful institution for initiating business. The firms established in Brussels, moreover, had the advantage of having their showrooms easy of access to the consumers from the provinces when they came to Brussels to attend the metal-exchange meeting.

In appointing agents in Belgium, machine-tool makers should avoid negotiating with firms whose principals are foreigners. They should also take good care not to be represented by manufacturers of machine tools, as sooner or later they will find their machines copied. They should, furthermore, make provision in their contracts that the agent is not to represent manufacturers of enemy countries.

A delicate matter is whether one firm of dealers would be able to represent two competitive makes of tools. To my notion, this matter will have little importance during the first two or three years following peace, there will be such a rush for machine tools in Belgium and other countries which have been stripped of machines that some machine-tool makers will quickly get filled up with orders and will consequently have to handicap the sale of their agents, who might be altogether out of the market. The question, however, would have to be adjusted promptly if the manufacturers did not get their full share of business from the said territories.

It is generally admitted that, whatever may be the outcome of the war, Belgium will be restored to her independence as before the war. It is impossible to conceive any other solution. However, although quite out of the question, let us for the sake of argument suppose that Germany should retain an economic lien on Belgium. In this case the situation for the American and English manufacturers would be the same as it was before the war in Germany. A great many American and even a number of English makers of machine tools were doing business in Germany then. Therefore, I do not think that the political situation in any way need prevent manufacturers from preparing their agencies for Belgium now, and getting things in readiness for the trade that is bound to come for somebody.

It is impossible, however, as I have said before, to conceive any other solution than that of the complete restoration of Belgium to her former position; but in any case, from the above argument it would seem that there is no obstacle in the way of completing agencies for that territory at the present time. As a matter of fact, far from being unwise, I venture to think that it is most advisable that some tentative arrangements should be made now, and for the following reasons:

As some English and American firms were represented in Belgium by French and neutral dealers, it stands to reason that these manufacturers immediately after peace will have at the start an advantage over others who have not completed their arrangements; and as such dealers will have been able to order stock before the end of the war, they will be ready before any Belgian firm to start work in Belgium. To get the full benefit of the market, machine-tool makers must be ready to commence work at once when normal conditions have been resumed. Manufacturers must not lose sight of the fact that, at the end of the war, there will be a considerable number of machines in stock in England and France, and a number of these will find their way into Belgium.

Another important reason for making arrangements soon is that all important manufacturers who have a reputation to keep up must discourage and avoid speculation by outsiders. There is no doubt that there was a great deal of speculation going on soon after the outbreak of war, both in America and England. This may not have had any effect so far; but it may be disastrous after the war is over, because then all those who have been buying to a large extent will wish to get rid of their machines at the first opportunity.

Another Reason for Early Arrangements

What, for instance, would there be to prevent speculators, who know that Belgium is an open territory, from dumping their surplus stock in Belgium at low prices? Manufacturers would have no possible means of preventing this, as the dealers would argue that they bought the machines for Belgium, knowing it was an open market. The confusion caused would be very great, and the new agents would be hit pretty badly, especially if they had been placing large orders with a view to obtaining the privilege of the agency. I have heard that at the present time several Belgian manufacturers are buying machines in the United States, to be supplied after the war. If any trouble arises when the machines are set to work, the user will of course immediately apply to the new agent to help him out of his difficulties. If the agents are at all conscientious, they will assist the consumer; and consequently a most unfair situation will be created for the former.

Another factor that many manufacturers in England and the United States should not lose sight of is that recently in England an amalgamation of a number of machine-tool makers has been formed to deal specially with the trade on the Continent after the war. This association has already started work in an office in London and is covering the ground in France, Italy and Russia. Unless proper care is taken and arrangements are made soon, the association will have temporarily a considerable advantage over any other firm, as it intends making provision for Belgium as soon as there is the slightest possibility of doing so—that is, if it has not been done already.

I have given my views of such an association before, and I honestly believe that it is a very great mistake for manufacturers to be represented in any foreign country by a firm the principals of which are not natives of the territory covered. I think time will prove that I am right.

For the various reasons given, it would seem advisable that the manufacturers of machine tools in England and America should take every precaution from now on and see that they are duly represented in Belgium as soon as peace is declared. Provision could be made, in contracts signed now, for any alteration or cancellation.

In conclusion, I will say that all those who are desirous or expectant of reaping a good harvest from the Belgian market should undoubtedly start their sowing now.

Universal Mandrel for Double-End Cutters

By H. E. McCray

We make and use hundreds of double-end boring tools, of the type shown in Fig. 1, for use in slotted boring bars. They are used, generally in pairs, for enlarging cored holes; a rougher and finisher are followed by a reamer for sizing.

Made of high-speed steel, they give a very cheap and reliable boring tool. They are sawed to an approximate length, and the locating slot is milled. Then they are placed in the mandrel, shown in Fig. 2, and turned to grinding limits. The cutters are hardened, placed in the mandrel, circle-ground and backed off.

The mandrel here described will accommodate, both for turning and grinding, cutters of the same thickness and of any diameter or width. The body is flanged and slotted and drilled from one end through to the slot. The bushings *B*, of the proper outside diameter to engage the locating slot in the cutter, are slid up to the shoulder; the cutter is set in place, and the hollow-head setscrew *S* tightened against the tool-steel pin *P*, which forces the tool back against the bushing, squares it up and holds it securely in place. The mandrel and bushings are hardened and ground to size and are concentric.

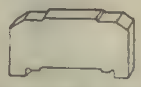


FIG. 1 Double-end Boring Tool. (High Speed)

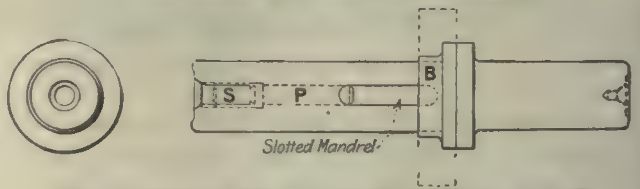


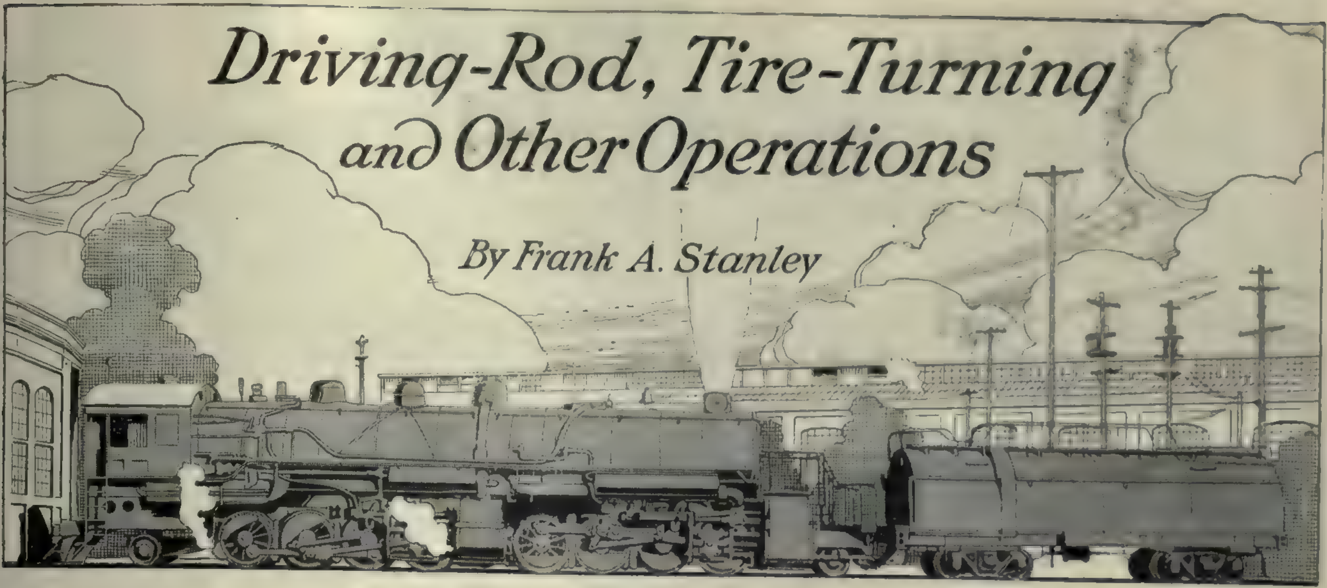
FIG. 2 A Universal Grinding Mandrel for Double-end Tools

FIGS. 1 AND 2. MANDREL FOR CUTTERS

We have a pair of each size with slots from $\frac{3}{16}$ to $\frac{1}{2}$ in., rising by sixteenths. With an assortment of inexpensive bushings they accommodate all sizes of tools from $\frac{3}{4}$ to 8 in. in diameter. I have seen forty or fifty slotted mandrels made up to cover the same range of sizes; they did not retain their accuracy and were costly.

Driving-Rod, Tire-Turning and Other Operations

By Frank A. Stanley



SYNOPSIS — *A number of useful methods and tools used in driving-rod, tire-turning, eccentric and other operations pertaining to railroad shops are reproduced in this article, which comes from the Southern Pacific shops at Sparks, Nevada.*

THE first illustration in this article shows a convenient hand appliance for touching up and finishing the inner bearing surfaces of locomotive links while the work is held in a bench vise at an angle and in any position to suit the operator. Referring to Fig. 1, it will be seen that the appliance is a small air-driven grinder with spindle of sufficient length and wheel small enough to permit the workman to cover any point on the bearing surfaces of either the concave or convex member of the link. The driving members of the machine is a fan-shaped wheel with curved blades that are perhaps 2½ in. across the diameter by 2 in. wide, the vanes having a curved form to catch the air jet and an angular position of about 45 deg. relative to the axis of the spindle, so that as the air at 80 lb. pressure is admitted at the side of the casing and against the radial edges of the vanes they rotate the spindle and grinding wheel at high velocity.

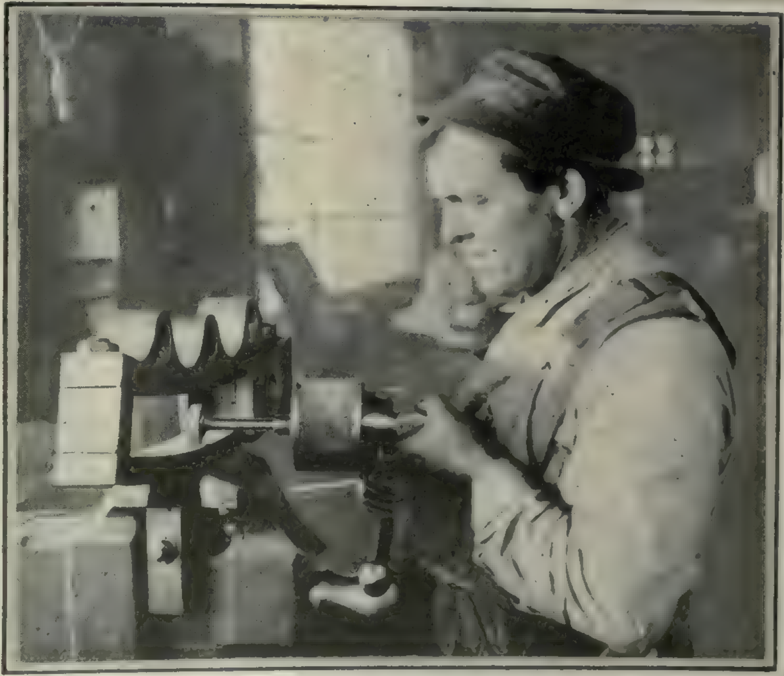


FIG. 1. A HANDY PNEUMATIC PORTABLE GUIDE FOR LOCOMOTIVE LINKS

The machine weighs but a few pounds and is readily manipulated by means of a substantial knurled handle attached to the rear head of the casing.

Overhauling of connecting and side rods always constitutes an important item in railroad-shop operations, and Fig. 2 shows some of the work of this character in the rod department of the Sparks shops. The examples included in this view represent various types and sizes of such parts.

Alongside the benches and trestles is located a shop-built hydraulic press, Fig. 3, for pressing brasses in and out and for other operations of similar nature. This press is of the upright type, with 2 ft. or more clear opening between base and ram when in uppermost position. The capacity of the machine is thus sufficient to cover a wide range of work. The pump, as will be noticed, is at the right side of the columns, and its plunger is reciprocated by means of an eccentric on the driving shaft across the top of the machine. This shaft is itself driven by the electric motor above the left side of the press. The slotter, in Fig. 4, is kept busy most of the time on rodwork. As here represented, it is engaged in

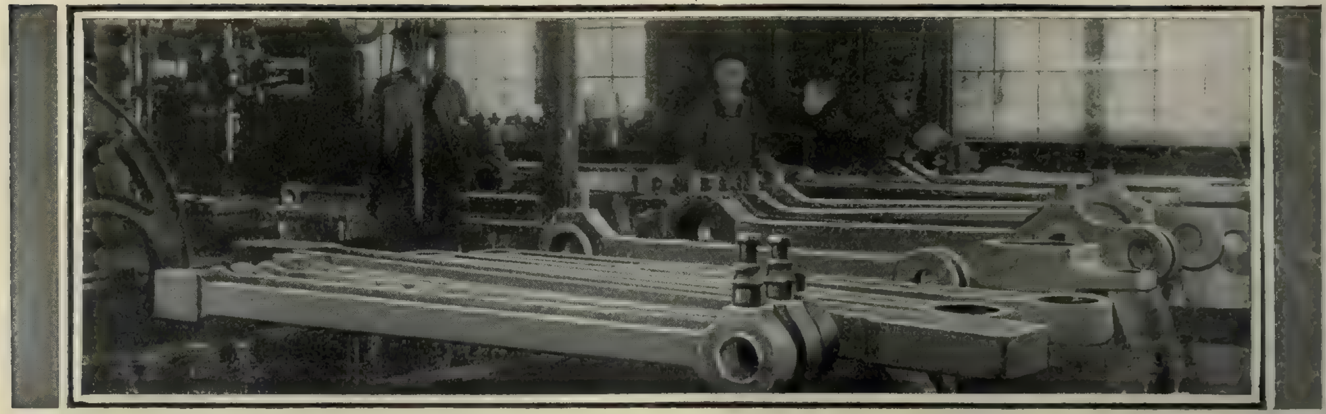


FIG. 2. OVERHAULING CONNECTING- AND SIDE-RODS

the operation of machining out the head of a heavy rod whose projecting outer end is supported upon a horse, as shown. The slotter tool is forged up as stiffly as feasible, and the cutting edge is ground to a form best adapted to enable the rod opening to be machined advantageously.

The brass rings for eccentrics are machined in the manner indicated in Fig. 5, where a casting long enough for several rings is shown held in the four jawed chuck of a 36-in. lathe while one ring after another is machined and cut off at the proper width.

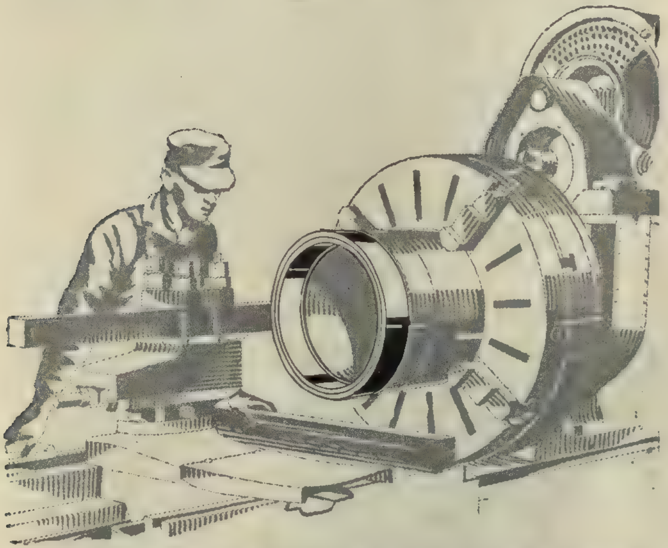


FIG. 5. HOW THEY CHUCK, BORE AND TURN ECCENTRIC RINGS FROM A BUSHING

In this process the outside of the casting is rough-turned for a distance sufficient for the machining of one ring. The inside is then bored, the outer end faced as required, the outside turned to size, and the ring cut off. The boring tool is carried in a long stiff bar, shown in the toolholder on the lathe, and the same bar is used for the turning tool, both outside and inside tools being inserted cutters readily placed in the bar and adjusted quickly as required.

The drivers of the Southern Pacific locomotives run up to 84 in. or more in diameter, and this means that wheel lathes of big swing are required for tire finishing.

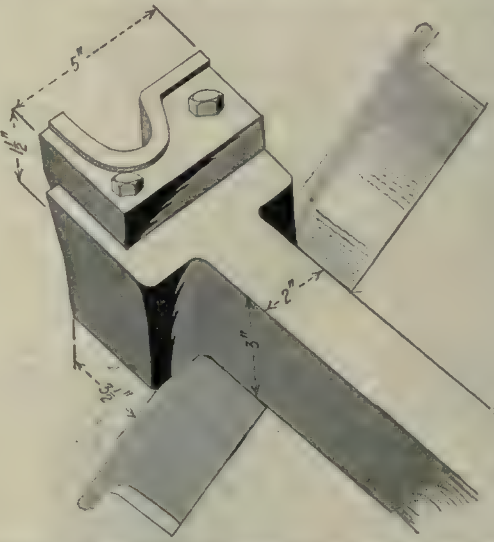


FIG. 8. DETAILS OF TREAD FORMING TOOL

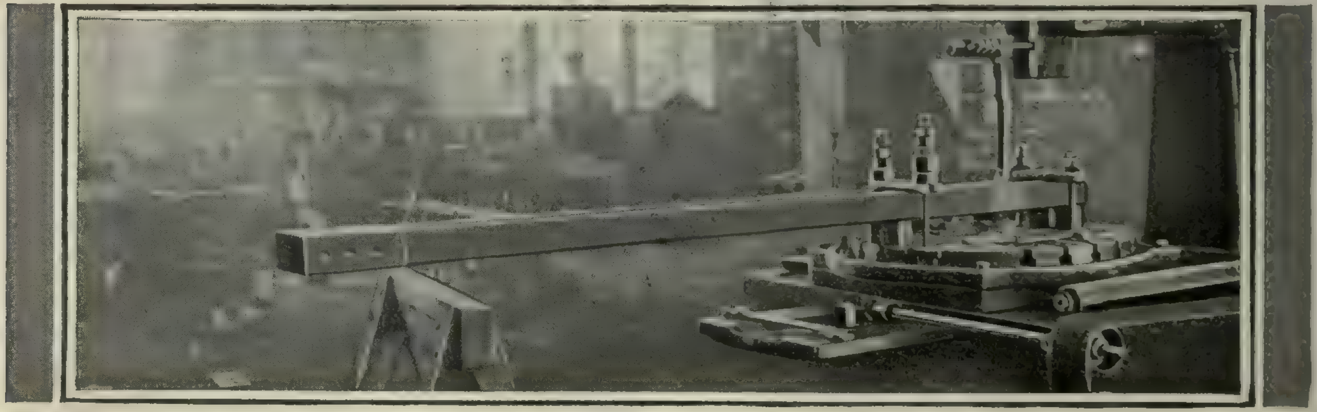


FIG. 4. USING THE SLOTTER ON THE HEAD OF A HEAVY ROD

A pair of such drivers are shown in the lathe, in Fig. 6, and at the side of the tailstock will be seen the double-hooked sling by which the work is picked up by the crane for placing between centers or for removing from the lathe. The frame of the sling is triangular in form, with a clevis at the top for receiving the hook of the overhead traveling crane and with a single long link and hook at each of the lower two corners for suspending the pair of wheels in balance.

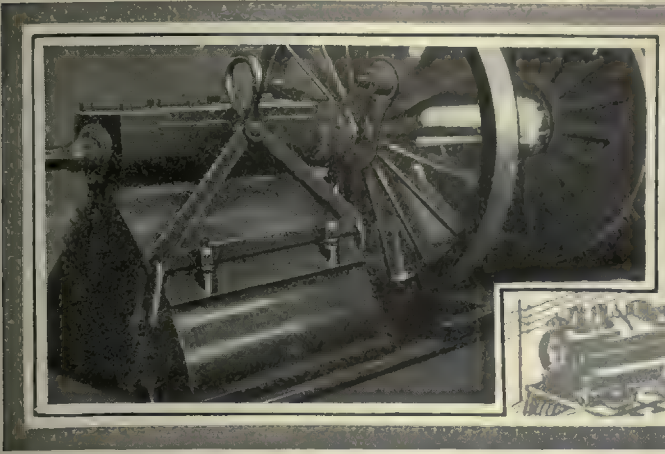


FIG. 6. TURNING A PAIR OF DRIVERS

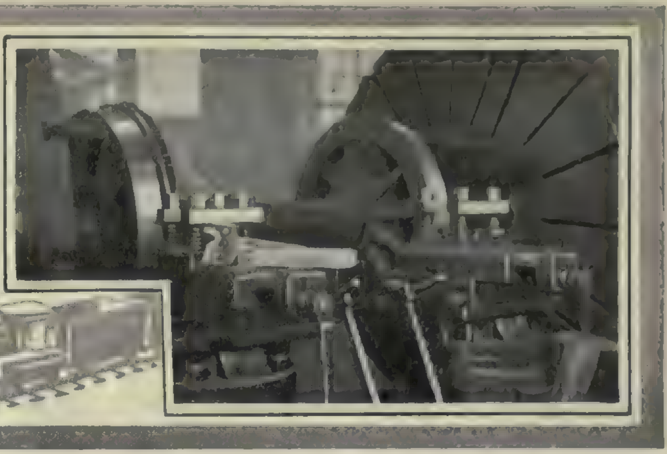


FIG. 7. TURNING TREADS AND FLANGES

The character of the tools used for turning treads and flanges is best shown by Fig. 7, which represents a pair of truck wheels in another big wheel lathe. The work is roughed out with hog-nose turning tools; then the treads and flanges are finished with broad-faced tools and forming tools like those shown in the cross-slide of the machine. A detail of one of the pair of forming tools is given in Fig. 8; and as there shown, the cutting is a heavy block of steel bolted to a seat on the 2 x 3-in. holder. The tools themselves are of Mushet steel 1½ in. thick, with the body of the tool formed ⅛ in. or so lower than the actual cutting edge, so that the narrow ledge around the formed section of the tool is readily ground off when sharpening, without having the entire upper face of the block dressed off.

FIG. 3. A PRESS FOR ROD BRASSES

In turning steel tires here the usual practice is to take about ¼ in. depth of cut with the turning tools and $\frac{3}{16}$ in. feed per revolution, the speed of the work being 13 ft. per minute; $\frac{1}{16}$ in. is left for finishing with the forming tools. In finishing the tread and flange with these tools the wheel is driven at a peripheral speed of about 9 ft. per minute.

ALLOWANCES IN BORING TIRES

It may be of interest at this point to mention the allowances in tire boring for various sizes of wheels. The table of allowances covers tires for all wheels from 45 to 84 in. inclusive.

Analysis of this table will show that the allowance for shrinking on the tires of different sizes, starting with 0.939 in. for the smallest, or 45-in. size, increases by practically 0.010 in. for each intermediate size up

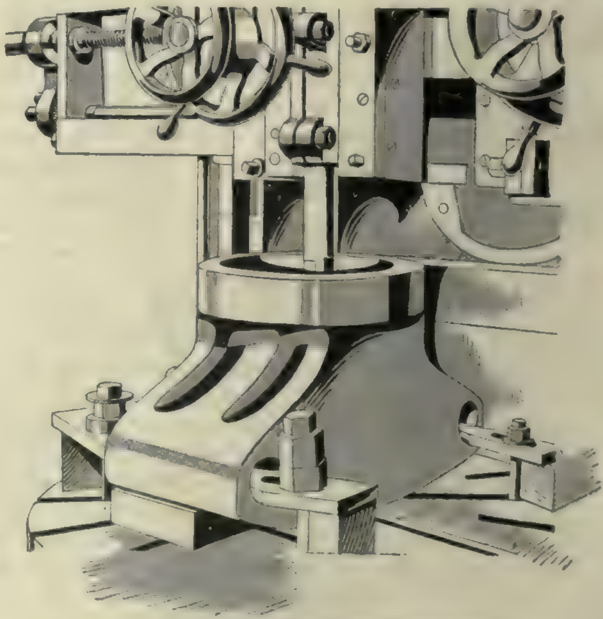


FIG. 9. A WORKHOLDING METHOD

to 73-in. wheels, where the shrinkage allowance becomes 0.085 in., the increment of advance then becoming about half that between the smaller sizes and reaching in the case of the 84-in. drivers an amount equal to 0.105 in., or virtually 0.1 inch.

Further data bearing upon the question of re-turning and replacing of driver and truck-wheel tires will be presented in another article devoted especially to wheel and axle operations.

ALLOWANCES FOR TIRE TURNING

Nominal Outside Diameter, Inches	Diameter of Wheel Center, Inches	Diameter to Bore Tire, Inches	
45	38	37.9603	37 31/32
51	44	43.9505	43 61/64
55	48	47.9500	47 61/64
57	50	49.9406	49 15/16
63	56	55.9308	55 59/64
69	62	61.9209	61 59/64
73	66	65.9144	65 29/32
77	70	69.9078	69 29/32
79	72	71.9045	71 29/32
81	74	73.9012	73 29/32
84	78	77.8947	77 57/64

OTHER WORK

Not all work of a miscellaneous nature coming to the shops to be machined is as readily handled as the casting in Fig. 9. While apparently of awkward form for holding on the table of the vertical mill, particularly because of its rocker-shaped lower surface, it is readily secured by resting it upon two wedge-shaped blocks that serve as a cradle, while four straps are used at the four corner openings to hold it fast during the boring operation.

The truck in Fig. 10 is one of a number made in various forms for handling certain classes of work conveniently. This particular truck is adapted especially for picking up and moving about the shop such parts as axles, shafts of one kind or another and other members of similar character. In the form illustrated the truck is fitted with a long steel handle made in one piece with an extension at the rear of the axle for suspending a pair of tong-shaped jaws that correspond in dimensions with a similar pair of jaws hanging at the front of the axle. The proportions of these jaws are such as to admit shafts or axles of practically any size used about the plant, and work of any length may be moved with facility. The handle, it should be noticed, is sufficiently long to enable ample leverage to be applied for readily lifting heavy work from the floor; and the balancing of long lengths is of course made possible by the liberal center distance between the suspending jaws the construction of which is clearly shown in the illustration. These carts have proved to be very convenient for handling axles.

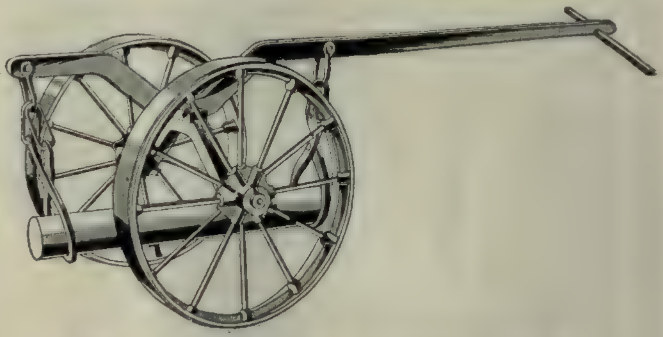


FIG. 10. A CART FOR HANDLING AXLES

The Engineering Council of the United Engineering Societies

On June 27 was held the first meeting of the Engineering Council. This body is a department of the United Engineering Society and has recently come into being as a medium of coöperation among the four national engineering societies. The function of the council may perhaps best be described by the following extract from the by-laws of the United Engineering Society: "The council may speak authoritatively for all member societies on all public questions of a common interest or concern to engineers."

The council is composed of twenty-four members, five being appointed by each of the four founder societies and four by the United Engineering Society. Its present membership follows:

American Society of Civil Engineers—J. F. Stevens (Charles Warren Hunt), George F. Swain, F. H. Newell, Alexander C. Humphreys, F. D. Galloway; American Institute of Mining Engineers—P. N. Moore, S. J. Jennings, B. B. Lawrence, J. Parke Channing, Edwin Ludlow; American Society of Mechanical Engineers—I. N. Hollis, Charles Whiting Baker, John H. Barr, A. M. Greene, Jr., D. S. Jacobus; American Institute of Electrical Engineers—H. W. Buck, E. W. Rice, N. A. Carle, P. Junkersfeld, C. E. Skinner; United Engineering Society—Clemens Herschel, B. B. Thayer, I. E. Moultrop, Calvert Townley.

At the organization meeting held in the rooms of the American Society of Mechanical Engineers at 2:30 p.m., June 27, the following officers were elected: President, I. N. Hollis; vice presidents, H. W. Buck, George F. Swain; secretary, Calvert Townley; Executive Committee, the four officers named, with J. Parke Channing and D. S. Jacobus.

The council discussed at length ways and means by which the founder societies through the council may be of use to the nation. The unanimous desire to help the Government in the prosecution of this war resulted in a resolution instructing the Executive Committee to coöperate with the Government in procuring the services of engineers, also the appointment of a committee of three, consisting of H. W. Buck, A. M. Greene, Jr., and Edmund B. Kirby, to consider the best means of utilizing the inventive ability of members.

The secretary was instructed to inform all Government bureaus that might be interested in the organization of the Engineering Council and its desire to be of assistance.

Development of Pneumatic Hand Tools

By GLENN B. HARRIS

SYNOPSIS—*How an invention in one line led to the development of one of America's great industries, and in a line entirely dissimilar, is here described by one of the pioneers.*

IN THE year 1877, a patent was granted to Samuel W. Dennis, of San Francisco, and a year later a patent to Dennis & Moreau, of the same place, both patents for dental plungers.

After several years of experimenting, the device had been developed to the point where the inventors believed a public exhibition of the instrument would be to their benefit, and accordingly such an exhibition was given in San Francisco, in the early '80s.

Before describing the results of this exhibition, it would perhaps be well to refer briefly to the construction of the little device. It consisted of a body portion having a cylinder in which was designed to reciprocate a small piston, only ¼ in. in diameter, controlled by a small valve moving transversely to the movement of the piston and carried thereby. The stroke of the piston was exceedingly short, and the blow was exceedingly powerful, even under the slight pressure—of from 5 to 8 lb. to the sq.in.—of compressed air.

THE EXHIBITION

In the clinic held in San Francisco, the plugger was set in operation, and its hum was like that of a drove of bees. It was estimated that at least 10,000 blows per minute were made. On the first application of the instrument to the patient's tooth, it was found to be too powerful for the purpose intended, and its action was so rapid that it could not be held in position. Injury to the jaw of the patient being operated upon was the net result of the test.

At the demonstration given, among those present was a gentleman from Vermont, who was heavily interested in marble quarries and in marble manufacturing. Possessing true Yankee characteristics, he shrewdly foresaw the possibilities of the instrument for cutting, dressing and carving marble.

Entering into negotiations with the owners of the patents, control was obtained, and the developing of the invention for use in marble was begun in Rutland, Vt. At this place various models of the "pneumatic tool," as it was now termed, were constructed and tried on Vermont marble, which is soft and easily cut. The machine seemed to work satisfactorily in a manner, but there was still something lacking to make it entirely successful. Finally, after repeated attempts, a tool was produced that the marble experts passed upon favorably. This machine was constructed of cast iron for a cylinder, with a steel piston ¾ in. in diameter for fine or finishing work, and 1 in. in diameter for the heavier or roughing work. The stroke of this piston was exceedingly rapid, probably as high as 6000 per minute.

The heavier tool would satisfactorily cut the marble, which was removed in pieces of considerable size, while the small tool would smooth or dress the marble perfectly, so there was necessity for but little finishing, in the way of rubbing, etc. In the finishing operation with the small tool, the marble was removed in the form of an almost impalpable powder. The tool depended for its rapid cutting ability on a great multiplicity of short, light strokes in a brief period of time, so there was not the danger of stunning a stone that is present in the hand operation, where the blows are heavy and swung from the shoulder. In addition to this, a much sharper arris could be run, and there was no danger of breaking out or otherwise injuring a delicate piece of carving work or statuary. The tool would cut probably from two to three times as fast as would the ordinary workman by hand. This fact worked to the detriment of the tool, as the men were apprehensive that it would displace an appreciable percentage of their number, although this was afterward proved to be far from true, due to the fact that the cost of fine and carved work was materially reduced and the demand therefore greatly stimulated.

A further objection to the tool was urged on the ground that it would produce paralysis. It is true that the extremely rapid reciprocation of the piston in the cylinder induced intense vibration of the tool in the hands of the workmen and produced a sensation similar to that of a galvanic battery, but so far as detrimental effect was concerned it was not present. The men, however, could not be persuaded of this fact. The objections of the workmen made the introduction of the tool extremely difficult, manufacturing facilities were crude, it was a new art in which the mechanics were unskilled, mistakes in manufacture were of frequent occurrence, breakages were a constant factor, and altogether the outlook was anything but bright.

DIFFICULTIES AND DISAPPOINTMENTS

The pneumatic tool is a machine that must be made with the greatest exactness, and the slightest variation will greatly affect its efficiency. Even in the present advanced state of the art of manufacturing this extremely efficient tool, where jigs and gages are employed and the work is to the thousandth of an inch or less in exactness, one tool will show a marked degree of efficiency over another of the same lot; and yet why this is so is unexplainable.

Disappointed at the lack of success in marketing the machine and unable to prosecute its further introduction by reason of lack of capital, the owner of the patents sought their disposal in New York, in which city he met James S. MacCoy, who had recently reached that point from the West, where he had installed waterworks at a considerable profit. Mr. MacCoy immediately saw the possibilities of the device and agreed to finance a company to manufacture and market the invention. It is proper here to give to Mr. MacCoy full credit for the initial, and more or less successful, commercial introduction of the pneumatic tool to the world.

In 1884, Mr. MacCoy and business associates organized the American Pneumatic Tool Co. and obtained quarters. After installing machinery and engaging a small force of the best mechanics obtainable, they started manufacture.

The lines of the tool were redesigned, and some refinements were effected. Efforts had been made at introduction, when fire destroyed the entire plant. A new start was made, and the tools were successfully introduced in a number of the largest marble-manufacturing concerns in New York City. The great prejudice of the workmen was gradually reduced, and prospects for the future seemed promising. However, at this point it was found impossible to interest the small dealer and manufacturer in the use of the machine.

HEAVY ROYALTIES CHARGED

The American Pneumatic Tool Co. had formulated a plan of royalty for the use of the tool, and this royalty involved the payment of $180 per annum. Aside from this exorbitant rental charged on a machine costing, at that time, at the utmost not more than $20 to manufacture, repair charges at a high rate were also added; and rental of the tool must be paid for whether it was in use or not. Rebates for non-use were not allowed, and the small manufacturer who did not have constant work for the machine felt that it would not be a paying investment. In addition, its merits were not realized; further, the introduction of an air-compressing plant was necessary, and at this time compressors were built mostly in the very large sizes for mining and tunneling work. At this period the stone manufacturer, as a rule, and especially those engaged in the monumental trade were of small means, and introduction was extremely slow under the almost prohibitive conditions imposed by the American company.

In 1888, the company had progressed to the point where its income from rent of tools for stone use and for their repair amounted to about $6000 per annum, but the expense of manufacture and introduction amounted to several times this sum. Funds were low, and the company was very deeply in debt. The sale of stock was resorted to; but customers for it were few and far between, and the prices realized for it were exceedingly small. Mr. MacCoy, president and organizer of the company, frequently came to its financial aid, and it was entirely due to his assistance that the company was able to continue in existence.

PNEUMATIC TOOLS ON STONEWORK

Among the largest users of the tool in the marble business was the firm of Batterson, See & Eisele, of which firm the senior member was extensively engaged in the manufacture of ornamental building and monumental granite. In noting the work of the tool on marble, he thought it possible to adapt it for use on granite and entered into negotiations for the installation of a complete plant at his large granite monumental works at Westerly, R. I. As previously stated, the tools were constructed of a cast-iron cylinder with a detachable front end or nosepiece, also of cast iron, and these parts broke on the refractory granite after but a little use.

They were strengthened, but the result was the same, and breakages were of such frequent occurrence that the shop was kept busy in making repairs and in supplying new tools, for which, of course, no charge could be made. Much valuable time and money were lost, but the field could not be abandoned. The chances of success in the granite industry seemed remote. It was then proposed to employ steel in the cylinder and nose, and this was done, with the result that the tools stood up fairly well, and in addition it was possible to make them lighter and altogether less cumbersome.

Attention was then given to the introduction of the tool for working granite, as it was proving highly successful for this purpose. Ninety average-size sunk monument letters could be cut per day as against 25 to 30 by hand. The machine letters were deeper and sharper, and presented an altogether improved appearance over those of hand cut. This was also true of raised letters and carving. It was hard, however, to convince manufacturers of the tool's practicability and adaptability for their work. The cry was always, "It may work all right on some granites, but it would not do for our stone." They were also incredulous that the machine could do the work performed by hand.

It was the practice of the American company to introduce the tool on trial for 30 days free of charge, to furnish and erect an air plant and also to supply an instructor without charge. There were always setbacks, and it was frequently necessary to retain the instructor at a given point for several months at a large *per diem* and expenses, in order that the worth of the tool might be proved, or the prejudice of the workmen overcome. If a plant was installed and then removed, every manufacturer in the neighborhood became skeptical, and it was impossible to prevail upon another to permit an installation, even though it was on trial and without expense to him.

Experiments were constantly being carried on in the shop, and new uses to which the tool might be put were thought out. It was believed that any work on which the hand hammer or mallet was then used could be better served by the pneumatic device, and an immense field for the tool opened to view from the promoters' standpoint.

BOILER AND FLUE WORK

The calking of boilers and the beading of flues of the latter were suggested, and a tool for this purpose was then designed and built. The attempt was without any material success, owing to lack of power and various other defects. To increase the power of the tool, the piston diameter was enlarged without materially lengthening the piston stroke, and this so greatly increased the difficulty of holding and also set up such an intense vibration that the workmen flatly refused to run the machine, even under a subsidy of from 50c. to $1 per day. Further, there was still lack of power except on the kick, which caused one customer to remark that we ought to turn the machine around and run it backward.

Continued effort and experiment finally resulted in the production of a tool that performed fairly satisfactory work; but the intense vibration was present, and the workmen were lamed for a considerable length of time by reason of the fact that a new set of muscles were brought into play. Strikes in boiler shops where introduction was attempted were frequent, and all imaginable means were resorted to, to discredit the hammer and its work. In one shop it was necessary to protect the company's instructor with an armed guard.

However, the tool for boiler calking and flue beading was now, so far as the quality of its work was concerned, a practical success; but it was termed a "man killer," and introduction was slow and costly. The machine was rented at $300 per annum plus repairs; this arrangement proved objectionable and retarded the obtaining of a larger business in this line.

By persistent and constant effort new customers were added; and in the year 1890 there were about one hundred concerns having the tool in use for boiler and tank work, netting rentals of approximately $36,000 per year, which with the income from the stone field, now increased, brought the company about $60,000 per annum gross, out of which there was a small profit.

The low cost of producing the tool and the relatively large amount at which it was rented naturally excited the cupidity of inventors and manufacturers, and numerous patents were applied for and granted in this line of invention.

Albert J. Bates, of Joliet, Ill., obtained a patent on a tool for cutting granite and other stone and constructed a number of tools that were used by the convicts in the Illinois State Penitentiary—on contract granite work. The Bates tool was crudely constructed, but did its work fairly well and possessed a principle that promised good results. This patent coming to the notice of the American Pneumatic Tool Co., it was negotiated for by the company and finally purchased at a nominal figure. While the patent was loosely drawn, it possessed one claim that seemed to be substantial and that proved to be a serious stumbling block to other concerns desirous of entering the pneumatic-tool field.

Among other inventors to enter the line of pneumatic tools was Daniel Drawbaugh, who had early invented a telephone and who for years contested the right of priority to this device with Bell, only to fail. The Drawbaugh tool did satisfactory work, and a number of New York capitalists organized a company for its manufacture and introduction to the market. They also proceeded on the royalty basis; but their rental charge was reduced to one-half that of the American company, and serious inroads were made in the latter's business.

THE PATENT-LAW SUIT

A patent-law suit was instituted against the Drawbaugh company and was vigorously contested. Large sums of money were spent for prominent patent counsel, patent experts, witnesses and other expenses. The case, on coming to trial, was decided in favor of the American Pneumatic Tool Co.; an appeal was taken to the higher court, which unanimously affirmed the decision of the court below, and the Drawbaugh company was forced to retire from the field. The patent litigation was based solely on the third claim of the Bates patent, which was declared valid and to be infringed. The other patents of the American company were weak and worthless, and sole reliance for protection against alleged infringers had to be placed in the third claim of the Bates patent.

The American company was now on the point of failure, owing to large expenditures in patent litigation and decreased revenue due to inroads in its income by the Drawbaugh company.

At an early period in the industry, the late Pierre Choteau, of St. Louis, had patented a small coal-mining machine. The valve action of this apparatus seemed to promise well for a calking and chipping hammer. Machines for this purpose were accordingly constructed and placed in one or more of St. Louis' boiler shops for test. These tools delivered a vicious blow; but they were extremely hard to control, were opposed by the workmen, were not serviceable in use and did not seem practicable. The Choteau hammer lay dormant for several years and was finally taken up by a local manufacturer.

In the early '90's the writer, who was secretary and sales manager of the American Pneumatic Tool Co., by chance met J. W. Duntley and in the course of conversation referred to the device that we were marketing and entered into a detailed description of the tool and its work. Mr. Duntley, who had been brought up in the metal trade, immediately became very much interested. He desired to know if we chipped metal and thought this an immense field, as it afterward proved to be. Our tool, due to its short stroke, would not cut the metal, but simply had a pecking action, cutting in a short distance and then stalling. It is true that we could remove a thin fin from cast iron, but the extremely rapid action of the tool caused such intense vibration that it could not be held in place. I advised Mr. Duntley that we were endeavoring to perfect the tool for chipping, riveting and general metalwork and that we were most anxious to do so at any early date, at which time he was desirous of connecting himself with us and handling the metal line.

A NEW TOOL INTRODUCED

It was unfortunate for the writer and for the company that the connection was not made then and there, for this conversation and the great interest aroused in Mr. Duntley were to lead directly and in the very near future to the introduction of a tool on the market which was to revolutionize the industry and also manufacturing methods. It was also to result in the formation of a company that by its progressive, aggressive and up-to-date business methods was practically to control the business of the world in pneumatic-tool products. Mr. Duntley, having in mind his conversation with the writer and the wonderful possibilities of the pneumatic tool, was probably ever watchful to gain an entrance into the field. At all events, he secured control of the Choteau hammer, and with his capital and that of such friends as he could interest, started the marketing of the tool. Their efforts were without avail. The hammers proved unsatisfactory for the work for which they were intended. Mr. Duntley's capital was soon exhausted; and as he has told me in subsequent conversations, he did not know which way to twist or turn.

Joseph Boyer, at that time owning a small machine shop in St. Louis, was manufacturing the Choteau hammer and had had some experience in this line. In 1887, he had patented a hammer for chipping glass molds. It was indeed crude as compared with later Boyer products to be given to the manufacturing interests of the world, but it seemed to serve his purpose on the mold proposition. Mr. Boyer apparently failed to appreciate the commercial value of a successful product in this line, for he was content to allow his invention to remain undeveloped and unintroduced.

After Mr. Duntley's failure with the Choteau hammer, he remained undaunted. He was still as determined as ever to make a success of the pneumatic tool and to make a fortune. Mr. Boyer gave assurance that he could produce a machine that would meet all requirements, and Mr. Duntley, even from his brief experience with the Choteau hammer, was confident that the product could be marketed. An agreement was accordingly entered into by which Mr. Boyer was to manufacture the tools and Mr. Duntley to sell them. Mr. Duntley was successful in raising a small amount of capital and immediately began a vigorous campaign of introduction. His efforts were naturally directed to the customers of the American Pneumatic Tool Co., and as it was only necessary to disconnect our machine and attach his own to the hose pipe and give a complete and what was at all times a satisfactory demonstration, the sale of his machine and the removal of ours resulted.

Mr. Duntley deemed the rental or royalty proposition a bad one and readily foresaw that only the largest concerns would enter into a contract for the rental of a small tool at $300 per year, and that the large concerns would only take the tools in very limited numbers. It was his idea to supply the many instead of the few, and to make the introduction of the tool universal. The efforts of the Chicago Pneumatic Tool Co. were also directed to the sale of hammers to the repair shops of railroads, where the work was of an intermittent character and would not warrant the payment of a rental charge as exacted by the original company, but would warrant the purchase of a number of these machines.

The business of the Chicago Pneumatic Tool Co. for the first year was small, amounting to approximately $8000; but the tool had proved itself in all ways acceptable, and in addition its price at outright sale was only that of five months' rental of our machine. There was no comparison between the two hammers. We were so far outranked that we could not even sit up and take notice or recover from the shock of its disclosure to us.

The Boyer Hammer

The Boyer hammer was a radical departure from previous tools. It was provided with a handle by which it could be conveniently held and guided, and with a thumb-controlled throttle valve by which it might be started and stopped and its blow regulated. Its valve was simple, but extremely effective; but above all, Mr. Boyer realized that vibration was the one great drawback to the general introduction of the hammer, as the workmen must be satisfied, and yet this vibration must be overcome at no sacrifice of power. In all hammers heretofore produced the stroke was very short, and increased power was obtained by enlarging the piston diameter, which resulted in marked increase in vibration, the latter making the tool almost impossible to hold. Mr. Boyer believed that a slower, longer and consequently a heavier blow would solve the problem. He therefore increased the stroke of the piston from $\frac{11}{16}$ in. in the American hammer to 3 in. for the all-round hammer, and decreased the piston diameter from $1\frac{1}{2}$ to $1\frac{1}{16}$ in. The result was a tool delivering a blow more like that of the hand hammer and capable of taking a heavy cut in boiler-plate or other metal at a high rate of speed, and with the vibration so reduced that the workmen preferred the pneumatic hammer to handwork and were as jealous of their own machine as is a man of his high-grade watch.

The business of the Chicago Pneumatic Tool Co., however, was not without its vicissitudes, and principal among these was lack of capital. Funds were so low that at times it was necessary to borrow small sums to pay for expressage and other minor expenses; and as soon as a tool was sold, the bill was promptly discounted at the bank for what it would bring. In this way the company maintained its existence. To those who think that the success of the most meritorious of inventions comes with luxurious ease and that all that is necessary is to sit by and watch the dollars roll in, disabuse your minds. In most cases well-directed effort in another line will bring equally good results and very, very much less worry.

Litigation and the Result

The American Pneumatic Tool Co. began suit against the Chicago Pneumatic Tool Co. under the Bates patent, the third claim of which had already been declared valid by the court of last resort. This suit made introduction by the Chicago company doubly hard, but it went ahead in spite of this obstacle, furnishing bond to its customers where required. The case went to trial, and was decided in favor of the American Pneumatic Tool Co., and an appeal was taken. The higher court held in its decision that there was some doubt as to whether the third claim of the Bates patent, while valid, could be held to include the Boyer device and remanded the case to the lower court for additional evidence on this point.

This evidence being taken, the case was reheard, and a decision in favor of the Chicago Pneumatic Tool Co. was rendered. The American company was now in a state of financial distress and had no funds with which to prosecute an appeal. It drifted in a desultory way and was finally wound up at a receiver's sale. Its career thus ended, the field was clear to the Chicago company, and it progressed by leaps and bounds. It had many imitators, all following the lines of a small piston diameter and long stroke. It seemed impossible, however, for any of these tools to reach the Boyer standard of efficiency, coupled with ease of holding and general absence of breakage or derangement of parts. The policy of the company was conciliatory toward the workmen, and they reciprocated by fair treatment of the hammer; and by their efforts and good will they greatly aided in its introduction and, when once introduced, in its sticking. What seemed at times to be prodigal expenditures for advertising, for attending conventions and otherwise promoting the introduction of the hammer were shown to be wise, and it is doubtful if any concern promoted the introduction of its goods more judiciously.

The company was at all times watchful for anything new and promising well in the line of pneumatics and showed by its faith in the future of the business that confidence which begets success. Its absorption of other pneumatic interests was on a large scale and seemed impossible of successful results. These results, however, followed.

I understand that at the present time the Chicago Pneumatic Tool Co. operates eight large plants and maintains 25 branch offices in this country. In my time, one was hard enough to provide with funds.

Thus from the simple dental plugger has resulted the calking and chipping hammer, the scaling hammer, the pneumatic hand riveter, the sand rammer, the pneumatic hand rock drill, the stone cutting, carving and dressing machines.

It is said by authorities that the construction of high buildings economically has been made possible by the hand riveter. An equal amount of saving is also found in ship and bridge work and, in fact, in all structural work where riveting is necessary. What the manufacturing industries of the world would do without this important time- and labor-saving device is hard to say, but many of the operations would doubtless be much more difficult than they are at present.

Electric Controllers for Direct-Current Industrial Motors

By A. G. POPCKE
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SYNOPSIS — *Characteristics of direct-current motors as regards control. General applications of both armature and field control. Faceplate, drum, multiple-switch and magnetic controllers are illustrated and their uses pointed out.*

THE rapid development of motor application in industrial work would have been impossible without a corresponding development of controllers and starters. The application of motors implies motion and the control thereof; industrial control, therefore, involves the starting and stopping of motors and controlling their speed. The function of an electric controller is to provide a means of starting and controlling the speed of electric motors, to protect the motors and supply lines against heavy current and to protect the operators against mechanical and electric injury. Industrial controllers can be classified with respect to the characteristic of the motors controlled and with respect to the type of construction used.

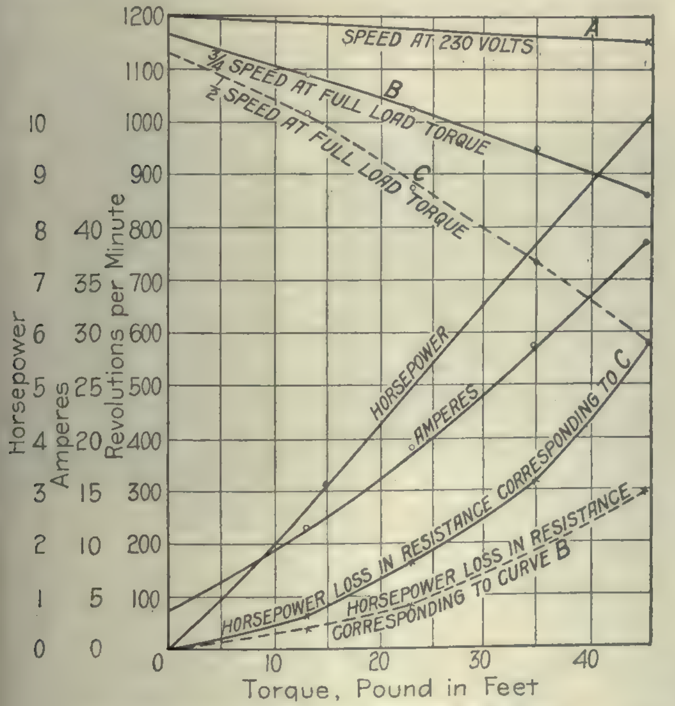


FIG. 1. RELATIONS OF SPEED, TORQUE AND HORSEPOWER

Shows horsepower lost in resistance when speed of 10-hp. 230-volt motor is reduced by armature control

The history of the development of control apparatus is similar to that of other industrial developments. At first, hand operation was used. Later, power-operated controllers were developed, power being supplied principally by means of electric magnets, motors or compressed air. Thus, non-automatic, semi-automatic and automatic controllers have resulted.

To select controllers intelligently, a knowledge of their functions and their relations to the characteristics of the motors that they control is essential. The control for direct-current motors will be discussed first and may be classified as follows, based on the characteristics of the motors:

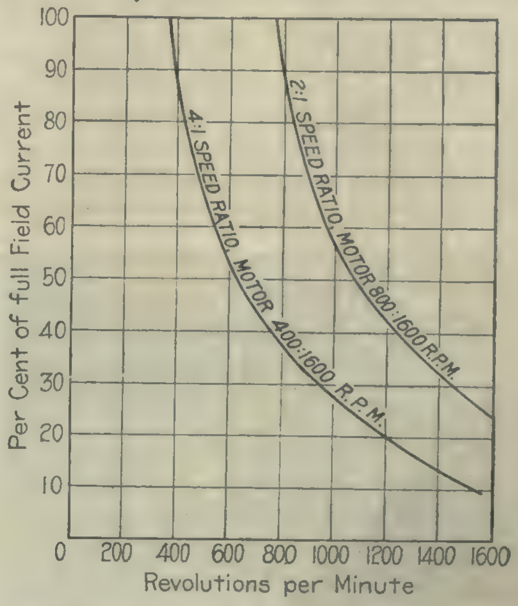


FIG. 2. RELATION OF MOTOR FIELD CURRENT AND SPEED

1. Shunt—constant speed or adjustable speed.
2. Compound—varying speed.
3. Series—varying speed.

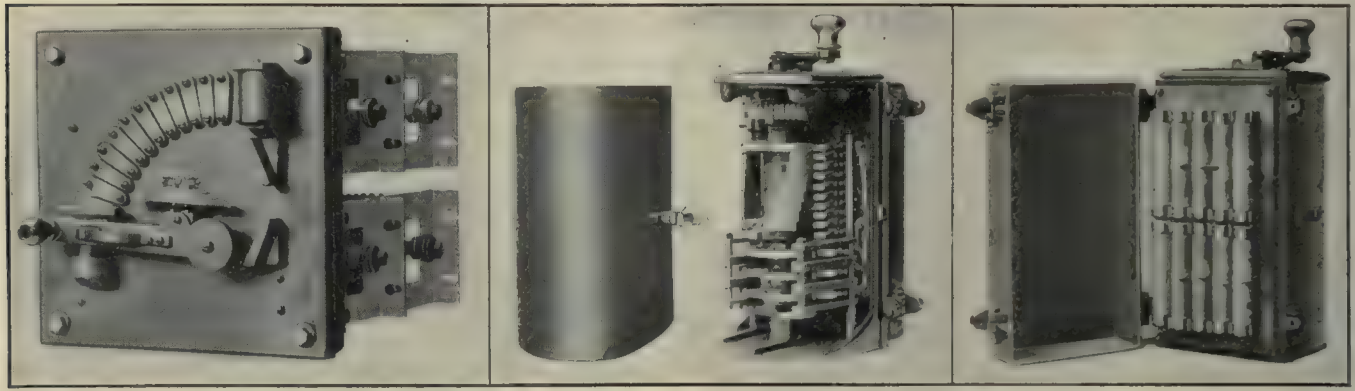
To start direct-current motors, resistance must be inserted in the armature circuit, first to limit the starting current, thus protecting the motor and line; second, to limit the starting torque, thus protecting mechanically the machine operated. Exception to this is taken in case of small direct-current motors smaller than ½ hp. and also in case of the so-called self-starting direct-current motors that are designed to limit the starting current without the use of external resistance. This type of motor is frequently used in operating pumps, where they are started from a remote point. In general applications the starting currents are limited to the values shown in Table I.

There are two standard methods of adjusting the speed of direct-current motors: (1) By armature control, or the regulation of the voltage at the brushes by means of an adjustable resistance in series with the armature; (2) by field control, or the regulation of the field strength by means of an adjustable resistance in the shunt field circuit. These two methods vary widely in the characteristics they impart to the motor and in the applications for which they are suitable, as will be shown. Motors controlled by method (1) operate as varying-speed motors; those controlled by method (2) are called adjustable-speed motors.

In this discussion of armature control it is assumed that the field strength remains constant, which should be the case in practice. By armature control any speed below that at full voltage can be obtained at reduced horsepower. The motor speed is approximately proportional to the voltage at the brushes. The brush voltage is the difference between the voltage of the line and the voltage drop in the controlling resistance. The voltage drop in the resistance is the product of the resistance in ohms, which remains practically constant unless adjusted, and the current. Since this current varies with the torque, the speed under armature control depends upon the torque developed.

TABLE I. STARTING CURRENTS AND FULL-LOAD CURRENTS OF DIRECT-CURRENT MOTORS—BASED ON 230-VOLT MOTORS

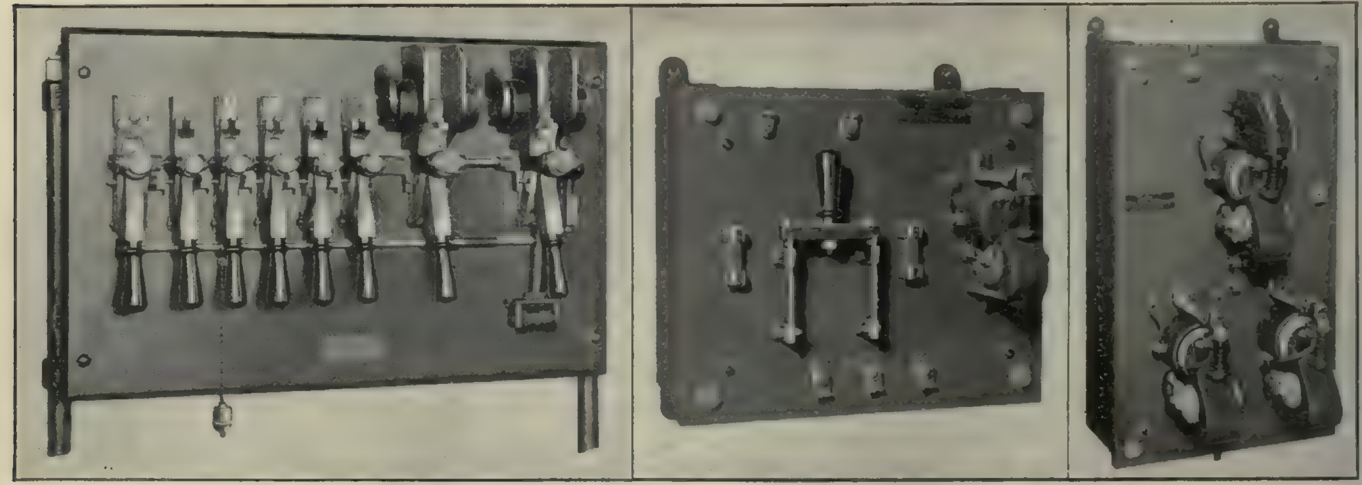
Horsepower	Starting Current, Amp.	Full-Load Current, Amp.	Horsepower	Starting Current, Amp.	Full-Load Current, Amp.
1	12	4	20	180	80
2	24	8	25	225	100
3	36	12	30	270	120
5	45	20	40	360	160
7½	68	30	50	450	200
10	90	40	75	685	300
15	135	60	100	900	400



FIGS. 3 TO 5. VARIOUS CONTROLLERS
Fig. 3—Faceplate-type controller. Fig. 4—Drum-type controller, front view, cover removed. Fig. 5—Drum-type controller with resistance mounted on back

With constant torque the motor current is constant, and at any given adjustment of the controlling resistance the motor speed remains constant. Every change in the controlling resistance produces a corresponding change in the voltage drop in the resistance and likewise in the motor speed with constant torque. Since the horsepower output is proportional to the product of the torque and the speed, the output must vary with the speed if the torque remains constant. Therefore, at half-speed with armature control the motor output is only one-half that corresponding to the same torque at full speed, the other half of the energy taken from the line being converted into heat in the resistance. This method results in reduced efficiency.

With varying torque and with any fixed portion of the armature controlling resistance in circuit, the motor



FIGS. 6 TO 8. A FEW DIFFERENT TYPES OF STARTERS
Fig. 6—Multiple-switch type starter. Fig. 7—Contactor-type motor starter. To start motor, operator closes the knife switch. When the starting current has reduced to a predetermined value, the magnetic contactor closes, throwing the motor on line voltage. The resistance is mounted behind the slate inclosure. Fig. 8—Type of magnetic starter furnished when remote control by push button is desired

current, the voltage drop in resistance and therefore, the motor speed will vary also; that is, at a given resistance an increase in torque will cause a decrease of speed and vice versa, constituting a varying-speed motor. Constant reduced speeds with varying torque are impracticable by armature control.

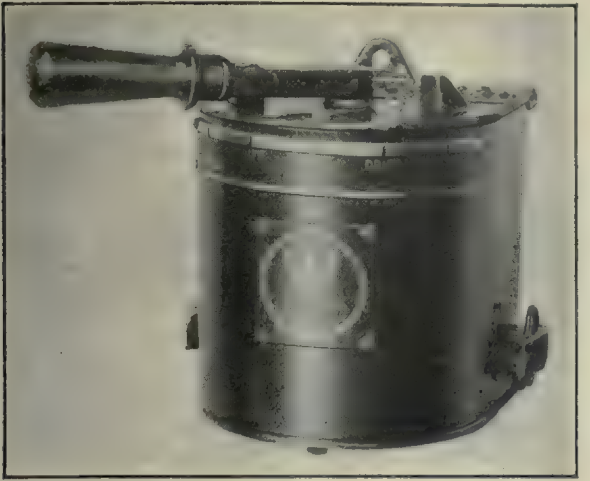


FIG. 11. DRUM SWITCH USED TO REVERSE MOTORS CONTROLLED WITH MAGNETIC CONTROLLERS

An example and reference to Fig. 1 will show graphically the relations just described. With full voltage on the motor the relation between torque and speed is shown by the curve marked *A* (speed at 230 volts). The relation between horsepower and speed with full voltage on the motor is shown by one of the curves. This shows that speed is nearly constant. If resistance is inserted in series with the armature to obtain one-half speed at full-load torque, the relation between speed and torque is represented by the curve marked *C* (one-half speed at full-load torque). Notice the large increase in speed with small reduction in torque or horsepower. The loss of power in resistance is also shown in this illustration. Similar relations are shown when resistance is inserted in the armature to produce three-quarters full-load speed at full-load torque (curve *B*). The principal advantages of armature control are simplicity, applicability to all direct-current motors, whether shunt, compound or series wound motors, and low speeds. Its disadvantages for many services are poor speed regulation and low efficiency at reduced speeds. For services in which the torque either is constant or decreases with the speed armature control is practicable and often very desirable. Examples are the operation of fans, blowers and centrifugal pumps. These require an unvarying torque at each speed, and with any given fan or blower operating under usual conditions the horsepower varies nearly with the cube of the speed, making this control fairly economical.

Armature control is also advantageous where operation at reduced speeds is intermittent or where very little speed reduction is required, as with conveyors and hoists; it can also be used in some cases with plunger pumps and air compressors.

For service requiring continuous operation with full-load torque at reduced speeds armature control is very inefficient. For varying torque service requiring constant speeds below normal this method of speed control is impracticable. For this reason armature control is not recommended for machine-tool service.

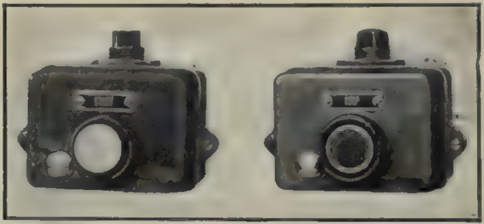


FIG. 9. PUSH BUTTONS ARRANGED FOR CONDUIT WIRING

With field control speeds higher than normal are obtainable. With constant voltage at the brushes the speed varies in inverse proportion to the change in field magnetism—that is, the weaker the field current of the motor the higher its speed and vice versa (see Fig. 2). With constant current the torque varies directly with the change in field magnetism, thus keeping constant the horsepower output, which is proportional to the product of the torque and the speed. The field magnetism changes with the change of shunt field current, though not always in a direct proportion.

This system of control is simple, effective and efficient. It involves the use of a minimum number of line wires and the smallest possible amount of auxiliary apparatus; as a rule, is can be installed for a given service at a lower cost than any other system. The current handled by the controller is small, and the resistors are of comparatively light construction.

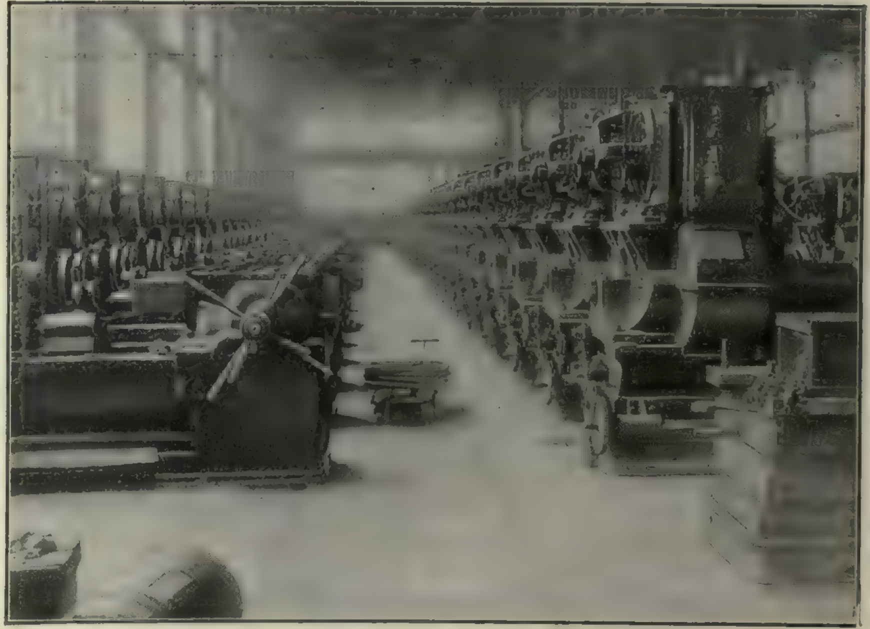


FIG. 10. INSTALLATION OF PROJECTILE LATHES WITH MAGNETIC CONTROLLERS FOR ADJUSTABLE-SPEED MOTORS

From the standpoint of operation this method is particularly satisfactory. With shunt motors the speed regulation at any given speed is good; that is, the speed remains practically constant at all loads within the motor capacity—a matter of special importance to the operation of machine tools and wherever constant speed with varying torque is desirable.

With constant armature current the armature copper loss is constant, and the only variable losses are the field copper, iron and friction losses. The iron loss and field copper losses are highest at the minimum speeds, while the friction losses are highest at the maximum speeds. These losses, varying in this manner, tend to keep the total loss constant, and therefore the efficiency remains approximately constant over the full speed range.

All the foregoing types of direct-current motors are used either in nonreversing service or reversing service. In the case of reversing service two types of control are used. The motor is reversed by plugging—that is, reversing the power applied while the motor is running—or is stopped by dynamic braking.

Dynamic braking is accomplished by allowing a motor to be temporarily driven as a generator by its load. The mechanical energy in the moving machinery is converted into electrical energy and then into heat, which is dissipated in resistance. The result is that the speed of the motor is quickly retarded. The amount of braking action can be adjusted by varying the current flowing in the motor armature.

A load exercising an active torque on the motor armature cannot be brought to a full stop by this method, since with the decreasing armature speed the braking action also decreases. For final stopping, some form of mechanical brake that acts automatically is therefore necessary.

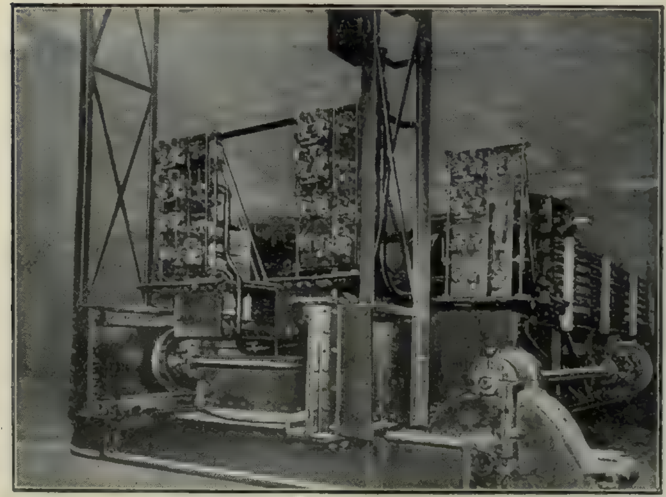
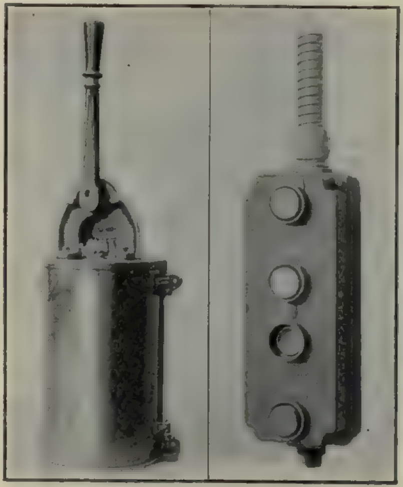


FIG. 12. MAGNETIC CONTROLLERS OPERATING WITH REVERSING MILL ON A FURNACE CHARGER

The advantages of dynamic braking are the practical absence of all wear and tear on the apparatus, convenience of application, and ease, accuracy and certainty of control. In dynamic braking with a properly selected motor, active deterioration is limited to the controller contacts, which can be arranged for quick, easy and inexpensive renewal. No special or additional apparatus is required for braking except the resistance, which can be placed wherever convenient within a reasonable distance from the motor. The braking effect can be adjusted with great accuracy over a wide range by varying the armature current or the field strength by means of suitable resistance. It is possible, as is done with electric railway locomotives, to return energy to the supply circuit; but in industrial service the energy generated is usually dissipated by resistance.

To insert resistance in the armature circuit of direct-current motors, a faceplate type rheostat is ordinarily used, Fig. 3. This type is also employed where speed below normal is desired by inserting resistance in the armature circuit. For use with adjustable-speed motors both armature and field control are often combined in one unit. This type of starter should be specified where a low-priced outfit is desired. Besides the low price, it is compact and is usually mounted (for motors of small and moderate sizes) with the resistor as a self-contained unit, as shown in Fig. 3. It is easy to mount on a wall or panel. The renewal of contacts and, therefore, repairs are inexpensive. Protective features, such as low voltage and overload protection, can be easily applied.



FIGS. 13 AND 14. MILL-TYPE AND PENDANT SWITCHES

Fig. 13—Mill-type master switch. Fig. 14—Combination of push buttons used as pendant switch with reversing-planer equipment

Low voltage protection is accomplished by the addition of a device that will return the starter to the off position when the voltage fails or drops to 40 to 60 per cent. of normal. It is necessary for an attendant to start the motor on return of voltage. This device, therefore, protects both operators and machinery against unforeseen starting. In general, all up-to-date starting rheostats are furnished with this protective feature. Overload protection, as the name implies, is a device that can be set to return the starter to the off position when the motor controlled is dangerously overloaded. In general, the faceplate type of starter, or controller, can be used where small currents are handled. Its disadvantages arise in applications where large currents above 50 hp., 230 volts, must be handled and where ruggedness is essential. This type of controller is rarely used where reversing service is required, or where the motor is started and stopped frequently.

Drum controllers, Figs. 4 and 5, are of medium price. They are compact in construction, but with the exception of the smallest sizes usually have the resistance separately mounted. As they increase in size, the power required to revolve the drum reaches a limit beyond which hand operation is possible, and the cost increases rapidly. They are easily arranged for reversing service and are therefore much used on motor-driven machine tools. In addition to the advantages of medium price and compactness these controllers can be entirely inclosed and made dustproof, and even spray or gas proof. They are mechanically strong and simple to operate, and they can easily be mounted on the motor-driven machinery which they are to control, with the controller handle placed in the position most convenient to the operator, motion being transmitted to the controller by means of small transmission shafts and gears.

In the case of lathes, for instance, the control handle can be located on the apron of the lathe and motion transmitted to the drum shaft through a splined shaft. These controllers are used where it is desired to reverse the motor. In case dynamic braking is desired braking connection can be made on the same drum.

MULTIPLE-SWITCH TYPE

A multiple-switch type of controller, Fig. 6, is built to handle a heavy current with long life of contacts. It is used for starting large motors, 50 to 75 hp. and larger. Low voltage and overload protection can be readily applied, and it is more "foolproof" than either the drum or faceplate type previously discussed. It is also more expensive and occupies considerably more space and is difficult to operate rapidly. This type is made for nonreversing service only.

The type of control best suited to automatic operation is the magnetic type. This consists of magnetically operated contactors mounted on slate panels, shown in the illustrations referred to in the following discussion. This control is the most flexible of all types.

Fig. 7 shows the simplest type for starting a motor. It is started by closing the knife switch shown. Where a push button is desired for remote control, the form of starter seen in Fig. 8 is used. In this case pressing the start button closes the upper switch, the two lower switches shown producing automatic acceleration. Fig. 9 illustrates the style of push button. In connection with push-button starting two general types of starters are supplied—those with low voltage release and those with low voltage protection. Starters provided with low voltage release are particularly adapted for fans, pumps, blowers and similar service, as when the voltage fails, the motor stops and upon return of voltage the starter automatically starts the motor. Starters provided with low voltage protection are arranged so that on failure of voltage the motor stops, and on the return of voltage the starter will not automatically start the motor until after the operator presses a push button or similar device; they are designed particularly for use with motors operating woodworking machinery and machine tools, or similar service where danger might be involved should the motor start automatically upon return of voltage. A starter of the type shown in Fig. 7 has always low voltage release, whereas that shown in Fig. 8 may have low voltage release or low voltage protection; it is necessary for the purchaser to specify which one is desired.

The controllers just described are for constant-speed nonreversing motors. For adjustable-speed motors the general form of controller is the same; a field rheostat with which to vary the field strength is supplied either on the same panel with the magnetic contactors or on a separate panel. Fig. 10 shows an installation of an adjustable-speed controller mounted on the side of the motor. In this case the field rheostat is mounted on the same panel with the contactor, so that it is within easy reach of the operator. Notice also that little wiring is required between the motor and the controller. Where the contactor panel must be placed out of reach of the operator, it is best practice to specify that the field rheostat be mounted separately, so that it can be installed within easy reach of the operator.

Magnetic controllers for reversing motors are supplied in two ways. First the reversing connection on the motor is made by means of a hand-operated drum reverse switch; second, the reversing is accomplished by means of magnetic switches through the operation of a suitable master switch. The first method is generally adopted for machine tools. In this case a controller the same as that applied to a constant-speed motor is used, in conjunction with a switch, shown in Fig. 11. Magnetically reversed controllers are preferable where a reversing service is severe, as in the case of the majority of steel-mill applications. Fig. 12 shows magnetic controllers on a furnace charger in a steel mill. These controllers are magnetically reversed, being controlled by a master switch, Fig. 13.

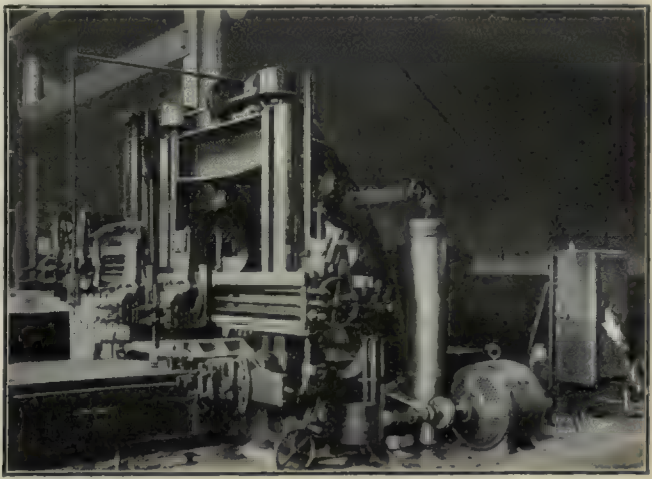


FIG. 15. REVERSING-PLANER EQUIPMENT, SHOWING INCLOSED MAGNETIC CONTROLLER

For reversing service or where a sequence of operations is desired, master switches are installed instead of push buttons, although push buttons are often selected for controlling several operations. Fig. 14 shows a pendant switch used in connection with a reversing-planer equipment, Fig. 15, the controller for which is magnetically operated. The control located at the right of this illustration shows how easily magnetic controllers can be inclosed to meet safety-first requirements. A summary of advantages of magnetic controllers is:

1. Design is flexible.
2. Contacts and mechanical parts are durable.
3. Contacts are renewed easily and cheaply.
4. Entire units can be easily replaced.
5. All parts can readily be inspected.
6. Automatic features and safety devices can be incorporated at minimum expense.
7. Saving in amount of copper required for wiring; the controller can be placed near the motors.
8. Automatic acceleration gives maximum protection to motors and the machinery driven.

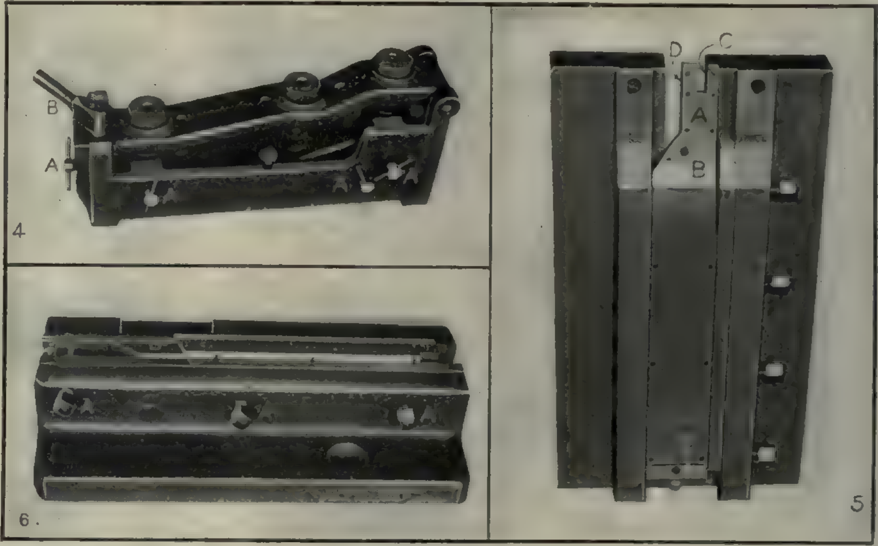
The disadvantages of this form of controller are its relatively high initial cost, comparatively large size and weight and complicated wiring on the back of the panel.

Machining Operations on a Stapling Machine

SPECIAL CORRESPONDENCE

SYNOPSIS—*In this article are shown some of the important manufacturing operations in making a stapling machine. The tools, jigs and fixtures are of modern design, and quick methods of locating and holding the pieces are followed.*

THE stapling machine illustrated in Fig. 1 is made by the W. E. Ellis Co., Haverhill, Mass. One of its uses is to attach a steel spring on a shoe stiffener or arch support. The wire to make the staple is carried on the reel, as shown. The two parts to be joined are placed on the anvil. Then the staple-driving slide immediately above the anvil is caused to descend, the wire being fed down by it. The machine in operation feeds the wire through in two places, cuts it to the correct length and clinches both ends, thus forming the staple. The machine is belt driven, as may be observed in the illustration. The jig used in drilling the base is shown in Fig. 2. The surface of the casting to be drilled is first machined. The jig is held on the base by means of two hook bolts *A*, the hook ends fitting under the flange of the casting. The jig is located so that the two contours—jig and pad—on the base are in line. Three ¼-in. holes are then drilled. In Fig. 3 may be seen the jig used in drilling the frame, which has been milled in a previous operation. The casting is located against pins, being held in position by setscrews. The cover is afterward dropped down and is fastened by the two thumb-screws shown. The following holes are then machined: Two 1⅜-in. and two ½-in. spot drilled and reamed, three ¼-in. and six $\frac{5}{16}$-in. drilled. This is ordinary shop practice and is done on a drilling machine.



FIGS. 4 TO 6. A JIG AND TWO MILLING OPERATIONS

Fig. 4—Jig for driver lever. Fig. 5—First milling operation on slide. Fig. 6—Second milling operation on slide

The jig used in drilling the driver lever is illustrated in Fig. 4. The casting is forced against locating stops by the pin-headed screws *A*. The cover is then fastened down with the thumb-screw *B*, which is of interesting design. It is provided with a handle on one end, which enables it to be quickly and conveniently operated. One ½-in. and two $\frac{7}{16}$-in. holes are then spot drilled and reamed.

The staple-forming slide is made from rectangular bar steel. The bar is first cut into the proper lengths to make the slides. One of these cut sections is then placed in the fixture, Fig. 5, and a ⅛ x 5-in. diameter saw is fed down to machine the end *A*. The fixture is then placed at an angle and the end sawed to form the tapered surface *B*. The slot *C* is also machined with a 2½-in. diameter by ¼-in. milling cutter; the surfaces *D* and *E* are machined with a 2½ x ¾-in. milling cutter.

The fixture for the next milling operation is shown in Fig. 6. The slide is placed on locating pins and held in the fixture by the setscrews *A*. The surface *B* is then

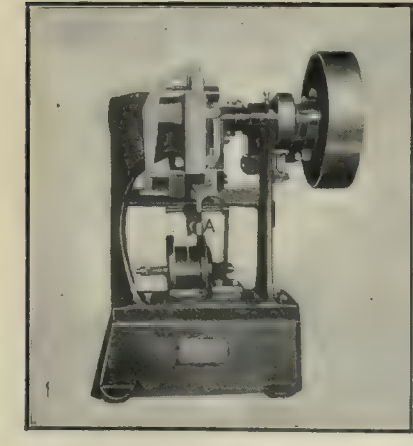


FIG. 1. STAPLING MACHINE

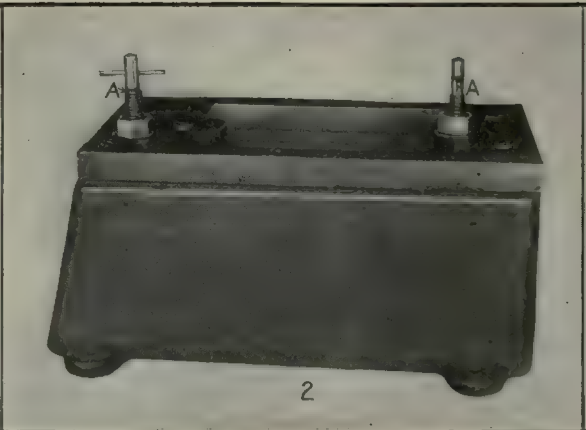


FIG. 2. DRILL JIG FOR BASE

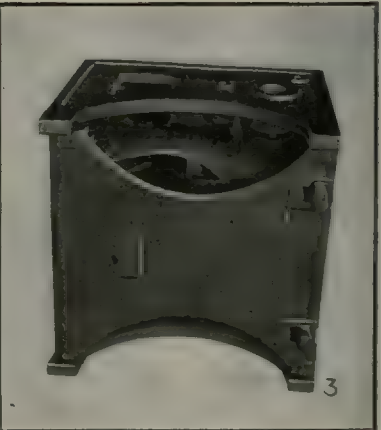
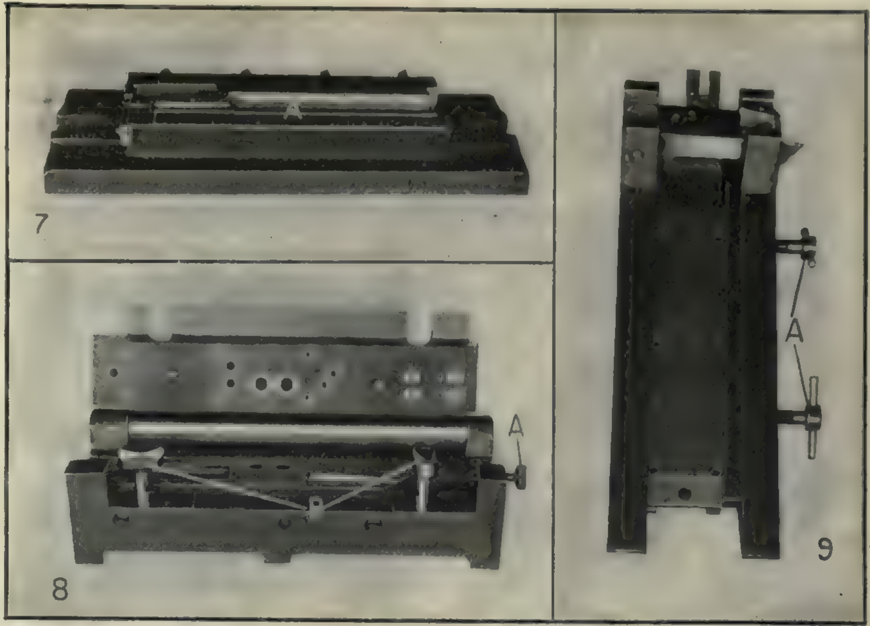
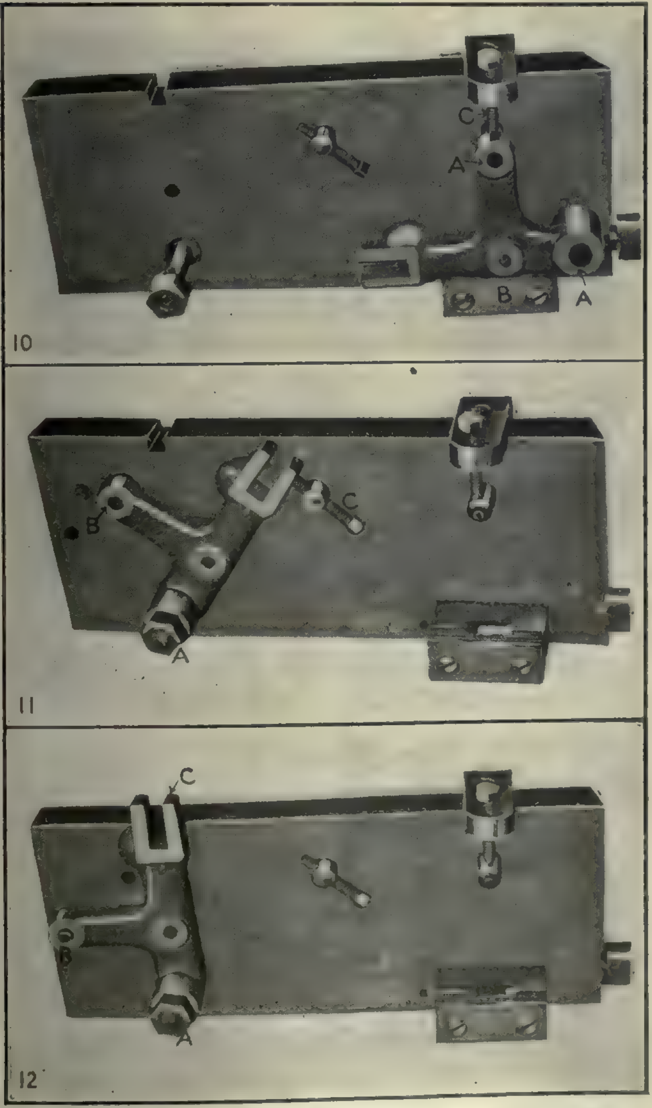


FIG. 3. JIG FOR THE FRAME

machined with a spiral milling cutter 2½-in. diameter and 3-in. face. This cutter operates at 67 r.p.m. with a feed of 0.011 in. per revolution. In Fig. 7 is illustrated the third milling fixture. The slide is held in a vise fixture similar to that shown for the preceding operation. The surface *A* is machined, using a 2½-in. diameter by ¾-in. milling cutter operating at 67 r.p.m. with a feed of 0.016 in. per revolution. The main drill jig used for the slide is shown in Fig. 8. The piece is dropped into the jig and forced against a locating pin by the knurled-head screw *A*. The cover is then dropped down and is fastened by the thumb-screws *B*. Screws through the cover are tightened onto the slide and hold it securely in the jig. The following holes are drilled: Two 17/64-in., six No. 42, two No. 13, one No. 10, seven No. 52, two No. 37 and two No. 31.



FIGS. 7 TO 9. VARIOUS JIGS USED
Fig. 7—Third milling operation on slide. Fig. 8—Main drill jig for slide. Fig. 9—Drill jig for beveled surface



FIGS. 10 TO 12. THREE MILLING OPERATIONS ON THE LEVER
Fig. 10—First milling operation. Fig. 11—Second milling operation. Fig. 12—Third milling operation

The jig used in drilling the holes on the beveled surface of the slides is illustrated in Fig. 9. The slide is located against a pin at the lower end and is held in position by the pin-headed screws *A*. The cover is fastened down by the thumb-screw, as shown. One No. 28 hole and one No. 42 hole are then drilled.

MILLING THE FEED LEVER

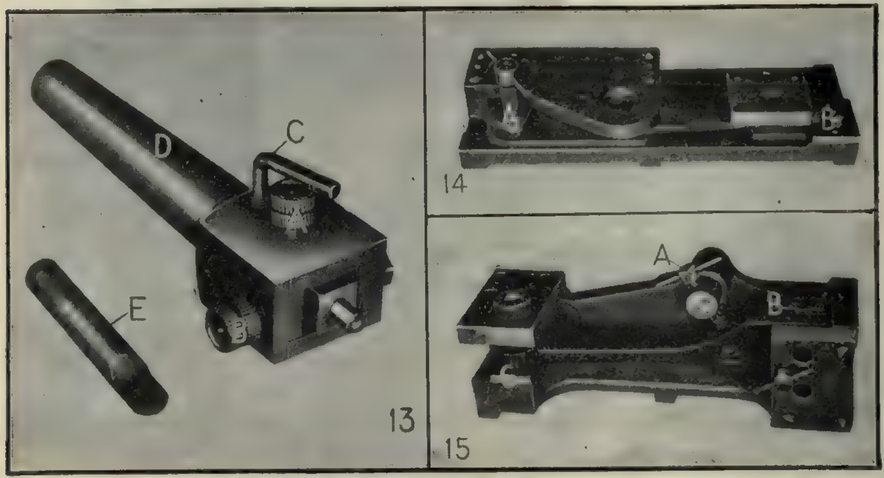
The first milling operation on the feed lever is performed with the casting in the position seen in Fig. 10. The lever is placed on pins *A* and is secured against the block *B* by the setscrew *C*. The four surfaces on the outside of the lever are then milled. For the second milling operation the lever is placed on the fixture in the position shown in Fig. 11. The casting is put on the stud *A*, and a pin is inserted through the jig and the hole *B*. The screw *C* is also tightened against the lever, to hold it securely against the cutting strains. Three surfaces are milled in this operation. The first and second milling operations are performed with a 7½-in. inserted-tooth cutter.

For the third milling the lever is set on the stud *A*, Fig. 12, as before, but the pin *B* is slid into the second position, as shown. The slot *C*, ⅜ in. wide by 1 in. deep, is then milled.

MACHINING STAPLE-DRIVING SLIDE

The method of turning the shank of the staple-driving slide is illustrated in Fig. 13. The piece, which has been previously drilled and milled, is located by the pin *A* fitting into the machined hole. The slide is then forced against a stop pin by the knurled-head screw *B*. The purpose of the hook *C* is to prevent the pin from coming out during the machining operation. The shank *D* is made to fit the headstock spindle of the lathe. The shank of the slide is first machined; afterward, the end is countersunk with the tool *E*, which is held in the turret of the lathe.

In Fig. 14 may be seen the jig for drilling the staple-forming anvil lever, which has been previously milled on the end to the correct length. This jig, it will be noticed, is arranged with a cam *A*, which, when turned with the handle forces the lever both into the block *B* and against a locating pin. The following holes are then machined: One 3/64-in., one 3/16-in., two No. 31, one No. 21 and one No. 4 drilled. This completes the operation. The jig used in drilling the reel bracket is shown in Fig. 15. The casting has been milled in a previous operation. The lever is slid into the jig, and the screw *A* is tightened down. The action of the screw forces the casting against the locating pads *B*. Two holes are then drilled 3/8 in., and one hole is spot drilled and reamed 3/8 inch.

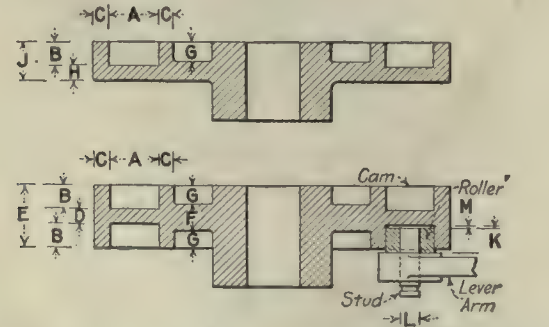


FIGS. 13 TO 15. A NUMBER OF JIGS
Fig. 13—Machining staple-driving slide. Fig. 14—Jig for staple-forming anvil lever. Fig. 15—Jig for reel bracket

Cams for Small Automatic Machinery

By G. E. Hall

These proportions for cams have been used by the writer in designing wall-paper printing machinery and cigar machinery. The proportions work out nicely for any sort of small automatic machinery where weight as well as strength is to be considered.



A	B	C	D	E	F	G	H	J	K	L	M
3/8	3/16	1/8	1/8	1/2	3/16	5/32	1/8	5/16	3/16	5/32	1/64
7/16	7/32	5/32	5/32	19/32	7/32	3/16	5/32	3/8	7/32	3/16	1/64
1/2	1/4	5/32	3/16	11/16	1/4	7/32	3/16	7/16	1/4	7/32	1/64
9/16	9/32	3/16	3/16	3/4	5/16	7/32	3/16	15/32	9/32	7/32	1/64
5/8	5/16	1/4	3/16	13/16	5/16	1/4	3/16	1/2	5/16	1/4	1/64
3/4	3/8	1/4	1/4	1	3/8	5/16	1/4	5/8	3/8	9/32	1/64
7/8	7/16	5/16	1/4	1 1/8	3/8	3/8	1/4	11/16	7/16	5/16	1/32
1	1/2	5/16	5/16	1 5/16	7/16	7/16	5/16	13/16	1/2	3/8	1/32
1 1/8	9/16	3/8	3/8	1 1/2	1/2	1/2	3/8	15/16	9/16	7/16	1/32
1 1/4	5/8	7/16	7/16	1 11/16	9/16	9/16	7/16	1 1/16	5/8	1/2	1/32
1 1/2	3/4	9/16	1/2	2	5/8	5/8	1/2	1 1/4	3/4	9/16	1/32
1 3/4	7/8	5/8	5/8	2 3/8	5/8	5/8	5/8	1 1/2	7/8	5/8	1/32
2	1	5/8	5/8	2 5/8	3/4	3/4	5/8	1 5/8	1	11/16	1/32
2 1/4	1 1/8	11/16	11/16	2 13/16	13/16	13/16	11/16	1 13/16	1 1/8	3/4	1/32
2 1/2	1 1/4	3/4	3/4	3 1/4	7/8	7/8	3/4	2	1 1/4	7/8	1/32
2 3/4	1 3/8	13/16	3/4	3 1/2	7/8	7/8	3/4	2 1/8	1 3/8	1	1/32

DIMENSIONS OF CAMS

Factory Locations

Coming just at this time, when preparations are being made in the various machine shops throughout the country to handle the excess of rush orders, the announcement from the Carlisle Chamber of Commerce, Carlisle, Penn., will interest many executives who are contemplating a branch of their plants in the eastern section of the United States. The Carlisle Chamber of Commerce announces that it will coöperate financially and otherwise with manufacturers seeking to locate in its city, and offers as special inducements: Free factory sites, electric power as low as 1 1/10c. per kw.-hr., a location in the Baltimore Freight Classification, an adequate supply of skilled machinists and the services of the Cumberland Valley R.R., which is a branch of the Pennsylvania R.R. system and the Philadelphia & Reading Ry. Manufacturers interested should communicate directly with the Carlisle Chamber of Commerce, where data are kept on file at all times regarding desirable sites, local facilities and other information of use to the prospective manufacturer or shop man.

Machining Data for Three-Inch Russian Shrapnel

By J. R. Van Wyck

Since the United States Government has decided to use a large number of Russian 3-in. shrapnel shells, the following data compiled from actual shop records will be of considerable value to prospective makers of these shells who wish reliable information on which to base their timesetting and handling methods. The table, showing the weight of the shells after each individual operation, will also be found of great value.

WEIGHT OF 3-IN. SHRAPNEL SHELL, TAKEN AFTER EACH OPERATION

Operation No.	Weight Lb.	Weight Oz.	Operation No	Weight Lb.	Weight Oz.
0	12	10¼	28	..	8
1	12	10	29	..	8
2	12	9¾	30	6	4½
3	12	9½	31	..	...
4	9	...	32	..	..
5	8	7½	33	..	..
6	7	7½	34	..	...
7	6	13¾	35	8	5
8	6	13¾	36	8	6½
9	6	13¾	37	12	8
10	6	2½	38	12	8
11	6	2½	39	12	14¼
12	6	1¾	40	12	14¼
13	6	...	41	..	...
14	5	12¾	42	..	...
15	5	12½	43	..	.
16	5	11	45	13	11
17	5	10½	46	13	12½
18	5	9¾	47	13	12¼
19	5	8¼	48	13	12¼
20	5	8½	49	13	12
21	5	8	50	13	12
22	5	8	51	13	11¼
23	5	8	52	13	11
24	..	4½	53	13	9½
25	5	12½	54	13	9½
26	5	12½	56	13	9½
27	5	12½	57	13	9½

AIR EQUIPMENT

Three-jaw universal chuck with double-acting cylinder, manufactured by Hannifin Manufacturing Co., Chicago, Ill, Air pressure, 90 lb.; 10-in. cylinders for operations 6, 7, 41 to 44, 12, 21 and 51; 8-in. cylinders for operation 19.

Details of Operations in the Manufacture of Three-Inch Russian Shrapnel

Operation No. 1	Operation 2	Machine 3	Manufacturer 4	H.P. 5	R.P.M. 6	Shells Per Hour 7	Cu.In. of Metal Removed Per Shell 8	H.P. Per Cu.In. of Metal Removed Per Min. 9	Sq.In. of Metal Cut or Sheared Per Shell 10	H.P. Per Sq.In. of Metal Cut or Sheared Per Min. 11	Cutting Speed, Ft. Per Min. 12	Cost in Cents Per Shell, Labor 13
1	Grinding butt	Double emery wheel grinder, 16x3-in. wheel	L. Best Co., New York	1½	1,242	400	0.055	4.1	....	....	5,206	½
2	Slotting	Punch press	.....	1½	106	400	.....	.....	0.8	2.81	.....	⅛
3	Drilling centers	Drills	Reed Prentice Co., Worcester, Mass									
4	Rough-turning	Automatic lathes	Reed-Prentice Co., Worcester, Mass	¾	821	200	0.055	4.1	....	....	.....	⅛
5	Cutoff (open end)	Shell machine, type A-1	T. H. Symington Co., Rochester, N. Y	6	75	20	12.65	1.4	....	....	60	3
6	Bore nose and body (taper-bore)	14-in. extra heavy turret lathe	Reed, Prentice Co., Worcester, Mass	1½	83	80	.....	.....	2.12	0.44	67	¾
7	Bore powder chamber	14-in. extra heavy turret lathe	Reed, Prentice Co., Worcester, Mass	3½	314	30	3.46	2.0	....	....	223	1
8	Heating furnace	Furnace burning oil and air.	Tate, Jones & Co., Pittsburgh, Penn	4	86	20	2.15	5.6	....	....	48	3
9	Drawing furnace	Furnace burning oil and air	Tate, Jones & Co., Pittsburgh, Penn	...	.....	.....	.....	.....	....	....	.....	1
10	Finish-turning	Automatic lathes	Reed, Prentice Co., Worcester, Mass	...	.....	.....	.....	.....	....	....	.....	1
11	Nose pressing	Single geared press, No. 4M	American Can Co.	2½	108	25	2.53	2.4	....	....	[illegible]	2¼
12	Bore, ream and tap nose	14-in. extra heavy turret lathes	Reed-Prentice Co., Worcester, Mass	4½	65	400	.....	.....	....	....	.....	1/10
13	Grinding nose	10x24-in. grinder, 18x2¾-in. wheel	Norton Grinding Co., Worcester, Mass	2	66	40	0.17	17.7	....	....	43	1½
14	Grinding body	10x24-in. grinder, 20x5-in. wheel	Norton Grinding Co., Worcester, Mass	17½	993	30	0.39	90.0	....	....	4,667	1½
15	Grinding bourtelet	7x16-in. grinder, 20x2-in. wheel	G. G. Townsend, Winchendon, Mass	22½	1,200	24	0.71	79.0	....	....	6,280	1½
16	Base turning	17-in. LeBlond heavy duty lathe	LeBlond Machine Tool Co., Cincinnati, Ohio	7	1,121	140	0.06	50.0	....	....	5,867	¾
17	Cutoff butt	14-in. extra heavy turret lathe	Reed-Prentice Co., Worcester, Mass	1½	285	50	0.33	5.4	....	....	220	1
18	Grinding bottom	No. 14 grinder, 16x4-in. wheel	C. H. Besley & Co., Chicago, Ill	3½	314	30	.....	.....	0.39	18.0	.....	½
19	Undercutting	14-in. engine lathe	Reed-Prentice Co., Worcester, Mass	12	1,188	50	0.17	84.5	....	....	4,980	1½
20	Knurling	Shell machine, type A-4	T. H. Symington Co., Rochester, N. Y	1½	57	25	0.33	9.0	....	....	42	1¾
21	Groove and radius	14-in. extra heavy turret lathe	Reed-Prentice Co., Worcester, Mass	2	316	300	.....	.....	....	....	233	25/100
22	Sandblast powder chamber	Injector sandblast	J. M. Benton, New York	2	69	180	.....	.....	....	....	.....	1
23	Cleaning shell of sand	.....	.....	...	.....	1,000	.....	.....	....	....	.....	6/10
24	Heating copper band	Air and gas furnace, 5-lb. air pressure	Tate, Jones & Co., Pittsburgh, Penn	...	.....	1,000	.....	.....	....	....	.....	2/10
25	Bumping copper band on shell	No. 15 power press	Torris, Wold & Co., Chicago, Ill	...	.....	960	.....	.....	....	....	.....	3/10
26	Pressing copper band in base side of undercut	Reducing press, geared, No. 85	E. W. Bliss & Co., Brooklyn, N. Y	2	100	960	.....	.....	....	....	.....	3/10
27	Pressing copper band in nose side of undercut	Reducing press, geared, No. 85	E. W. Bliss & Co., Brooklyn, N. Y	5	281	960	.....	.....	....	....	.....	1/10
28	Lead, drive and press fuse tube in diaphragm	No. 23 punch press	Adriance Machine Works, Brooklyn, N. Y	5	281	960	.....	.....	....	....	.....	1/10
29	Expand and flare fuse tube	No. 16 punch press	E. W. Bliss & Co., Brooklyn, N. Y	...	.....	700	.....	.....	....	....	.....	3/10
30	Paint, place rod and press diaphragm in place	.....	.....	...	.....	700	.....	.....	....	....	.....	
31	Melting lead and antimony and casting into slugs	Kettle, oil and steam burner	J. Robertson & Co., Brooklyn, N. Y	...	.....	250	.....	.....	....	....	.....	½
32	Heating and pressing slugs into cable	Heater and hydraulic press.	J. Robertson & Co., Brooklyn, N. Y	...	.....	220	.....	.....	....	....	.....	1⅛
33	Punching cable into bullets.	No. 19 punch press	E. W. Bliss & Co., Brooklyn, N. Y	25	.....							
34	Tumbling bullets	.....	E. W. Bliss & Co., Brooklyn, N. Y	1	160	30	.....	.....	....	....	.....	6/10
35	First loading bullets	Note: The total power consumed in the various operations of loading shells (Nos. 35 to 40; 30, 45 to 48), requires about 10 H.P. (per line)		4	46	300	.....	.....	....	....	.....	
36	Loading smoke powder			...	.....	250	.....	.....	....	....	.....	[illegible]
37	Second loading bullets			...	.....	250	.....	.....	....	....	.....	[illegible]
38	Pressing bullets in place	.....	.....	...	.....	250	.....	.....	....	....	.....	[illegible]
39	Pouring and pressing resin	.....	.....	...	.....	250	.....	.....	....	....	.....	[illegible]
40	Removing rod, facing and reaming fuse tube	.....	.....	...	.....	250	.....	.....	....	....	.....	4
41	Drill and countersink fuse socket	No. 4 turret lathe	Warner & Swasey	...	.....	250	.....	.....	....	....	.....	¾
42	Bore, ream and tap fuse socket	No. 4 turret lathe	Warner & Swasey	1½	120	90	.....	.....	....	....	.....	165/1000
43	Undercut and thread outside fuse socket	No. 4 turret lathe	Warner & Swasey	1½	70	35	.....	.....	....	....	.....	2
44	Facing fuse socket	No. 4 turret lathe	Warner & Swasey	1½	55	70	.....	.....	....	....	.....	[illegible]
45	Screwing on fuse socket	.....	.....	1½	200	100	.....	.....	....	....	.....	[illegible]
46	Screwing brass disk in socket	.....	.....	...	.....	250	.....	.....	....	....	.....	[illegible]
47	Rough-turning of fuse socket	.....	.....	...	.....	250	.....	.....	....	....	.....	[illegible]
48	Cleaning shell of resin	.....	.....	...	.....	250	.....	.....	....	....	.....	[illegible]
49	Drilling fuse sockets	Double-spindle drill	Leland-Gifford Co., Worcester, Mass	...	.....	250	.....	.....	....	....	.....	[illegible]
50	Tapping fuse socket	Single-spindle drill	Leland-Gifford Co., Worcester, Mass	½	810	450	0.05	0.134	....	....	.....	¾
51	Turning nose and face	14-in. engine lathe	Reed-Prentice Co., Worcester, Mass	¼	502	450	.....	.....	....	....	.....	¼
52	Grinding nose and socket	1½ double emery wheel 15½x-2½ wheel	L. Best Co., New York	1	120	275	0.16	1.36	....	....	86	2/10
53	Copper-band turning	Band-turning machine	Allis-Chalmers Co., Milwaukee, Wis	...	1,708	100	0.05	.....	....	....	6,917	3/10
54	Copper-band trimming	Shell machine, type A-4	T. H. Symington Co., Rochester, N. Y	3½	391	150	0.28	5.0	....	....	388	1/10
55	Retapping fuse sockets	Single-spindle drill	Rockford Drilling Machine Co., Rockford, Ill	2	447	150	.....	.....	....	....	445	1/10
56	Sandblast (outside)	Injector sandblast	J. M. Betton, New York	½	592	200	.....	.....	....	....	.....	[illegible]
57	Lacquering	.....	.....	...	.....	.....	.....	.....	....	....	.....	[illegible]

Calculating Operating Expense

By FRANK METZLER

SYNOPSIS—*Means whereby a shop foreman can calculate his operating expense.*

FOREMEN of shops occasionally meet the charge that "their overhead is high" with suggestions covering its reduction. To the average shopman who has not made a study of overhead expense, there is more or less confusion as to the process of its application to direct labor. The following discussion is submitted with the idea that the attempted explanation will help some to a better understanding of what is implied by the term mentioned. The factor overhead is likewise referred to as nonproductive labor, indirect expense, expense burden, manufacturing expense and operating expense. The latter seems to be the most acceptable term and will be used throughout.

Direct labor is understood to refer to work performed by a skilled workman, an operator or a laborer on a product to be sold, for which the business is established, or a product to be used by the business in the promotion of its object.

The operating expense referred to occasionally as indirect labor is that part of the business contributory to the above object and involves such items as management, superintendent, foreman, set-up men, etc., which come under the heading of supervision. In addition, we have the various divisions of heat, light and power, maintenance, supplies, depreciation of equipment and building, taxes and interest, etc. A departmental expense is generally understood to cover supervision and supplies for a particular department and ranges from 20 to 75 per cent., depending on the work.

Cost accounting or, plainly stated, the cost of production, is a complex problem. The grand divisions are labor, material and expense (O.E.). Ordinarly, there is no difficulty experienced in any accurate determination of both labor and material, since they are associated with specific order numbers. The problem consists in accurately distributing the operating expense over the direct labor. There are a variety of channels through which this distribution is made. The three fundamentally different ones are the man-hour plan, the machine-hour plan and the percentage plan.

MAN-HOUR PLAN AND MACHINE-HOUR PLAN

The man-hour plan is based on the hours instead of on the cost of labor. It is a logical plan, more generally available and considered more accurate than the percentage plan, where the distribution is on the cost of labor. It is considered that each employee throughout the factory or in each department requires approximately the same amount of attention, occupies the same number of square feet of floor space and is just as much a factor as the next fellow, in the general planning of work and factory conditions.

Let us assume that a factory has 400 employees receiving an average of 30c. per hour, the week to consist of 50 hours with no lost time. We have 20,000 hours for the week, with a payroll of $6000. Also assume that the full operating expense for the week is $5400. Expense divided by the hours gives 27c. as the expense constant to be applied to every hour of labor. To illustrate: A machinist at 40c. per hour spent 160 hours performing a certain piece of work which gave a direct labor charge of $64, to which we add 27c. per hour O.E., totaling $43.20, and material at 50c., making a total cost of $107.70.

With the machine-hour plan, there is no indirect expense. Light, heat, power, depreciation, floor space, etc., are all directly apportioned and become direct expense. Whether the machine be a single unit or a battery of machines, every expense is traced down as far as possible and applied directly to the product through a gross hourly charge for the machine service. Each machine or group of machines is treated as a separate unit, and all costs incident to the use of the machine are charged to it directly.

To secure the hourly rate, one takes into account the original purchase price or inventory appraisement, the value of motor shafting, tool equipment, etc. Interest on the investment is computed and recorded; cost of supplies, repairs and liberal depreciation are likewise added with the cost of labor, power and operating expenses, all of which go into the establishment of the rate.

This plan, while most scientific, is particularly applicable to "job work," where the work varies.

PERCENTAGE PLAN OR DIRECT-LABOR COST METHOD

The percentage plan is most generally followed—in short, it is the one most invariably applied, not by virtue of its superiority, for it is less accurate, but because the manufacturer has less difficulty in its comprehension and with a percentage supplied from month to month he feels confident he has his finger on the cost pulse. Moreover, it involves less expense in the cost department.

The accuracy or inaccuracy is dependent entirely upon the product. If it is one of fairly uniform character and the operations are quite similar, if wages fluctuate but little and there is a comparatively small variable in rates, it is a sufficiently accurate means of distributing the operating expense.

Let us say that wages paid for direct labor during a given period were $4000 and that for the same period the segregated operating expense totaled $3600. By dividing the O.E. by direct labor we have 90 per cent. as the O.E. percentage. To illustrate: Assume that a drill jig is to be made for an outside firm and that the estimated price has been met. We have, as an analysis, cost in direct labor—that is, hours paid the toolmaker—$80, with material cost as $5. We have a cost without profit of $80 plus 90 per cent. O.E. plus material as $157. Assuming that we ask 20 per cent. profit on cost less material, we add $30.40, which gives a charge to the customer of $187.40.

To one unacquainted with the distribution of O.E. and generally lacking the knowledge of business, the above charge seems all out of reason. Nevertheless, if one wishes to continue in business, the O.E. must be accurately determined and the distribution applied.

IDEAS FROM PRACTICAL MEN

Accurate Angles Without a Protractor

By Robert Spurgin, Jr.

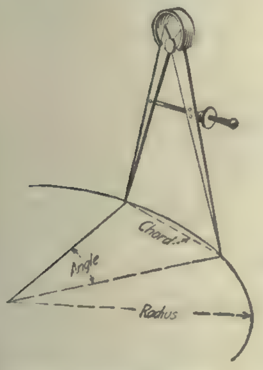
The method here given for laying out angles without a protractor has been used in a large toolroom for several months and has proved highly satisfactory.

TABLE I. ACCURATE METHOD OF LAYING OUT ANGLES WITHOUT A PROTRACTOR

Chords, in Inches

Angle	$\frac{57}{64}$-In. Radius	$1\frac{51}{64}$-In. Radius	$3\frac{19}{32}$-In. Radius	$5\frac{3}{4}$-In. Radius	$7\frac{3}{16}$-In. Radius	$14\frac{3}{8}$-In. Radius
7′	....	....	....	....	$\frac{1}{64}$	$\frac{1}{32}$
15′	....	....	$\frac{1}{64}$	....	$\frac{1}{32}$	$\frac{1}{16}$
22′	....	....	....	....	$\frac{3}{64}$	$\frac{3}{32}$
30′	....	$\frac{1}{64}$	$\frac{1}{32}$	0.05	$\frac{1}{16}$	$\frac{1}{8}$
37′	....	....	....	....	$\frac{5}{64}$	$\frac{5}{32}$
45′	....	....	$\frac{3}{64}$	....	$\frac{3}{32}$	$\frac{3}{16}$
52′	....	....	....	....	$\frac{7}{64}$	$\frac{7}{32}$
1°	$\frac{1}{64}$	$\frac{1}{32}$	$\frac{1}{16}$	0.1	$\frac{1}{8}$	$\frac{1}{4}$
2°	$\frac{1}{32}$	$\frac{1}{16}$	$\frac{1}{8}$	0.2	$\frac{1}{4}$	$\frac{1}{2}$
3°	$\frac{3}{64}$	$\frac{3}{32}$	$\frac{3}{16}$	0.3	$\frac{3}{8}$	$\frac{3}{4}$
4°	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{4}$	0.4	$\frac{1}{2}$	1
5°	$\frac{5}{64}$	$\frac{5}{32}$	$\frac{5}{16}$	0.5	$\frac{5}{8}$	$1\frac{1}{4}$
10°	$\frac{5}{32}$	$\frac{5}{16}$	$\frac{5}{8}$	1.0	$1\frac{1}{4}$	$2\frac{1}{2}$
15°	$\frac{15}{64}$	$\frac{15}{32}$	$\frac{15}{16}$	1.5	$1\frac{7}{8}$	$3\frac{3}{4}$
20°	$\frac{5}{16}$	$\frac{5}{8}$	$1\frac{1}{4}$	2.0	$2\frac{1}{2}$	5

Table I gives the chords of various angles for a number of radii. To lay off an angle, describe an arc of the largest of these radii that there is room for, and lay off on it with the dividers the space that corresponds to the angle; then draw a line through this point and the center. Any angle up to 20 deg. may be spaced off by adding together the amounts given in the table to make up the angle; for instance, take 17 deg. 45 min. to be laid off on a $7\frac{3}{16}$-in. radius. From Table I, 15 deg. = $1\frac{7}{8}$ in., 2 deg. = $\frac{1}{4}$ in. and 45 min. = $\frac{3}{32}$ in. $1\frac{7}{8} + \frac{1}{4} + \frac{3}{32} = 2\frac{7}{32}$ in. Therefore the dividers, should be set to $2\frac{7}{32}$ in. To lay out angles over 20 deg., set the dividers for 20 deg. and step off on the arc up to within 20 deg. of the desired angle. Then reset the dividers to make up the remainder of the arc which it is desired to lay off.



THE METHOD USED

TABLE II. ERROR AT $14\frac{3}{8}$-IN. RADIUS

Deg.	Min.	Deg.	Min.
1	—0.001	11	—0.006
2	—0.002	12	—0 005
3	—0.003	13	—0.005
4	—0.003	14	—0.004
5	—0.004	15	—0.003
6	—0.005	16	—0.001
7	—0.006	17	+0.001
8	—0.006	18	+0.003
9	—0.006	19	+0.005
10	—0.006	20	+0 008

In Table II are given for the different angles the amounts that the chords obtained by the foregoing method vary from the mathematically correct chords, figured for $14\frac{3}{8}$-in. radius. For the smaller radii the error is proportionately less. To make allowance for this error, add the amount when the sign is minus and subtract when the sign is plus.

Extruding and Tapping Holes in Sheet Steel

By A. H. Harris

In manufacturing devices made of sheet metal where nuts cannot be used for holding screws in place, the method of extruding, or drawing, and tapping the sheet metal will prove satisfactory. The practice of extruding and tapping sheet metal is confined mostly to small screws, or machine screws, and the steel must be soft, so that it will extrude, or draw, to a depth to allow for a maximum number of threads. If the tapping is to be done by hand, a smaller tap punch can be used than when the tapping is done by machine. In both cases oil or a good cutting compound should be used to get the best results. The following table shows the size of tap punches to be used when the holes in the sheet metal are to be hand-tapped or machine-tapped.

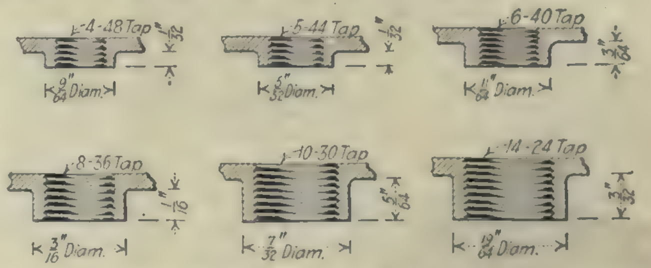


TABLE OF PUNCH SIZES FOR DRAWN TAP HOLES IN SHEET METAL

Screw Size	Tap Punch for Hand-Tapping, In.	Tap Punch for Machine-Tapping, In.
No. 2x64	0.070	0.077
No. 3x56	0.079	0.087
No. 4x48	0.089	0.097
No. 5x44	0.099	0.106
No. 6x40	0.110	0.115
No. 8x36	0.136	0.143
No. 10x30	0.152	0.165
No. 14x24	0.194	0.205

When extruding these holes no stock should be removed, but it should simply be pushed through and tapped as shown in the illustration.

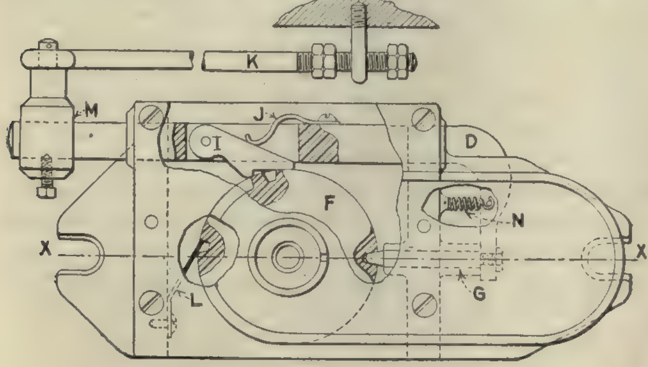
The depth of the extrusion, as stated before, depends on the softness of the metal. If the sheet is thick, a slight extrusion only will be necessary, as no more threads are needed than in a standard nut of the same size. For instance, the thickness of a No. 8 x 36 or 8 x 32 standard nut is $\frac{1}{8}$ in.; it therefore follows that if our sheet is $\frac{1}{16}$ in. thick, and is extruded another $\frac{1}{16}$ in., we have a total depth of $\frac{1}{8}$ in., equal to the thickness of the nut. It is advisable not to go beyond $\frac{1}{4}$ x 20 by the extruding method.

Another point to be considered is the method of tapping out the extruded holes. Hand-tapping is better than machine-tapping. The process is slower, but a better and deeper thread is obtained. A smaller tap punch can be used for hand-tapping, but a larger one is necessary for machine work. The table given has been tried out for soft steel, and the sizes have worked very well on hand-tapped and machine-tapped holes. If the steel is not soft, larger tap punches will be necessary than those given in the table.

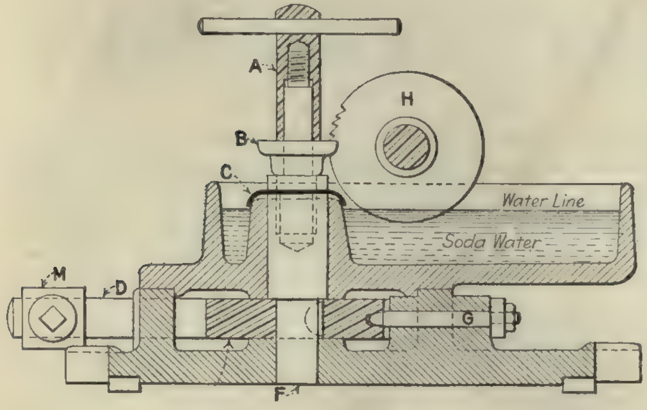
Self-Indexing Milling Fixture

By Cecil H. Strupe

Although cutting 15 slots in a small shaft coupling is not a difficult job, it was a slow one in the dividing head. The fixture illustrated, which was designed to be used in an ordinary miller, did the trick in short order. The work *B* is held in position by the handnut *A*, and the cutter *H*, cutting downward, throws all chips into the pan, which is cast in the fixture. The cutter is partly immersed in a suitable cutting compound contained in this pan and is thus kept perfectly lubricated. The flanged washer *C* keeps all dirt and compound from getting into the working parts of the mechanism.



Plan



Section X-X

SELF-INDEXING FIXTURE

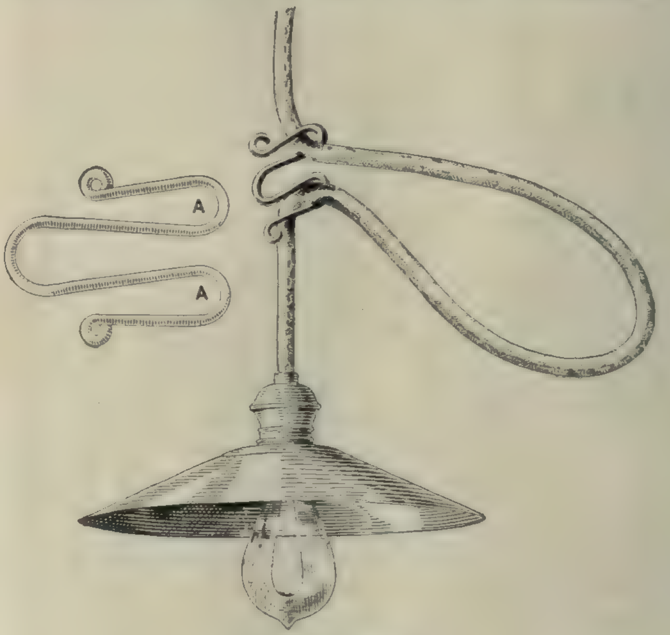
The mechanism is so arranged that, as the work is withdrawn clear of the cutter, the locknuts on the rod *K* come in contact with the stop fixed to the machine body. This causes the thrust shaft *D* to withdraw the index pin *G* from the index plate *F*. At the instant the index pin *G* is clear of the index plate *F*, the dog *I* is forced into one of the holes in the index plate by the spring *J;* and as the table is withdrawn farther, the index plate is turned until the stop *M* reaches the body of the fixture. At this instant the spring *L* moves into the corresponding hole of the index plate, thus keeping the index plate from moving backward as the table is reversed, to feed the work into the cutter. When this is done, the coil spring *N* causes the index pin to follow the movement of the table and enter the index plate just before the cutter reaches the work.

As can be seen, the fixture indexes itself every time the table is moved away from the cutter, so all the operator has to do is to move the table backward and forward 15 times, load and unload the fixture. As the cutter is partly immersed, it may be run at a greater speed.

Droplight Adjuster

By O. Anderson

The illustration shows a simple and effective droplight adjuster made from small drill rod. The loops *AA* are for the light cord, and the device can be instantly snapped on or off the cord.



CORD ADJUSTER

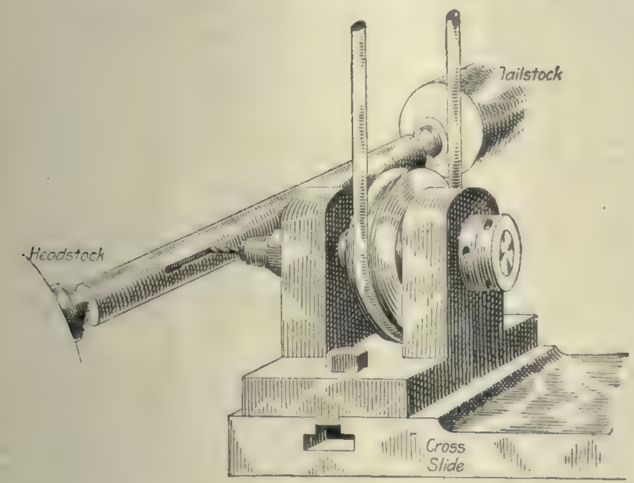
Milling Keyways in the Lathe

By F. E. Wilder

On page 473, Vol. 46, of the *American Machinist* is shown a fixture, in the shape of a block with a V and two straps which are fastened to the cross-slide of a lathe, for milling keyways in shafts held at right angles to the lathe spindle.

The accompanying illustration shows a fixture which I used 25 years ago when I was an apprentice boy in a Massachusetts shop. I used it for cutting keyways in rub rolls, employed in wool-carding machinery. The shaft is held on the centers of the lathe. The fixture is bolted to the cross-slide at right angles to the spindle.

There was a grooved pulley on the countershaft and a round leather belt with a half-turn that ran the spindle in the fixture on the cross-slide. A small drill chuck was fitted into the spindle. A drill was first used to give a starting point for an end mill. We could get any desired depth and length of keyway and always straight.



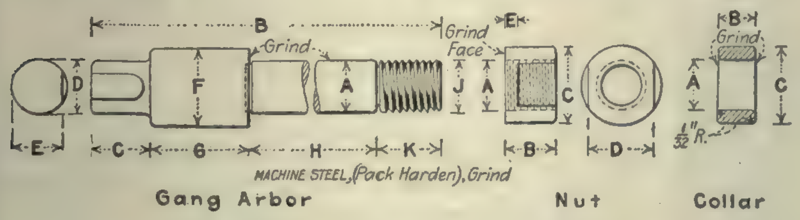
KEYWAY MILLING ATTACHMENT

This, however, is a more expensive fixture than the one described by Mr. Kuhne. On the other hand, it is better adapted to work where both quality and quantity are needed. I wish to emphasize the fact that it was used more than 25 years ago.

Gang Arbors Should Be More Widely Used

BY H. M. DARLING

While working in a large number of shops in New England and the Middle West, I have been surprised that so few gang arbors are in use. It seems almost impossible to do quantity work without them, and yet in many shops they are practically unknown.



STANDARD SIZES FOR GANG ARBORS

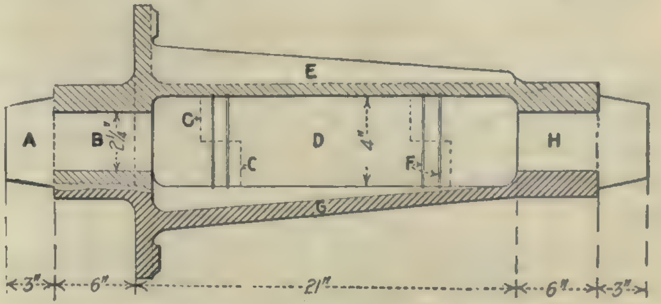
In an Eastern shop recently I noticed a miller operator cutting gears singly, putting them between centers on an ordinary lathe mandrel. When I inquired why a gang arbor was not employed, I was surprised to find that such things were unknown in that shop. At my suggestion a gang arbor was made up to hold six gear blanks, which resulted in a tripled production. In other shops I have seen men turning the outside diameter of gears, cutter blanks or similar jobs on regular mandrels, when a gang arbor would help greatly in pushing production.

I present herewith a table of standard sizes of gang arbors. This does not represent the practice of any one firm, but is a combination of tables of standard-sized arbors which I have found to be the most convenient sizes for all-around machine and tool work. It seems strange to me that some of the small-tool concerns do not list gang arbors, but I have been unable to find them in any catalog.

Influence of Design on Rush Repairs

BY M. E. DUGGAN

In building standard machinery considerable thought is given to design, strength and finish. When a breakdown occurs specialized design often demands complicated and difficult pattern and core-box making in the pattern shop, and leads to trouble in the foundry, unnecessary work in the machine shop and delay in getting the machine started again. But in instances of this sort why bother about theory or good practice? If, by altering the original design, the pattern is simplified; the casting made in the shortest possible time; the machining and assembling easily and quickly done, and the finished work answers the purpose of the broken casting, why delay with theory? The two-bearing journal bracket shown is a fair example of an altered design. To simplify comparison I have drawn one half like the original broken part, the other half like the altered design. The casting is shown to the left, in the section at *G*. The tapered cored chamber requires a special core box. The conventional way of making and molding this pattern is in halves, split through the center endwise, to be molded on the



ORIGINAL AND IMPROVED DESIGN

STANDARD SIZES FOR GANG ARBORS

Arbor											Nut					Collar		
A	B	C	D	E	F	G	H	J	K	Size of Center Drill	A	B	C	D	E	A	B	C
1/2	6	7/8	1/2	7/16	1	1 1/4	3 1/4	1/2; 13 Threads	3/4	No. 1, or 1/16x1/4	1/2-13	1/2	1	3/4	1/8	1/2	1/4-1/2-3/4-3/4-1	1
5/8	6 3/4	1	5/8	11/16	1 1/8	1 1/2	3 3/8	5/8; 11 Threads	7/8	No. 2, or 3/32x5/16	5/8-11	5/8	1 1/8	1	3/16	5/8	1/4-1/2-3/4-1-1	1 1/8
3/4	7 1/2	1	3/4	11/16	1 1/4	1 3/4	3 3/4	3/4; 10 Threads	1	No. 2, or 3/32x5/16	3/4-10	3/4	1 1/4	1 1/16	3/16	3/4	1/4-1/2-3/4-1-1 1/8	1 1/4
7/8	8	1	7/8	23/32	1 3/8	2	3 7/8	7/8; 9 Threads	1 1/8	No. 3, or 1/8x3/8	7/8- 9	7/8	1 3/8	1 3/16	1/4	7/8	1/4-1/2-3/4-1-1 1/4	1 3/8
1	8 1/2	1 1/8	1	29/32	1 1/2	2	3 7/8	1; 8 Threads	1 1/4	No. 3, or 1/8x3/8	1 - 8	1	1 1/2	1 1/4	1/4	1	1/4-1/2-3/4-1-1 1/2	1 1/2
1 1/8	8 7/8	1 1/4	1 1/8	1 5/32	1 5/8	2	4 1/8	1; 8 Threads	1 1/2	No. 3, or 1/8x3/8	1 - 8	1 1/8	1 5/8	1 5/16	1/4	1 1/8	1/4-1/2-1-1-1 1/2	1 5/8
1 1/4	9	1 1/4	1 1/4	1 5/32	1 3/4	2	4 1/4	1; 8 Threads	1 1/2	No. 4, or 1/8x1/2	1 - 8	1 1/4	1 3/4	1 7/16	1/4	1 1/4	1/4-1/2-1-1 1/4-1 1/2	1 3/4
1 3/8	9 5/8	1 1/4	1 3/8	1 3/8	2	2 1/4	4 1/2	1 1/4; 7 Threads	1 5/8	No. 4, or 1/8x1/2	1 1/4- 7	1 3/8	2	1 1/2	1/4	1 1/2	1/4-1/2-1-1 1/2-1 1/2	2
1 1/2	10 5/8	1 1/4	1 1/2	1 3/8	2 1/4	2 1/2	5	1 1/4; 7 Threads	1 5/8	No. 4, or 1/8x1/2	1 1/4- 7	1 3/8	2 1/4	1 5/8	1/4	1 3/4	1/4-1/2-1-1 1/2-2	2 1/4
2	11	1 3/8	1 1/2	1 5/8	2 1/2	2 1/2	5 1/2	1 1/2; 6 Threads	1 3/4	No 4, or 1/8x1/2	1 1/4- 7	1 1/2	2 1/2	1 3/4	1/4	2	1/4-1/2-1-1 3/4-2	2 1/2

side. These details require labor and time in the pattern shop and foundry, before the job is ready to handle. To follow the original design in making the repair pattern would mean a delay of 48 hours at least.

The altered design is shown to the top. It is a straight cylinder with four ribs, one of which is shown at *E*. The pattern is plain and easy to make. No core box was made for this job. The casting is made with a chamber core. This is a trick in molding that few pattern makers know.

The core *D* was to be 4 in. in diameter by 39 in. long. The foundry did not have a stock core of this size, neither was there a core box in which to make a core. However, there were some 4 x 16-in. stock cores. These were shaped, pasted, joined and bound together with wire as shown at the jointed parts *C* and *F*. To form the journals *B* and *H* the core was filed down to about the required size, with plenty of allowance left for finish. The ends of the core are filed tapering, as shown at *A*.

The print ends are *the same diameter as the chamber*. This is important, as it insures the setting of the core in the center of the mold. To turn the core print to the diameter of the journal is wrong, as the molder cannot file the print ends of the core concentric to the chamber section.

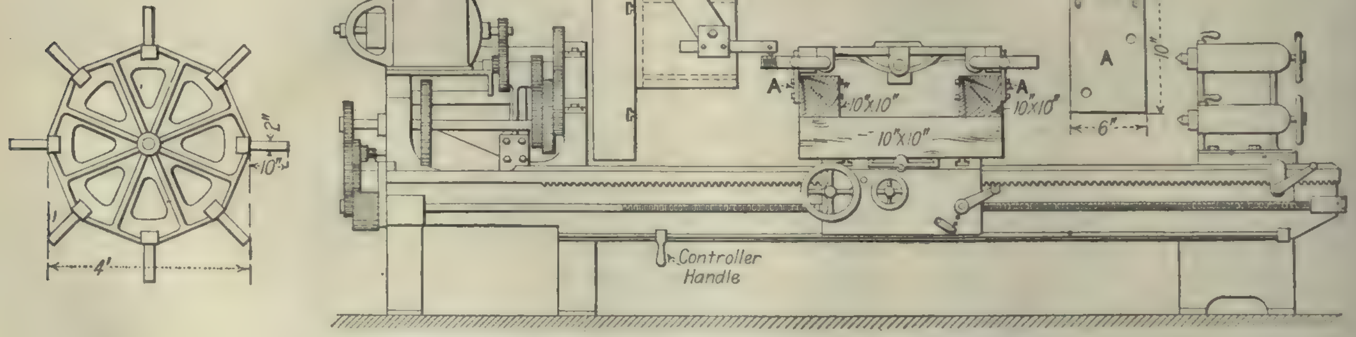
The pattern is molded and the casting poured on end. For this no special cope or rigging up is required. With this core it is impractical to pour the casting on the side. As the core is made without core rods, the metal rising in the mold and pressing against the core would cause it to break at the spliced joints.

An Awkward Job of Threading in the Lathe

By George L. Johnson

A job in a small repair shop required V-threads to be cut on the shafts of an 8-in. roller turntable for a coal-car loading machine. No hydraulic press or other means of pressing the shafts out was available, so I hit upon an idea and rigged up a McCabe lathe as follows

First I picked up a piece of wrought iron 1 x 6 x 20 in. and drilled a 1¾-in. hole in the middle, also holes for bolts, and then cut the plate so as to make two plates like *A* in the illustration. Next I got four pieces of 10 x 10-in. pine and the necessary bolts, and made a cribbing on the carriage. Then I bolted on the plates *A* and bored them out to 2 in., the size of the shafts, with a boring bar between centers, and laid the job in place and clamped it down. Next I fastened an angle plate on the large faceplate, and on this I secured the compound rest, with a boring bar extended and tool inserted, and proceeded to do the thread cutting, which was accomplished in this manner with a big saving in time and labor.



LATHE ARRANGED FOR AN AWKWARD JOB OF THREADING

How Would You Make This Casting?

By M. E. Duggan

The casting shown in Fig. 1 was for a breakdown job on which there was no time to waste. The piece was to be cast in gray iron, open at one end, solid at the opposite end and chambered in the middle. The instructions accompanying the order were as follows: "A casting is wanted sound and clean; the chambered section must be round and in the middle of the casting, so that the walls, when the casting is finished,

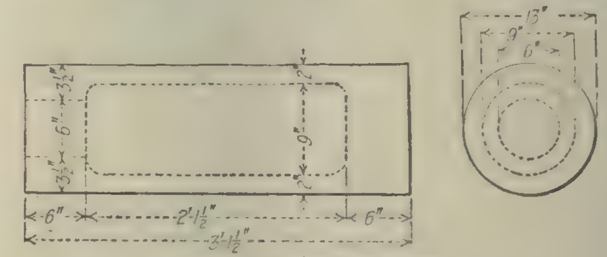


FIG. 1. THE CASTING

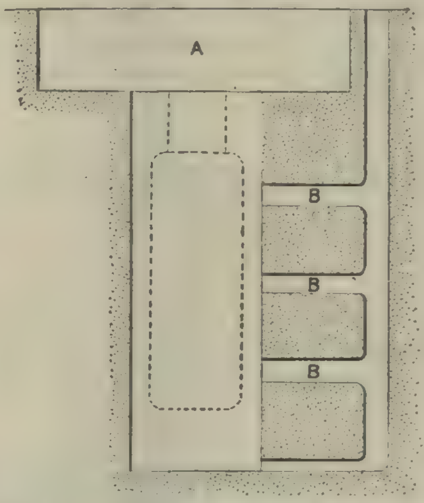


FIG. 2. POSSIBLE METHOD OF MOLDING

will be of uniform thickness; no chaplets are to be used in making the mold."

I made the pattern and sent it to a foundry some distance away. When the pattern arrived at the foundry the molder said that "the casting cannot be produced from the pattern as it is now made."

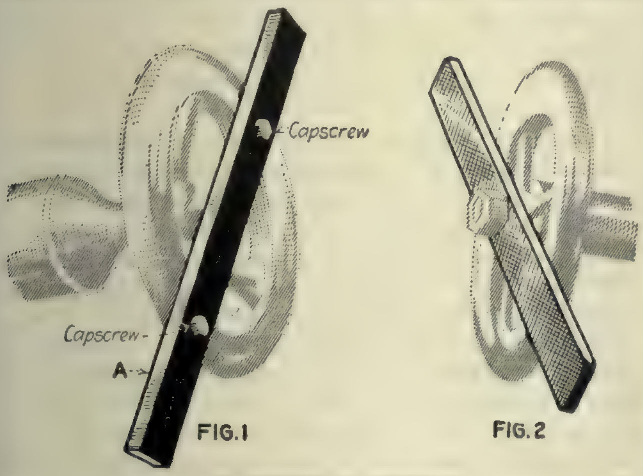
[The casting shown in Fig. 1 can be made as shown in Fig. 2. The pattern would be made with a print at *A* large enough to support the core. The core would have to be well supported by core irons, thoroughly vented through the top and well weighted to prevent lifting. The openings at *B* permit hot iron to flow into the mold as it fills.—Editor.]

Tail Spindle Levers

By J. H. Davis

Two holes are drilled and tapped in the handwheel rim as shown in Fig. 1, to receive capscrews. Two clearance holes are drilled in a piece of flat stock *A*. The flat stock should be of any convenient length to swing over the bed and give enough leverage.

In Fig. 2 the tailstock handwheel is of the straight-spoke type. Take a piece of flat stock of convenient length and size to swing over the bed, drill and tap in the center of its length to suit the thread on the end of the tailstock screw, remove the nut used to keep the handwheel on, and screw the flat stock in position. The flat stock should be thin enough to allow the nut to be screwed on a couple of threads or so.



TAIL-SPINDLE LEVERS

Setscrew Kink

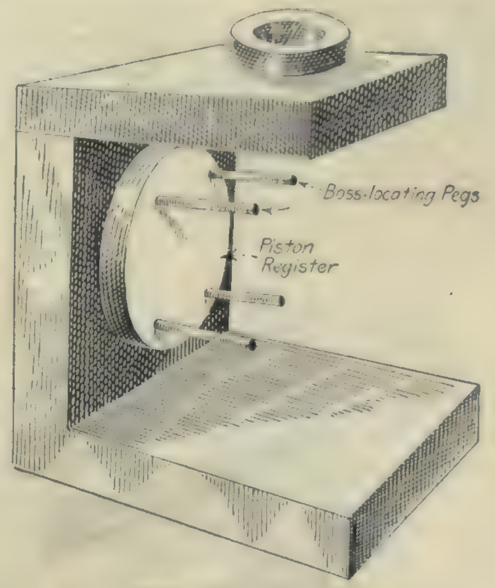
By M. Jacker

On page 599, Vol. 46, E. Hartman shows a setscrew kink, but there are others. He might have saved the company those extra lengths and made a much neater job of it by inserting the modern headless screws. These can be placed so close to each other that their threads touch, and still can be easily turned without interfering with one another or anything else in their neighborhood.

Locating Pistons for Wristpin Holes

By J. Eld

In the article on drilling wristpin holes in pistons (page 31), D. D. Barrett advocates the use of a chalk line on the outside of the piston to set up for internal bosses. I think a much more accurate and quicker method is one that I have used with complete success for some years, in conjunction with a similar jig. My scheme entailed the use of four locating pins for bosses, as shown in the illustration. These are made from $\frac{3}{16}$-in. wire, and as the bosses are situated about halfway up the piston, the pins have sufficient spring to allow of slight variation in the diameters of the inside bosses.

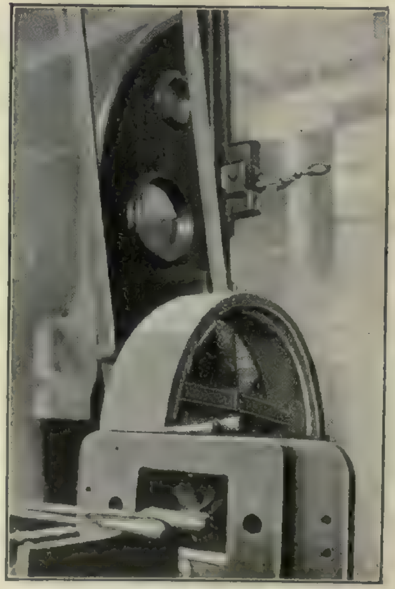


THE DRILLING JIG

Turning a Large Pulley

By Dan Kees

The illustration shows the manner in which a planer was used to turn the crown off a big wood split pulley which was too large to go in any lathe we had in the shop. The planer table was first run far enough out on the ways to be out of mesh with the bull gear. Then the outer driving pulley of the planer was taken off and the big wood pulley bushed and clamped on the driving shaft. The driving was done by the regular belt on the inner planer pulley. A solid rest for the hand turning tools was rigged up out of an old bed-plate placed and clamped as shown. The pulley was then started and the crown turned in a very satisfactory manner. The total time for the job was about half an hour and the results obtained were very satisfactory.

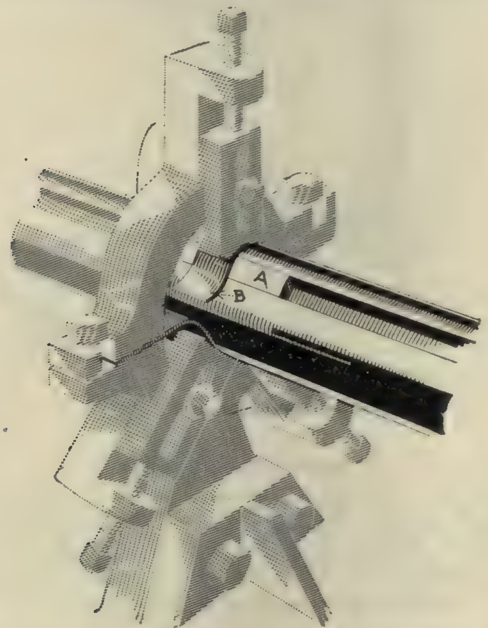


TURNING A LARGE PULLEY

Holding Keywayed and Finished Work in Steadyrest

By M. Jacker

On page 1042, Vol. 45, H. H. Parker describes a somewhat elaborate method of holding a keywayed shaft in a steadyrest. The accompanying illustration shows another method that has been employed satisfactorily.



RUNNING A KEYWAYED SHAFT IN THE STEADYREST

A is a piece of hard wood, *B* a strip of sheet brass a little wider than the thickness of the steadyrest jaws and clamped in the rest as shown.

Advantages of Plate Patterns

By E. J. Leach

In his article on "Advantages of Plate Patterns," page 300, Vol. 46, M. E. Duggan invites an exchange of ideas in regard to the merits of wood and metal patterns. I have had quite a little experience with matched patterns made of both wood and metal. My experience has been that if the pattern is to be used for a short time only wood is as satisfactory as metal and will produce many good castings. However, if the pattern is to be used over a long period of time, and large or even small quantities of castings are to be produced from it month to month or year to year, metal patterns are far superior. Wooden patterns require more attention to keep them from loosening from the board, and they absorb moisture. Also, on wooden patterns, small projections are much more liable to break off.

My method of matching patterns is as follows: The two pieces of material from which the halves of the pattern are to be made are machined with plane surfaces and securely fastened together. The pattern is then turned, filed and scraped to shape.

Before separating the halves, dowel-pin holes are drilled entirely through the patterns, perpendicular to the parting line. Next the boards, which have been planed and fitted with flashpins and pinholes, are put together and securely clamped. One-half of the patterns are arranged on one of these boards and a drill is run down, through the dowel-pin holes in the patterns, entirely through the two plates. The plates are then taken apart and the patterns put on with pins. From the underside of each plate I drill through the plate into the pattern and tap the pattern for fillister-head screws, relieving and counterboring the plates.

If the work is done carefully to insure the drilling going straight the pattern will match perfectly.

Where a perfect match is required I usually fasten the pattern on the board with dowels and run a trial cast before putting in the screws.

Introducing a Perpetual Record of Shop Equipment

Since 1900 the *American Machinist* has conducted a special editorial department containing concise descriptions of the new developments in machine tools and appliances. Our purpose in so doing has not been to fill our editorial columns with unpaid-for material nor to insert complimentary advertising in these columns. Our sole object in this matter has been service to the reader in keeping him informed on what is new in shop equipment. We have proceeded on the assumption that the reader is a busy man and wants the news—the essentials of the new development—without padding or puff.

This "Shop Equipment News" section has become an invaluable part of the *American Machinist*. A policy of *verity without verbosity* has conclusively demonstrated its worth, according to the response from both our machinery-buying and our machinery-building readers. As a result, all the worth-while developments in shop equipment and machine tools come to us as a natural course. Even during the past two years, while our editors, by request of the War Department, have been devoting so much time to the cause of munition-making preparedness, the receipt of the new developments has increased, in spite of a necessarily diminished editorial solicitation.

The individual items of equipment described from week to week in our "Shop Equipment News" section form a complete history of developments in this field. Unfortunately, the form in which it has been necessary to print these descriptions, with illustrations of varying size and with a varying amount of space, combined with the fact that it was necessary to print these descriptions on both sides of a sheet, has made it impossible to arrange them satisfactorily for filing, unless two copies of each issue are available.

We have realized for some time the necessity of giving our readers a means of filing and preserving this valuable material for reference, so that they may have at hand in convenient form a complete index of development in machine-shop equipment, made up and maintained with a minimum of effort. On page 174 is the solution of this problem. It forms a perpetual inventory of accomplishments. This feature will be entirely additional to the regular descriptions in the "Shop Equipment News" section, and this service will be restricted to readers of the *American Machinist*. Men who are doing big things in the machine-shop field and who must keep themselves posted will realize the value of this service.

Editorials

Raw Materials and the Cost of War

JUST as land is the first necessity for agriculture and farm products, so raw materials, taken from the land, form the basis of all manufacturing; for without metals there can be no machinery, which is the foundation of modern civilization in both peace and war. This fact makes of the greatest importance the wise distribution of such raw materials as enter into the conduct of warring operations; and it is a problem that vitally affects our success in the great struggle which we are now entering. Unwise distribution, even with the best of intent, may unnecessarily cost thousands of lives and millions of dollars—a waste that is one of the things most carefully to be guarded against.

If, for example, all the steel should be apportioned to the making of cannon, none would be available for making the machinery with which to bore and turn the guns; and the purpose of selection would be defeated. This example indicates the necessity for wise decision, after a careful study of existing needs, by those who are in position to overlook the whole field and not be influenced by the demand of any one branch of industry, but of the whole as a unit. The importance of the machine-building industry must be recognized, not for any preference of its own, but because of its great importance in the making of all the products, from rifles to field kitchens, which are required in the present crisis. There is not a single item of equipment that does not require machinery of some kind; and even where the mechanism is not a machine tool, as usually defined, it cannot exist without the machine tool in the first place.

Next to the apportioning of the materials is the consideration of its cost, as this affects every one of us in the amount of taxation that we shall be forced to pay. Every dollar of unnecessary expense means that this dollar, with interest for perhaps 30 years, must be paid for by us all. The factors which make up the cost of raw material are so different in one particular from the costs of any manufactured product that they deserve a little careful attention at this time.

The cost of a manufactured product depends on the amount expended for the raw material, labor and overhead requirements, and it varies directly as the cost of any one item increases or decreases. Any other changes in the price are due to increase or decrease of profits. The cost of raw materials, such as coal, iron, copper, brass, tin and zinc, the metals that enter so largely into the building of machinery of all kinds, depends on only labor and overhead, the material being supplied by nature in a more or less limited quantity. The mere possession of it gives the opportunity to dictate prices according to the needs of the purchaser, as without raw material no machinery can be built.

With the cost of labor, overhead and profit remaining the same, the machine builder must vary his prices according to the cost of his raw material. There is no other way. Consequently, an increase in the price of metals, whether due to increased labor costs or because of the opportunity for greater profits due to an insistent need, must be passed on to whoever buys the machine.

Getting down to specific cases, let us see the effect of the present prices of iron, steel and copper on the cost of the war, which, now that we are in it to the extent of at least $7,000,000,000, is no small item. The reduction from market prices on both copper and steel which Mr. Baruch secured for the Government, as well as the reports of the copper and steel companies, give an idea of the amount of profit that present market prices allow. While we should and do appreciate the concession made to Government purchases, we must not forget that this does not affect the price we, as taxpayers and citizens, pay for iron and steel when machines or supplies are bought by the Government from private manufacturers. Furthermore, much of the money we are lending our allies at a low interest rate finds its way back into the profit column of these producers of raw material, when they charge stricken France $55 a ton for steel rails.

The machine builders of the country are asked to give preference, not only to machines on Government order, but to those going to contractors for Government work, and for the general good, to change their plans in other ways. They very willingly comply with these requests. There are many cases where machines are supplied at prices that allow but little more than a normal profit, so as to avoid taking advantage of the necessity of our own people or of our allies. Yet in spite of this, some of those who not only supply raw material, but also manufacture war material, have asked for special prices on machines to be used on Government work while at the same time they refuse any concessions on the raw material entering into the construction of the machines.

A high price for this material adds unnecessarily to the cost of each machine, and this increased price in turn goes down the line and adds to the general high cost of living—all for the profit of the industries that control our national resources, making possession of what should be our national wealth an opportunity for increasing the cost of war, as well as of peace.

The more it costs to run the war the greater will be the tax on everyone. With the indication that the excess profit may be taxed very heavily, as in England, it may be that we shall get back a fair share of these extra profits. But it seems better in every way to show our desire to help by sticking to smaller profits and so avoiding the reproach too often and too truly made, that wars are full of profit for the few and full of sorrow and privation for the many. We have entered the struggle to safeguard the democracy of the world, and we have the opportunity of proving to the world that justice and not economics is our aim. We can not believe that a few industries will allow a desire for inordinate profits to injure the reputation of the nation.

SHOP EQUIPMENT NEWS

"Sterling" Grinders

Two types of grinders are now being built by the McDonough Manufacturing Co., Eau Claire, Wis., of which Fig. 1 shows the universal tool and reamer grinder, while Fig. 2 illustrates the 18 x 50-in. plain, universal, or crankshaft grinder.

On the tool grinder, Fig. 1, a base of the cabinet type is used with a cylindrical column mounted at the top. The swivel frame is bored to fit the column, and the vertically adjustable knee is carried on 45-deg. slides. The frame is locked in any desired position by setscrews bearing against half-collars fitted into grooves in the column. The saddle moves on the knee on 45-deg. adjustable slides. Carbon steel is used for the spindle, which is finished to an outside diameter of 1 in. by grinding. Adjustable bearings of phosphor bronze are used, which have a length of 3 in. The work table is fitted to the longitudinal slide by a 10-in. disk and may be swiveled to any angular position. A rack and pinion are used for the table movement and adjustable stops are provided. The table is 30 in. long and takes pieces 16 in. long between centers and swings 9 in. The headstock is bored for a Morse taper, swivels vertically and horizontally, and is fitted for driving on live or dead centers or by means of a clutch. A device for internal grinding fits the main head and is driven from a pulley fitted in place of one of the grinding wheels. A detachable power feed with automatic reverse can be supplied if desirable.

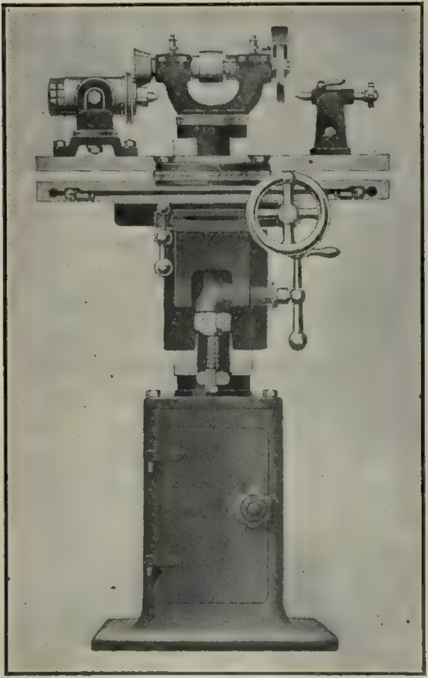


FIG. 1. TOOL AND REAMER GRINDER

The main frame of the cylinder grinder, Fig. 2, consists of a cabinet type semi-steel casting. The table is fitted to the bed by flat- and V-slides, no gibs being used. Oiling of the slides is accomplished by means of automatic oiling rollers. The table may be set over for grinding tapers up to 1½ in. per ft. The grinding-wheel carriage is also fitted with flat- and V-slides and is moved by a 2½-in. square thread screw dipping into an oil bath. The spindle is of carbon steel, ground to size, and runs in adjustable bronze bearings. Head and tailstocks carry dead centers and accommodate work up to 50 in. in length. A steadyrest is supplied for crankshafts, but other special rests can be supplied if necessary. Lubricant tank and pump are mounted at the rear of the machine. Either a motor drive or a floor-type countershaft is used.

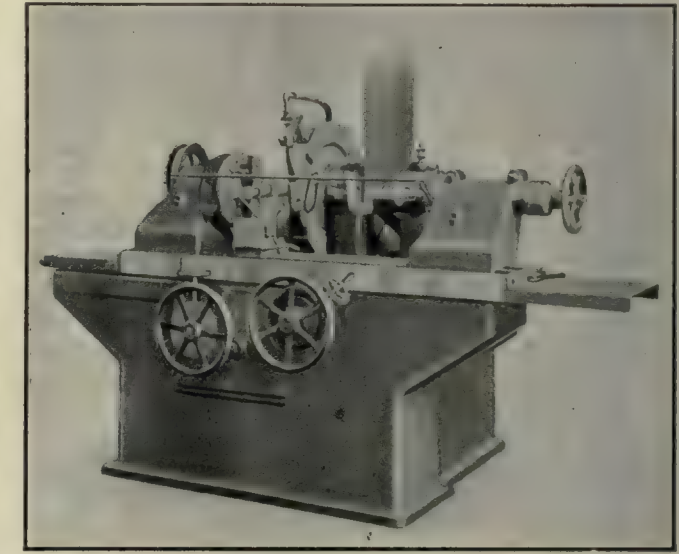
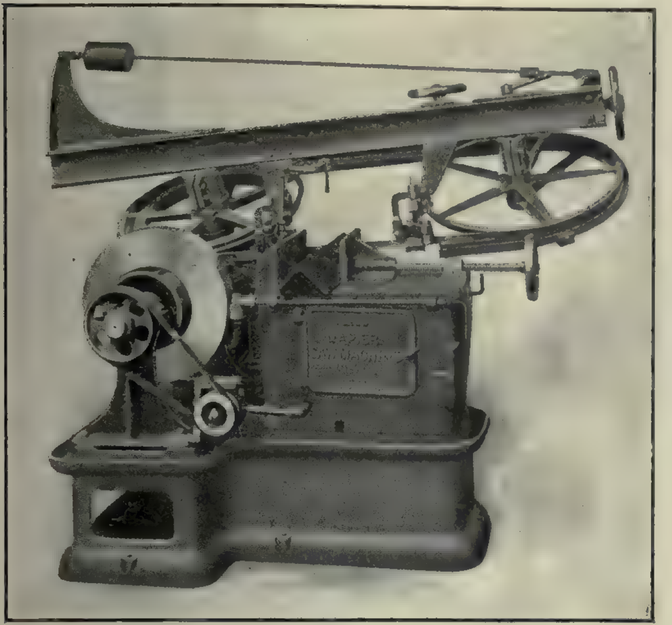


FIG. 2. "STERLING" 18 x 50-IN. GRINDER

Diameter of tail spindle, 2½ in.; diameter of centers, 1½ in.; diameter of wheel, 20 in.; face of wheel, 1½ to 2 in.; bore of wheel, 5 in.; spindle bearings, 3½ x 6 in.; spindle speed, 1000 r.p.m.; distance floor to spindle, 42 in.; horsepower required, 10; weight, 8000 lb.; floor space, 6 x 10 feet

Napier Band Saw

The Napier Saw Works, Inc., Springfield, Mass., are now marketing three sizes of band-saw machines with capacities of 6 x 6, 8 x 8 and 10 x 10 in. The illustration shows the larger size. The base is of the cabinet type, with a flange on the upper edge to retain the cutting compound, and incloses the compound tank. All bearings are of either bronze or babbitt. The tilting arm is made of two channel sections, and a truss rod is used to counteract the bending effect due to the tension of the saw. The driving gears are in such a position that no chips can fall onto them from the saw. It will be noticed that the cutting band is lower than the returning band, this feature allowing work of any length to be handled. The working part of the band is held in a vertical position by two guides. The guides are of brass with hardened tool-steel strips. Power is transmitted to the band through a clutch inside of the driving pulley, and feed is by gravity. Two speeds are provided. A rotary pump is used to circulate the cutting compound.

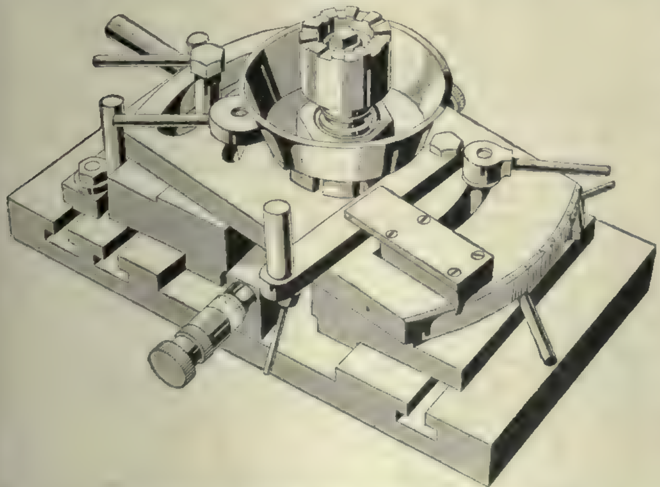


BAND-SAW MACHINE

Capacity, 10 x 10 in.; length of saw, 12 ft. 3 in.; width of saw, 1 in.; thickness of saw, 0.035 in.; speeds, 2; diameter of saw wheels, 24 in.; weight, 1750 lb.; floor space, 43½ x 43 inches

Adams Clutch Milling Attachment

To enable the milling of dog clutches on a hand miller is the purpose of the attachment illustrated below. This device, which has recently made its appearance on the market, consists of a spindle, base, slide and swivel arranged in such a manner that movements necessary for cutting clutches with any number of teeth up to 32 may be quickly and easily performed. Other indexing jobs of a similar character may also be handled. The spindle is machined for a standard taper holder. The device is the product of William C. Adams, 40 Cleveland Ave., Hartford, Conn., and castings and drawings for the device may be procured from him.



ATTACHMENT FOR MILLING DOG CLUTCHES

Kelly Multiple "Production" Tools for Boring and Facing

The illustration shows one of a line of boring and facing tools which have recently been added to those already being maufactured by the Kelly Reamer Co., Cleveland, Ohio. The tools are adapted for boring, facing and reaming, the one shown being equipped with a hardened pilot of generous size to insure accurate work. It is intended for machining a number of shoulders in close proximity to each other, the work being done in an automatic. The tools are made in a variety of sizes and types.

KELLY "PRODUCTION" TOOL

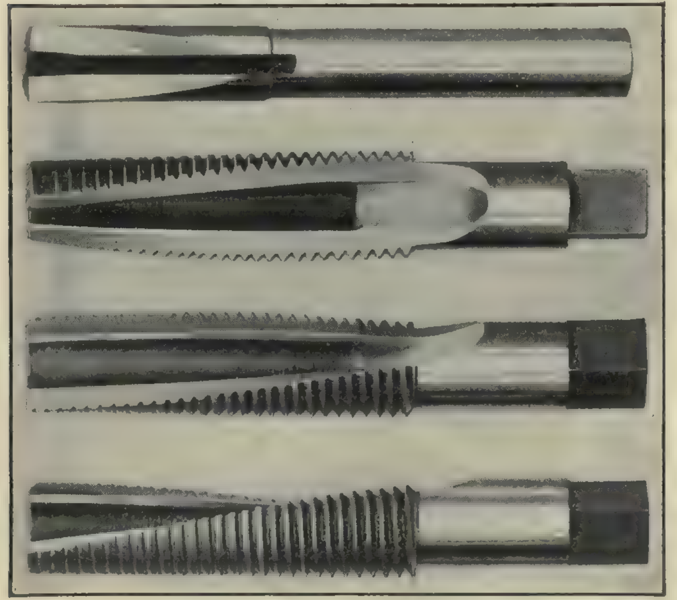
Gilbert & Barker Portable Oil Tank Outfit

For the purpose of providing a convenient method of handling oil around the shop, the Gilbert & Barker Manufacturing Co., Springfield, Mass., is now manufacturing the portable pump and tank outfit shown in the illustration. The tank is made of steel plate with oxy-acetylene-welded seams. The frame and axle are of wrought iron, welded into one piece, and are mounted on 6-in. malleable-iron wheels. The pump can be set to fill any small-size container without overflow and has a lock to prevent unauthorized use. A pan is placed on top of the tank for holding oilers, funnels, etc. The capacity of the tank is 30 gal., but the space occupied is considerably less than that taken by an ordinary barrel. While the tank is not intended to be large enough for general storage purposes, it forms a convenient means for transporting oil from the main storage to the point where it is to be consumed.

PORTABLE OIL-TANK OUTFIT

Schoenert Taps and Reamers

Carl Schoenert & Sons, Inc., 631-633 South 20th St., Newark, N. J., are now marketing the new type of taps and reamers pictured below. It is claimed that the reamers will cut a smoother and truer hole than a fluted reamer, owing to the fact that they are guided by the entire length of the body, and that chatter is impossible. Another advantage is that the reamers may be sharpened on an ordinary grinding wheel without any special attachments. There is more chip space than in a fluted reamer, and the chips cut resemble those from a lathe. The reamers may be used either right- or left-handed and are made with either straight or taper shanks.

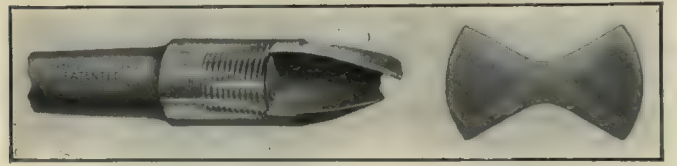


SCHOENERT TAPS AND REAMERS

The taps are made on the same principle and have a very large chip clearance. The construction also lends itself readily to good lubrication. Like the reamers, they may be easily ground when they become dull, a feature claimed to be of great value.

Latrobe High-Speed Drills

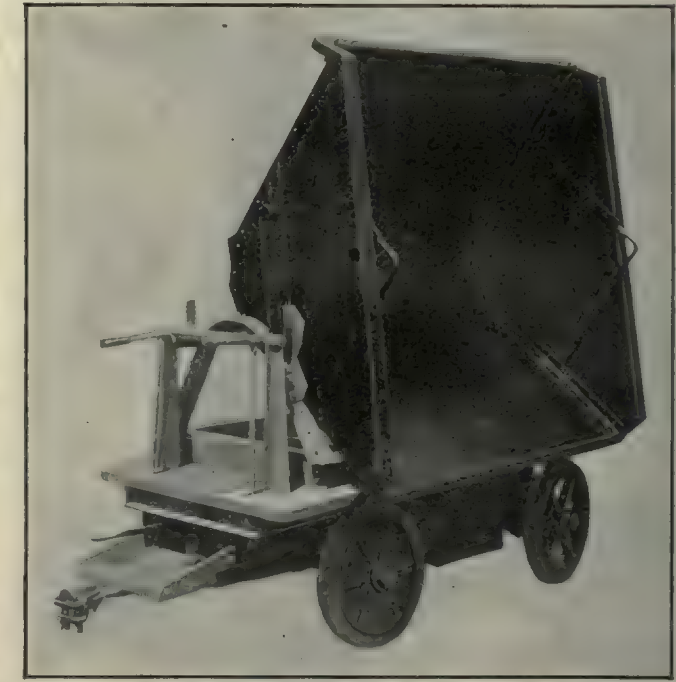
The illustration shows a phantom view and a section of the Latrobe high-speed drill being manufactured by McKenna Brothers, Pittsburgh, Penn. The drilling section, which is screwed and brazed into the carbon-steel shank, is of "Red Cut Superior" steel. In the cross-section the shaded portions show the compression of the steel, which is about $\frac{1}{8}$ in. wide at the outer edge. When the steel is twisted the toughest portion is brought to the center. Drills of this type are made in sizes of from $\frac{37}{64}$ to 3 inches.



LATROBE HIGH-SPEED DRILL

Electric Truck with Dumping Body

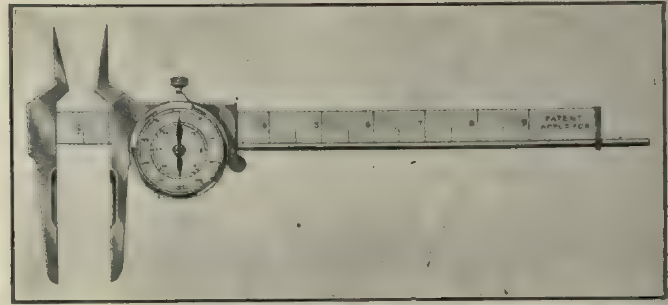
The illustration shows the latest type of storage-battery truck to be placed on the market by the Orenstein-Arthur Koppel Co., Koppel, Penn. The body is of the self-clearing cradle-dump type, with a dumping angle of 40 deg., the dumping operation being accomplished from the platform. The truck proper has a steel channel frame and a metal-edged oak platform made in two parts and hinged. Wheels are of cast steel, 20 in. in diameter, with 3-in. solid rubber tires. Timken bearings are used on the wheels and power is furnished by a Wagner motor and control operating from an Exide battery. The wheelbase is 52 in. and the tread gage 34 in. The capacity is 3000 lb., which can be transported at a maximum speed of 7 miles per hour. Lifting hooks are provided at each end of the body in order that it may be easily removed for inspection of the batteries.



ELECTRIC DUMPING TRUCK

Todt Direct-Reading Caliper

The direct-reading caliper illustrated, which is simliar in type to a vernier caliper, has been placed on the market by Fred Todt, 17 Jenks St., Springfield, Mass. Mounted on the slide is a graduated dial on which are two pointers, spaced 180 deg. apart, and sweeping over

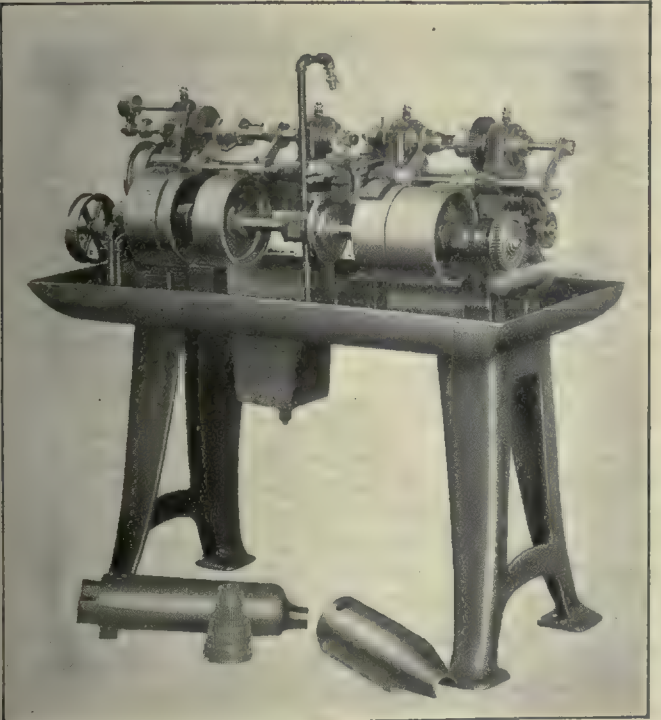


DIRECT-READING VERNIER CALIPER

a double graduated dial. The outer scale has 500 divisions while the inner scale has 32. A ½-in. movement of the slide along the bar causes a complete revolution of the pointers, thus making the instrument read by thousandths or by sixty-fourths of an inch. The instrument is manufactured in a number of sizes and will be graduated to read millimeters if desired. Two extra-short jaws are provided for determining the inside dimensions of holes. It will be noticed that one section of the jaws is beveled at an angle of 60 deg., this feature being utilized to measure the root diameters of threads. A rod extension is also provided which allows the instrument to be used as a depth gage.

Detroit Automatic Pin Machine

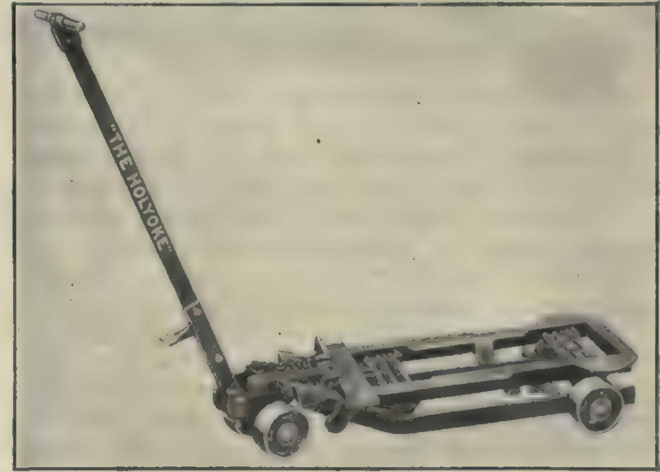
The machine illustrated, which is the product of the Detroit Tool Co., 1487 St. Antoine St., Detroit, Mich., is used for cutting-off and turning operations on pins up to ⅜ in. in diameter. The pieces machined are finished on both ends, thus making an auxiliary burring operation unnecessary. The machines are also adapted for making any small turned pieces of brass or steel which do not have to be threaded or drilled. The stock is fed through the head spindle to a feed stop and is then caught by the tail spindle, which revolves at the same speed, both spindles being geared to the same drive-shaft. The tail spindle holds the work rigid during the entire cutting-off operation to prevent a burring of the corners. The cross-slides work independently of one another, enabling both back and front tools to be used at the same time. Fourteen change gears are supplied with each machine, which allows timing of the cams for a minimum of lost motion. The camshaft is at the rear and the lubricant pump is at one end of the machine. Bearings are of phosphor bronze and are adjustable for wear.



AUTOMATIC PIN MACHINE

The Holyoke Transfer Trucks

The illustration shows one of a line of transfer trucks which have recently been placed on the market by the Holyoke Truck Co., Holyoke, Mass. The trucks are made of metal throughout and do not contain springs or other complicated parts to get out of order. They are made in either the three- or four-wheel styles, all wheels being fitted with Hyatt roller bearings and mounted on heat-treated axles. The operation of raising or lowering the wooden skids, with which the trucks are used, is performed entirely by the handle, a downward pressure, after a small hook is engaged, serving to either raise or lower the platform depending upon the position which it already occupies. The front truck may be turned at right angles, allowing the truck to be swung around in its own length. Four models are manufactured in various sizes, the larger of these being designed for loads up to 4000 pounds.



HOLYOKE TRANSFER TRUCK

Help the Economy Board

The Commercial Economy Board of the Council of National Defense wants the voluntary assistance of every business man. This board is endeavoring to save lost motion in business during the war and in this manner to release men and materials for the war.

In practically every trade there have grown up non-essential services, some of them mere conveniences and others hardly that. In time of peace they may be permissible. In time of war they are a serious waste, and should be stopped. Business men must consider what activities or services may be dispensed with during the war. The Board of Commercial Economy wants suggestions. Associations of business men should immediately appoint committees, if they have not already done so, to consider and act along the lines suggested. Much loss may be avoided by prompt, intelligent action.

The Board of Commercial Economy is in the Munsey Building, Washington, D. C.

The Firm of Lodge & Shipley

The new officers of the firm of Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, are: President, M. G. Lodge; vice president and general manager, J. W. Carrel; secretary and treasurer, L. A. Hall.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

The experiences of the British and French fliers, as voiced by Wing Commander I. W. Seddon, of the British Flying Corps, and Lieutenant Lagrange of the French Air Service, are very interesting and of great value.

The great air problem seems to be to get an overwhelming number of fast, single-seater, fighting machines so as to clear the air of enemy fighters. This not only enables you to take your own observations in safety, but to keep enemy observers away from your lines, to prevent bombers from attacking, and at the same time to allow your bombing machines to attack at will. This, however, is not considered to be an efficient mode of fighting, unless you can send huge squadrons of bombing machines that can completely wipe out a fortification or destroy bases or troops massed for attack. The present practice in the fast fighting machine is to have 1 hp. for every 10 or 12 lb. weight of machine, with the tendency to increase the power so as to give a horsepower for 8 lb. of machine. This means from 130 to 150 hp. for a small fighting machine.

The French engine tests for a motor of new design consist of a 50-hour run, divided over 5 days. There is a 5-hour run in the morning and a similar run in the afternoon. The first half-hour of each run is at full load and the remainder at 90 per cent. load, as this is all a motor delivers at 6000 ft. altitude, the power decreasing as the machine ascends. New motors of accepted design are run for 3 hours, pulled down and examined, reassembled and run 20 min. They are then ready for service.

EFFECT OF ALTITUDES

The difference in temperature at different altitudes is a problem peculiar to the airplane motor. The low temperature of a high altitude cools the motor excessively at times, and this is particularly bad when diving from above to catch an enemy beneath. As the motor is shut off to dive, the water cools still more, in spite of the decreasing altitude; and when you throw on power again at the new fighting level, you have a cold motor that is not lively and will not develop the power you would like at that particular moment.

It seemed to be the opinion of both the aviators that a higher-speed motor will be developed for the air service—not under 2000, and probably 2500 r.p.m. There are of course several which now reach the lower figure, but the majority are below that. This statement was taken to mean that there is a great probability of the cast-iron cylinder coming back, as it possesses better qualities for high-speed work than the steel cylinders that are being used on account of lightness. The motors must be in the neighborhood of 2 lb. per hp., some being even a trifle under that at the present time. The main thing at the present time, however, is to build all we can of the very best motor we know of and at the same time to make all the improvements possible.

THE AIRPLANE MECHANIC

The matter of airplane mechanics is important, and it opens up a new and wonderfully interesting field for many shopmen who can do good work and particularly who know internal-combustion motors; for this is a war of internal-combustion motors in every important field of activity. We shall need thousands of good mechanics in the field as well as in the shop, and it presents an opportunity to many to do their bit in the way in which they can be of the greatest service. The first requirement is extreme care and conscientious work; for there can be no slighting in work of this kind, where not only the man's life, but the service he can render to his army depends on it. For this reason each flier has his mechanicians, generally two, who look after his machines and no others. This arrangement establishes a personal relationship between the flier and his men, which insures extra care and a quality of work that would be almost impossible under a "pooling" system, which may work out well enough on railroads and in similar places. The personal touch counts tremendously here and is taken full advantage of by the flying corps at the front. Every mechanic feels a personal interest in and responsibility for the flier to whom he is attached and is just as proud of his achievements as though they were his own.

Every mechanic who wishes to be of direct service in this line should immediately begin to study the details of airplane construction, particularly of airplane motors, and also get in his application to the air corps of either the army or the navy, as he prefers. There will of course be many more opportunities in the army, at least in the beginning, and this service comes under the Signal Corps, which has divisional headquarters in various sections of the country.

A STANDARDIZED AIRCRAFT MOTOR

The Aircraft Production Board is hard at work on its project for a huge output of airplanes, as has been mentioned before. The situation appears to be nearing the point where there will be interesting developments to relate. Arrangements for large production promise to be announced in the near future, as well as the standardizing of a motor that can be built, or rather manufactured, in large quantities and at a minimum cost. It has been developed along novel lines and gives promise of being the latest word in airplane-motor design and manufacture. It is understood that a standard cylinder has been adopted and that this will be combined in groups of four, six, eight or twelve, according to the amount of power desired. The cylinders will of course be interchangeable, developing possibly 25 hp. each, the motors ranging from 100 to 300 hp., according to the plane in which they are to be used.

A large number of training machines are under way, and the different training camps are constantly growing. The final training is likely to be done in France under the same weather conditions as will be encountered in fighting, the field at Avord being suggested for the bulk of this work. This is said to be an excellent field and to have a capacity sufficient for handling thousands of men. It is a city by itself, with workshops for repairs; and in this department it is said Chinese workmen have been giving an excellent account of themselves.

This is one of the ways in which we can help also, by recruiting the working force from our shops in which similar work is handled, such as the better grade of automobile shops. Many of the French airplane shops are said to be undermanned, owing in a measure to the early mistakes of not exempting skilled mechanics in this line of work. A force of high-grade mechanics sent to France to assist in airplane work would not only greatly increase the production of machines, but would become thoroughly familiar with the methods of the French factories in this work and be of great assistance in this country in later developments of the air machines.

It takes a special type of man to make a high-grade air pilot, and very severe tests are imposed in selecting the men for this work. Some of these tests seem unnecessarily severe and not calculated to get the right kind of men. But this will straighten itself out in time. The cost of training a first-class aviator is estimated at $4000, which does not include the damage to machines. This item has, however, been greatly reduced by care and system and is now said to be less than 1 per cent. of the training machines.

All preliminary training is done in machines having a double control, so that an experienced pilot can be with the student to give him confidence and to assume control in case of necessity. After the student becomes expert enough to fly alone, he can use single-control machines that have been returned from the front as showing signs of wear and not being quite up to the mark for fighting machines.

THE LANGLEY FIELD AND AVIATION STATIONS

Among the interesting projects in the field of aviation is the establishing of an experimental camp at Hampton, Va., to accommodate about two hundred civilian flyers. There will also be the full complement of commissioned officers, two full companies of enlisted men of the signal corps, and the usual accompaniment of hangars, docks for hydro-airplanes or seaplanes, as our British friends very sensibly call them, and other necessary paraphernalia. Very appropriately, the camp will be called Langley Field, in honor of Professor Langley, who did so much for scientific aviation but never lived to see his ideas proved correct and of world-wide value.

For the information of those who are interested in the flying corps, or "winged cavalry" as General Squires calls it, examination boards have been appointed at the following places in addition to the boards already located at the older flying stations: Urbana, Ill., Austin, Tex., Columbus, Ohio, Boston, Mass., Ithaca, N. Y., and Berkeley, Calif. These boards are composed of two officers in each case, one of them being a medical officer from the Medical Reserve Corps.

FRED H. COLVIN.

New Publications

How To Study—By George Gilmore Swain, LL.D. Gordon McKay Professor of Civil Engineering in Harvard University and Massachusetts Institute of Technology. Sixty-five $4\frac{5}{8}$ x $7\frac{1}{2}$-in. pages; bound in paper. Published by the McGraw-Hill Book Co., 239 West 39th St., New York City. Price 25c.

Those who read technical literature and are, by virtue of this fact, seekers after knowledge, will welcome this little book of 65 pages, which contains more useful thoughts per page than many a more pretentious volume. It is a concise statement of how to study, the object being to point out how to develop understanding through reading. Since at least 90 per cent. of the knowledge available to man is conveyed through reading, it would seem that the field of this little book is indeed a broad one.

Business Items

The Bound Brook Oil-Less Bearing Co. will occupy its new foundry at plant No. 2, Lincoln, N. J., about the Aug. 1.

The Die Casting Co. of New Jersey, Irvington, N. J., has taken over the business of the Irvington Die and Tool Works.

R. M. Klein has been appointed sales manager of the New York office of the International Oxygen Co., 115 Broadway, New York City.

C. W. Metzger has resigned his position as salesman and demonstrator with the Haines Stellite Co., and has accepted a position with the Pivot City Realty Co., Indianapolis, Indiana.

Alfred Spangenberg has resigned as assistant superintendent of the machine shop of the S. L. Moore & Sons Corporation, Elizabeth, N. J., to accept a position as superintendent of the ordnance shop of the Mead-Morrison Manufacturing Co., East Boston, Massachusetts.

Forthcoming Meetings

The twelfth annual exhibit of foundry and machine-shop equipment and supplies will be held under the auspices of the American Foundrymen's Association in the Mechanics Building, Boston, Mass., from Sept. 25 to 28, 1917. The officers of the exhibit committee are: President, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; vice president, Benjamin D. Fuller, Westinghouse Electric and Manufacturing Co., Cleveland, Ohio; secretary and treasurer, A. O. Backert, 12th and Chestnut Sts., Cleveland, Ohio; manager of the department of exhibits, C. E. Hoyt, 123 West Madison St., Chicago, Illinois.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

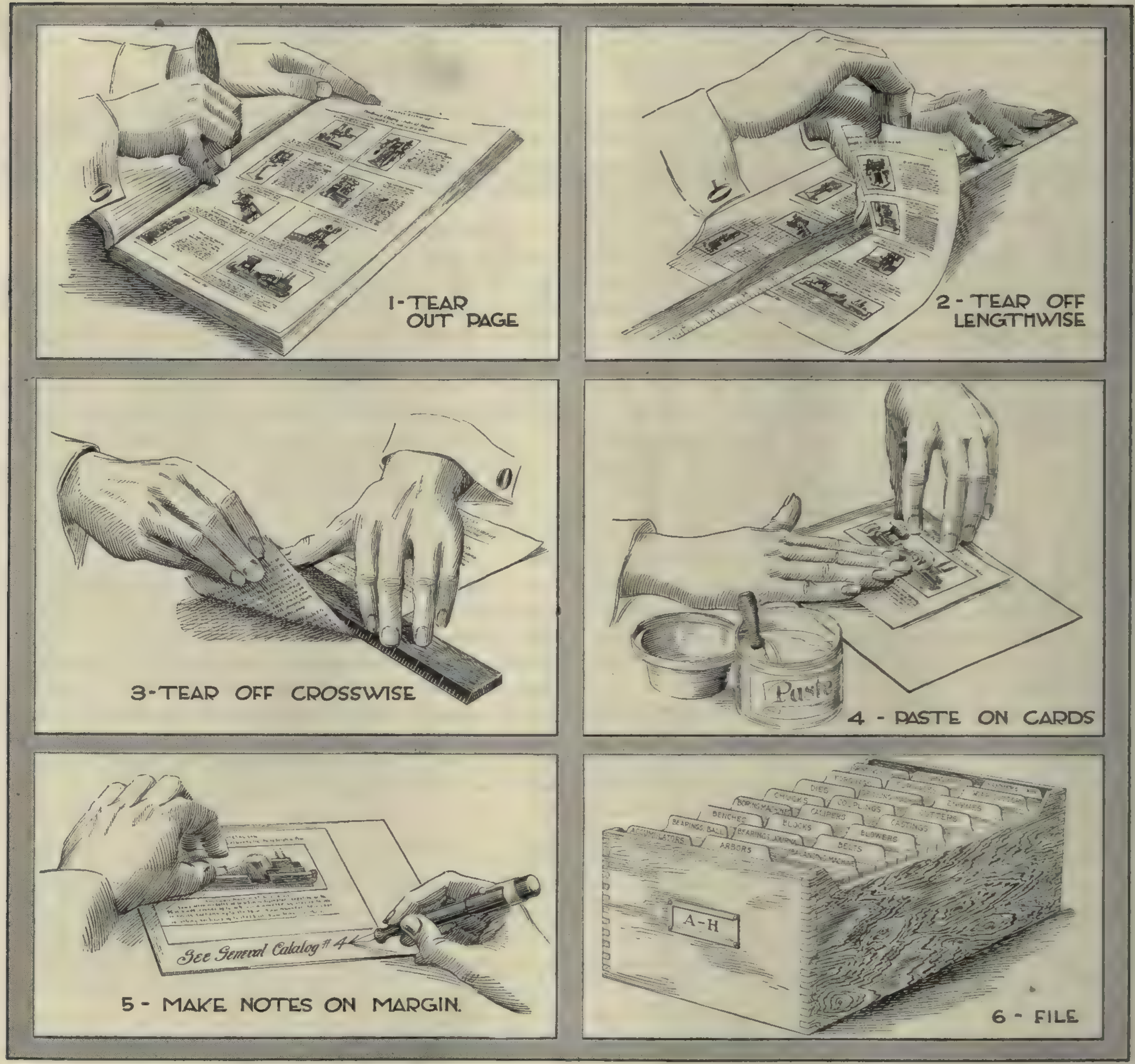
Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

The American and Canadian engineers and architects of Norwegian birth and descent will hold an informal congress and reunion at the Chicago Norske Klub, Logan Square, Chicago, Ill., Sept. 27 to 29, 1917.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North Philadelphia, Penn.

Introducing the Index of Equipment



On the opposite page is an innovation in technical literature that will be a valuable aid to every man who has to do with machine-shop equipment. It preserves for permanent record, in standardized form, a classified and illustrated history of progress in machine tools and minor equipment; a record that will gain in value in rapidly increasing measure as the weeks go by.

The superintendent and factory manager looking for the last word in labor-saving appliances will find in this an index of all the new tools available for cutting costs—and find them instantly. There will be no need of going over back issues.

The designer who must keep in touch with progress will find in this clipping index a complete summary of new developments.

Machine-tool and equipment dealers and purchasing agents have in this index a centralized directory of "What is What" in new equipment for their requirements. Patent lawyers will use this index as an indisputable evidence of priority, since the date of publication is printed on each item.

Consulting engineers will welcome a perpetual record with such flexibility of filing. Technical schools and colleges will appreciate the value of a continually up-to-date textbook on the important subject of shop equipment.

The method of utilizing this information is clearly indicated in the illustrations. Separate the individual descriptions each week, paste them on 3 x 5-in. cards and file as desired. Heads for alphabetical filing can be taken from the *American Machinist's* Buyers' Cyclopedia.

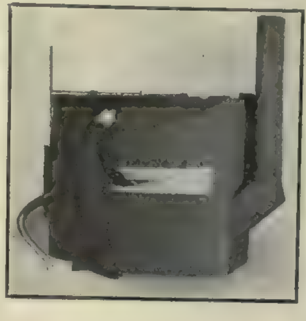
The *American Machinist* is glad of the opportunity of presenting this accomplishment to its readers.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

SANDBLAST ROOM

American Foundry Equipment Co., 52 Vanderbilt Ave., New York City



"American Machinist," July 19, 1917

Consists of a room or cabinet in which parts to be sandblasted are placed, being viewed by the operator through a wire screen at the top front part of the machine. The hose nozzle is operated through a slot in the front kept closed by rubber flaps. Work is loaded from the rear of the machine on a rotary table. Made in various sizes with table diameters of from 5 to 12 feet

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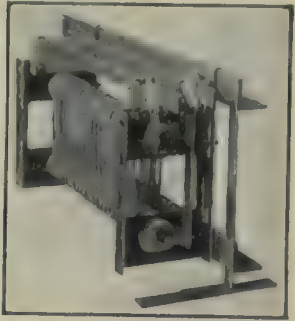
HEATER, ELECTRIC OVEN

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.



"American Machinist," July 19, 1917

Intended for heating, enameling or japanning ovens or for other baking or drying process. Consists of ribbon wound on fireclay bushings and assembled on steel tie-rods supported between pressed steel end plates. Hooks provided on end plates for suspending the heater if desirable. Protecting screens attached to the end plates for preventing injury to heating coils

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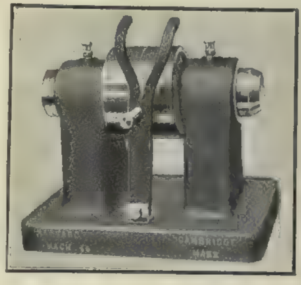
POLISHING HEAD

Harvard Machine Co., Harvard Sq., Cambridge, Mass.



"American Machinist," July 19, 1917

Designed for polishing or lapping and made either with a No. 2 Morse taper in the spindle, as illustrated, or with spring chucks accommodating work up to ½ in. in diameter. Special equipment furnished if desired

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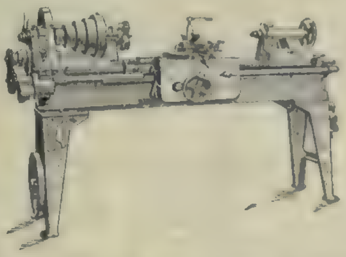
LATHE, 14-INCH ENGINE

Richard H. Kiddle, Kinsman, Ohio



"American Machinist," July 19, 1917

Swing over carriage, $8\frac{3}{4}$ in.; cone diameters, $3\frac{1}{2}$ to $8\frac{1}{32}$ in.; belt, 2 in. wide; hole through spindle, $1\frac{1}{32}$ in.; front babbitt bearing, $1\frac{7}{8}$ x $3\frac{3}{4}$ in.; rear babbitt bearing, $1\frac{9}{16}$ x 3 in.; tail-spindle diameter, $1\frac{7}{8}$ in.; tapers, Morse No. 4; lead-screw diameter, $1\frac{1}{16}$ in.; weight, 1200 lb.; lengths of bed, 4 to 10 feet

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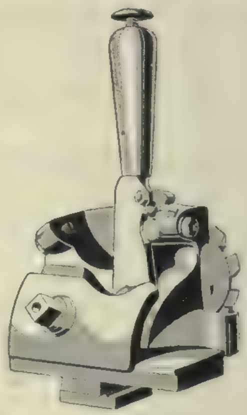
THREADING TOOL

Rivett Lathe and Grinding Co., Brighton, Boston, Mass.



"American Machinist," July 19, 1917

Consists of a sub-base, eccentric cutter arbor, operating lever, clamping plate, micrometer stop, etc. Micrometer stop engages locking pawl on the operating lever, allowing readings of 0.0005 in. Locking pawl is controlled by means of spring push rod and thumb pad. Clamping plate groove milled to coincide with a rib on sub-base

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LATHE, 13-INCH THREADING

Automatic Machine Co., Bridgeport, Conn.

"American Machinist," July 19, 1917

Swing over shears, 13 in.; swing over carriage, $4\frac{1}{4}$ in.; driving pulley, 14 x $4\frac{1}{2}$ in.; hole through spindle, $1\frac{3}{8}$ in.; front spindle bearing, $3\frac{1}{4}$ x 5 in.; rear spindle bearing, $2\frac{9}{16}$ x $4\frac{1}{2}$ in.; diameter of tailstock spindle, 2 in.; centers, Morse taper No. 4; spindle nose threaded $2\frac{3}{8}$ x 6; lengths of bed, 6, 8, 12 and 16 feet

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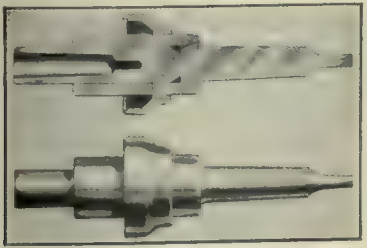
CHUCK, QUICK ACTION

Quick Action Chuck Co., Grand Rapids, Mich.



"American Machinist," July 19, 1917

Used for drilling, reaming and tapping operations where tools must be changed quickly. Complete assembly consists of five parts, work being released by raising the collar, which operation may be done while the chuck is either stationary or revolving

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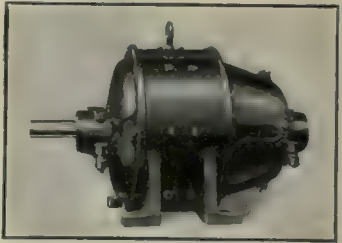
MOTORS, DIRECT-CURRENT

The Reliance Electric Engineering Co., 1044 Ivanhoe Road, Cleveland, Ohio.



"American Machinist," July 19, 1917

Type T motors designed for heavy-duty work. Made in either open, semi-inclosed or fully inclosed styles, with either constant or adjustable speeds. Brush holders are removable and adjustable, and current density of 35 amp. per sq.in. is not exceeded.

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Qutations were current as follows at the points and dates indicated:

	July 20, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$47.00	$40.00	$14.50
No. 2X Northern Foundry, Buffalo.....	53.00	47.00	19.75
No. 2 Northern Foundry, Chicago......	55.00	50.00	19.00
Bessemer, Pittsburgh	57.95	55.95	21.95
Basic, Pittsburgh	53.00	50.00	18.95
No. 2X, Philadelphia.................	54.50	46.75	19.75
No. 2, Valley........................	55.00	50.00	19.25
No. 2, Southern Cincinnati...........	49.90	42.90	16.90
Basic, Eastern Pennsylvania..........	50.00	42.50	19.00
Gray forge, Pittsburgh...............	47.95	47.95	18.70

STEEL SHAPES—The following base prices in cents per pound are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	July 20, 1917	One Month Ago	One Year Ago	July 20, 1917	One Year Ago	July 20, 1917	One Year Ago
Structural shapes ...	5.25	5.00	3.25	4.50	3.25	5.00	3.10
Soft steel bars......	5.00	4.75	3.30	5.00	3.25	4.50	3.10
Soft steel bar shapes.	5.00	4.75	3.25	4.50	3.25	4.50	3.10
Plates, ¼ to 1 in. thick	9.00	8.00	4.00	8.00	3.65	8.00	3.50

BAR IRON—Prices in cents per pound at the places named are as follows:

	July 20, 1917	One Year Ago
Pittsburgh, mill	4.75	2.50
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		July 20, 1917	One Month Ago	One Year Ago	July 20, 1917	One Year Ago	July 20, 1917	One Year Ago
*No. 28 black......	8.75	10.50	9.50	3.65	9.50	3.20	9.50	3.20
*No. 26 black......	8.65	10.40	9.40	3.55	9.40	3.10	9.40	3.10
*Nos. 22 and 24 black	8.60	10.35	9.35	3.50	9.35	3.05	9.35	3.05
Nos. 18 and 20 black	8.55	10.30	9.30	3.45	9.30	3.00	9.30	3.00
No. 16 blue annealed.	9.10	10.20	9.20	4.45	9.70	3.70	9.70	3.60
No. 14 blue annealed.	8.85	10.10	9.10	4.35	9.60	3.60	9.60	3.50
No. 12 blue annealed.	8.65	10.05	9.05	4.30	9.55	3.55	9.55	3.45
No. 10 blue annealed.	8.25	10.00	9.05	4.25	9.50	3.50	9.50	3.40
*No. 28 galvanized..	10.75	13.00	12.00	5.40	11.00	5.20	11.00	5.10
*No. 26 galvanized..	10.45	12.70	11.70	5.10	10.70	4.90	10.70	4.80
*No. 24 galvanized..	10.30	12.55	11.55	4.95	10.55	4.75	10.55	4.65

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring fair-sized lots, the following quotations hold:

	July 20, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	40%	45%
Cleveland	40%	45%
Chicago	45%	50%

SWEDISH (NORWAY) IRON—This material per 100 lb. sells as follows:

	July 20, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	13.30	6.30
Chicago	12.00	5.25

In coils an advance of 50c. usually is charged.
Note—Stock scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16 No. 8, 5/32 and No. 10 ⅛ .... No. 12 .... 3/32, No. 14 and 1/16 .. No. 18 .... No. 20	21.00@30.00

*Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York July 20, 1917	Cleveland July 20, 1917	Chicago July 20, 1917
Tire	5.00	5.00	4.50
Toe calk	5.00	5.50	4.75
Openhearth spring steel...	7.00	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Ordinary carbon tool steel, base price	14.00	13.00	15.00
Special base cast steel....	18.00	20.00	....

*In bars.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe, of Apr. 1 for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜..	42%	15½%	⅜ to 1½.....	33%	22%
½	46%	31½%			
		LAP WELD			
2	42%	27½%	1¼	18%	3%
2½ to 6......	45%	35½%	1½	25%	11%
			2	26½	12%
			2½ to 4.......	28%	15%
			4½ to 6.......	28%	15%
	BUTT WELD.	EXTRA STRONG PLAIN ENDS			
⅛, ¼ and ⅜..	38%	20½%	⅜ to 1½.....	33%	18%
½	43%	30½%			
¾ to 1½.....	47%	34½%			
	LAP WELD.	EXTRA STRONG PLAIN ENDS			
2	40%	28½%	1¼	19%	3%
2½ to 4......	43%	31½%	1½	25%	11%
4½ to 6......	42%	30½%	2	27%	14%
			2¼ to 4.......	29%	17%
			4½ to 6.......	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	29%	15%	38.8%	24.8%
3½ to 6 in. steel lap welded	28%	10%	36%	21%	42.8%	27.8%

Malleable fittings, Class B and C, from New York stock sell at 5% from list price. Cast iron, standard sizes, 27 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound:

	July 20, 1917	One Month Ago	One Year Ago
Copper, electrolytic (carload lots).....	28.00	31.00	27.00
Tin	62.50	61.00	38.75
Lead	10.37½	12.00	.650
Spelter	8.75	9.25	9.00

*Third-quarter copper; for spot copper the market price is 29c.

ST. LOUIS

	July 20, 1917	One Month Ago	One Year Ago
Lead	10.12½	12.00	6.37½
Spelter	8.50	9.25	8.50

At the places named, the following prices in cents per pound prevail:

	New York			Cleveland		Chicago	
	July 20, 1917	One Month Ago	One Year Ago	July 20, 1917	One Year Ago	July 20, 1917	One Year Ago
Copper sheets, base.	42.00	42.00	37.50	42.00	37.50	42.00	37.50
Copper wire (carload							
Brass pipe, base...	47.50	47.50	46.50	46.00	45.00	47.00	45.00
Brass sheets	45.00	45.00	44.50	38.00	42.00	43.00	38.00
(case lots)	39.125	45.00	24.12½	39.50	27.00	39.00	25.50
Solder ½ and ½ lots	39.50	39.50	37.50	39.00	33.00	39.00	38.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse: 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	July 20, 1917	One Month Ago
Mill	$42.00	$42.00
Ntw York	45.50	45.50
Cleveland	38.00	38.00
Chicago	42.50	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.................................. 19.00

	In Casks		Broken Lots	
	July 20, 1917	One Year Ago	July 20, 1917	One Year Ago
New York	21.00	21.50	21.50	22.00
Cleveland	23.00	22.75	23.25	23.25
Chicago	22.50	20.00	23.50	21.00

ANTIMONY—Chinese and Japanese brands in cents per pound for spot delivery, duty paid:

	July 20, 1917	One Year Ago
New York	16.00	14.00
Cleveland	19.00	19.00
Chicago	18.50	20.25

The Panoramic Sight

By

W. L. Olmstead

SYNOPSIS — *Our nation is now at war with the country noted for its specialization in instrument making. Those of our readers who, under ordinary conditions, would be but mildly interested in a general description of a panoramic sight of American make are face to face with the impossibility of obtaining these instruments from their usual source. We have been depending upon Germany for many of the important optical instruments that make modern artillery effective. The tool and instrument manufacturers of the country have heretofore given little attention to this class of work and as a result have shown some disinclination to submit prices to the Government, based upon their present knowledge of requirements, which they conceive in a vague way to be beyond the reach of their equipment or skill. It is the purpose of this and succeeding articles to give a general outline of the construction and operation and a description of the manufacturing requirements of the panoramic sight.*

THE use of the panoramic sight, shown in Fig. 1, in field-artillery service has become absolutely necessary in order to obtain the accuracy demanded in laying the gun to the target. In action the usual conditions are such that the target is not visible to the eve of the gunner. The remarkable performances credited to the Krupp siege guns and howitzers and the French 75's were accomplished under these conditions, and the accuracy of the firing was made possible by the use of the panoramic sight, with which the guns were equipped.

In the earliest days of field artillery the pieces were aimed by the eye, using the front and rear open sights similar to those on a shot gun. The open sights were used for rapid aiming at close range. For direct aiming at moderate ranges the gun was equipped with an adjustable peep sight and a corresponding front sight.

The use of a telescopic sight of some sort became necessary when the ranges at which the guns were employed became longer and the accuracy of functioning of gun and ammunition greater. At first the telescope took the form ordinarily seen, that of the straight tube. This form of sight was soon found inadequate for the reason that when it became necessary for protection purposes to conceal the artillery behind hills, woods, etc., where the target was invisible, a sight was required that could utilize as an aiming point a conspicuous point about the horizon instead of the actual target.

This method of aiming is know as indirect fire and is made possible by the use of the panoramic sight. The peculiarity of its function consists of the rapid circular movement of the headpiece, which brings into the gunner's field of view a magnified image of an object situated at any point on the horizon. Where the target is not visible to the gunner, an auxiliary aiming point is selected from some point on the horizon that will be visible to the gunner using the panoramic sight. This aiming point is usually located in a direction oblique to the front of the gun (see *A*, Fig. 2).

A point of observation *B*, Fig. 2, is selected by the battery commander, from which both the target and the gun are visible. The azimuths and ranges of the aiming point and target are measured, usually with the battery commander's telescope and the distance from the observation station to the gun is determined.

The scale readings of the altitude and azimuth graduations of the battery commander's telescope correspond to those of the rear and panoramic sight. The measured distances are transmitted by the battery commander to the gunner, corrected to the position of his gun. The rear sight is then set at the height required, and the scale of the azimuth circle of the panoramic sight is set to the reading ordered. The gun is then turned with the aid of the traversing handwheel until the vertical line of the panoramic sight is directed at the auxiliary aiming point *A*, the range quadrant being used for elevation. The panoramic sight in itself is a combination of lenses and prisms held in proper relation by mechanical means. The sight is shown in Fig. 1, and the sight with its sight bar and sight shank, upon which the sight is mounted, is shown in Figs. 3, 4 and 5. The sight bar *A*, shown in Figs. 3 and 5, which is turned to fit the holding bracket on the gun, forms the support for the peep and panoramic sights and carries the socket, or guide, upon which the sight shank, or sword, is mounted. The sight shank *B* is an arm curved to the arc of a circle, which slides in the guides *C* in the shank socket and is moved up and down by a scroll gear engaging in a rack cut upon the shank. The scroll gear is held in mesh with the rack by a spring and can be disengaged from the rack by compressing the spring, permitting the sight shank to slide freely in the guides, or to be entirely removed The sides of the upper sight shank converge above the peep sight and form a support for the panoramic sight. This support has a vertical T-slot, not visible in the illustration, into which the guide lug of the panoramic sight fits (see *O*, Fig. 6). A clamp screw *L*, Figs. 3 and 5, with a ratchet head is seated in the support and holds the panoramic sight in position by forcing it against the beveled ways of the support.

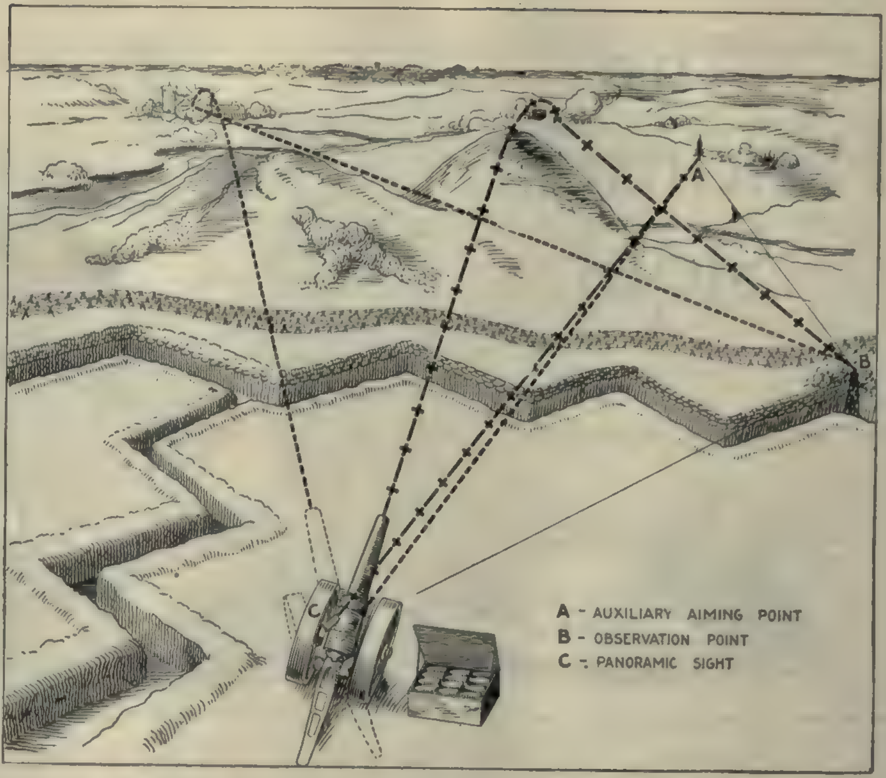


FIG. 2. DIAGRAM SHOWING PROCESS OF SIGHTING ON AN AIMING POINT

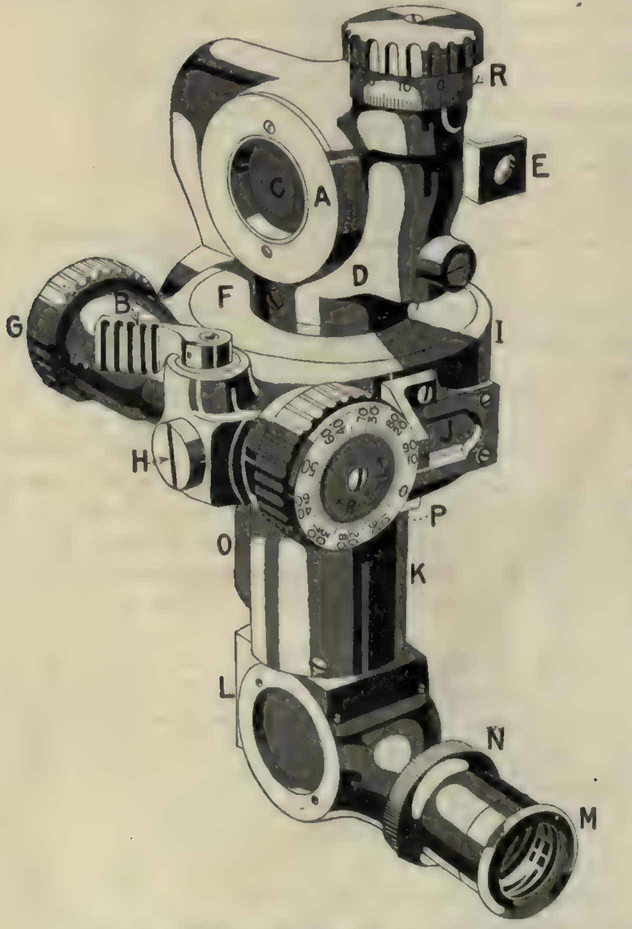


FIG. 1. ANORAMIC SIGHT, MODEL 1917

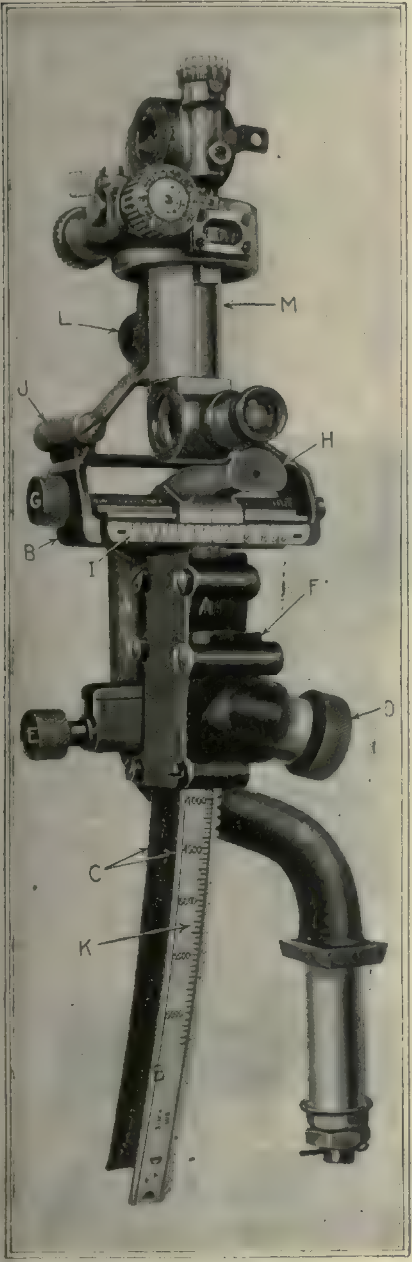
A, elevation index. B, throw-out lever. C, elevation-index support. D, rotating head. E, open sight. F, spring tension plate. G, azimuth worm knob. H, plunger-spring retainer. I, hood. J, azimuth circle. K, shank. L, elbow. M, eyepiece. N, night-illumination shutter. O, T-lug. P, micrometer index. R, elevation micrometer

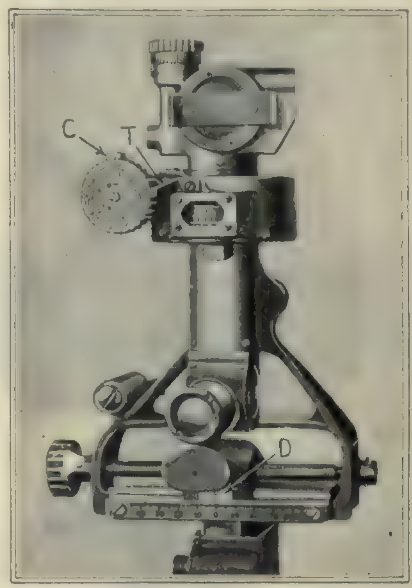
The body, as shown in Fig. 6, consists of a shank *K*, with a T-lug *O*, to the upper end of which is screwed and doweled the azimuth-circle support *C*. This in turn carries the seat for the rotating mechanism of the sight, as shown. The azimuth circle *J*, graduated into 64 equal divisions, is seated thereon and held to position by the beveled wall of the azimuth-circle support, to which it is fitted. It is retained in place by the spring tension plate *F*, seen in the assembled view, Fig. 1.

The hood *I*, Fig. 6, forms the housing, which screws into position on the shank and is provided with bearings for the operating worm, which engages in a worm rack cut on the azimuth circle. This worm is held in contact by a spring and can be disengaged from mesh by the movement of the throw-out lever *B*, Fig. 1, operating an eccentric. When disengaged, the rotating head *D* can be revolved rapidly in the desired direction. The worm is then thrown into gear, and finer adjustments are made by turning the worm knob *G*, Fig. 1. A gear sleeve (*F*, Fig. 6), is fitted within the shank, to the upper end of which is screwed a holder *N*, which carries the revolving prism *B*.

The teeth on the geared sleeve engage with the small gear teeth on a double pinion, not shown in the illustration the large gear of the double pinion is driven by the gear cut upon the lower inside hub of the azimuth circle. The double pinion is seated in the nonrotating azimuth-circle support. The gears and pinions are calculated so that the angular velocity of the rotating-head reflecting prism is twice that of the geared sleeve carrying the rotating prism and in the same direction.

The upper hub of the azimuth circle carries the seat for, and is threaded to fit into, the rotating head. Within the rotating head is fitted the rotating-head prism holder *M*, as shown in Fig. 6. A worm segment is cut thereon, positioned to control the reading of the elevation scale of the rotating head. The worm segment meshes with the elevation worm, which is provided with a micrometer head. By this means the line of sight may be moved up and down from a horizontal position, reading the variation on the elevation scale in mils.





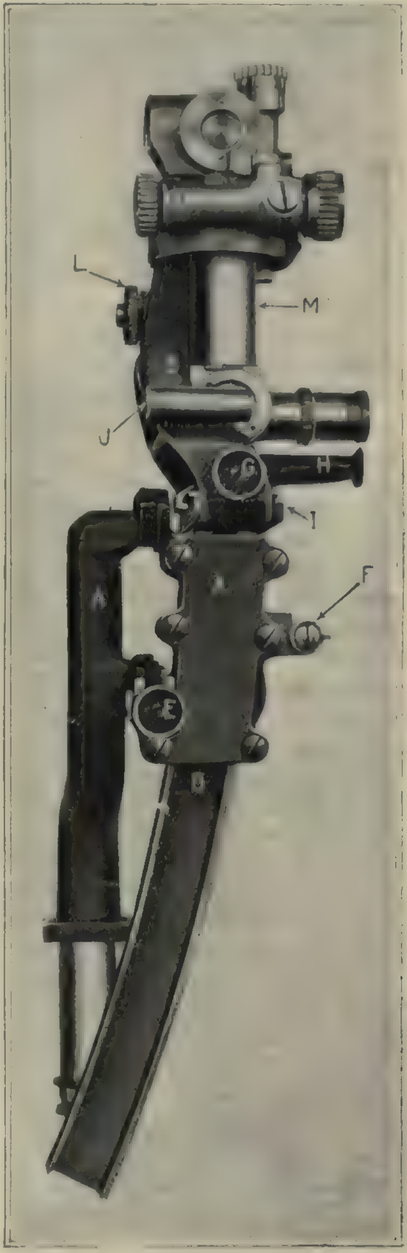


FIG. 3 (LEFT). PANORAMIC SIGHT MOUNTED ON SIGHT BAR AND SIGHT SHANK

A, sight bar; B, sight shank; C, guides; D, up and down gear knob; F, cross spirit-level holder; G, peep-sight screw knob; H, peep sight; I, deflection scale; J, elevation spirit level; K, range scale; L, clamp screw; M, panoramic sight

FIG. 4 (ABOVE). FRONT VIEW OF PANORAMIC SIGHT MOUNTED

C, micrometer knob; D, deflection index; T, index for micrometer knob

FIG. 5 (RIGHT). SIDE VIEW OF PANORAMIC SIGHT MOUNTED ON SIGHT BAR AND SIGHT SHANK

A, sight bar; B, sight shank; F, cross spirit-level holder; E, cross leveling screw knob; G, peep-sight screw knob; H, peep sight; I, deflection scale; L, clamp screw; M, panoramic sight

The mechanical work on the panoramic sight is exacting, and the machine-tool equipment should be of correspondingly high grade when work of this kind is undertaken. Worn tools, in ill health, with rattling bearings and adjustments, would prove too severe a handicap where a successful outcome is expected. Approximately 40 per cent. of the work performed on the sight is generally devoted to assembling operations. This percentage can be reduced in direct proportion to good or poor qualities shown in the machining of the component parts that have been prepared for the assembling operations, such as the alignment and correct relation with which one hole has been machined with another or the accuracy of the various operations performed upon the work before reaching the assembler.

When the assembler is furnished with a component part, the essential points of which have not been properly machined, he may assume the condition of error to be unimportant; but later developments in the assembly are liable to show a loss of position or of adjustment, due to looseness of surrounding parts, which cannot be traced at once to the offending part. Unnecessary and expensive work usually follows.

All parts of the instrument are not strictly interchangeable, but it is desired to finish the pieces as closely as possible to a condition of practical interchangeability. Owing to the nature of the instrument, the assembling operations are performed by the selective method, each instrument being composed of parts bearing the same identifying numbers.

Special tools, such as drill jigs, special arbors and dies, holding fixtures, etc., can be made of the type usually adopted for the machining of metal parts, with the exception of the indexing fixtures for cutting the gear teeth in the pinions, the special arbor for indexing the nicking operation for hobbing the worm gear and the graduating operations. The three last-named operations require apparatus differing but slightly from the regular holding and indexing arrangements provided on a universal miller and will be described later. Assembling and adjusting the sight is a delicate operation, and the attempted forcing of parts together is sure to bring disastrous results. It is necessary that the instrument shall be fitted together without perceptible shake in the movable parts, all threaded parts being interchangeable and lenses and prisms accurately and firmly secured to the metal parts. All prism seats are interchangeable. The graduated scale on the azimuth circle, when made to conform to the detailed drawing, shows graduations of 100 mils for each unit, each division equaling one sixty-fourth of the complete circle. The reading, when set at zero, coincides with the line of sight lying in the vertical plane that passes through the axis of the eyepiece, elbow and shank, the location of which is arranged so that the line of sight of the panoramic sight is parallel to that of the rear sight and also to the axis of the gun when both sights are set at zero. The optical parts of the instrument consist of two distinct elements—the telescopic part and the prismatic system. The assembled elbow complete, when unscrewed from the shank, contains the eyepiece lenses and lower reflecting prism and also carries the objective cell and lens, Fig. 6. This mechanical and optical combination contained in the elbow performs the functions of the ordinary terrestrial telescope, its function being to magnify the object. The magnifying power is four diameters. The prismatic system performs the erection of the image, retaining the image erect during rotation of the headpiece. For illustration, if the headpiece containing the rotating-head prism *A*, Fig. 6, is rotated through an angle of 90 deg. and the revolving prism *B* remains stationary, a vertical object would appear to be horizontal when viewed through the instrument. The erecting prism *B*, however, is so shaped that, when rotated about its vertical axis, the image of an object seen through it turns with twice the angular velocity of the turning prism itself. Consequently, if the headpiece is moved through an angle of 90 deg., it is only necessary to revolve the prism *B* through 45 deg. in order to retain the image in its true position. As shown in Fig. 6, the prism *B* is of rectangular cross-section and revolves around the same axis as the prism *A*. The gears and pinions are so calculated that, when the rotating-head prism *A* is turned through any part of 360 deg., the revolving prism *B* will turn with it at half

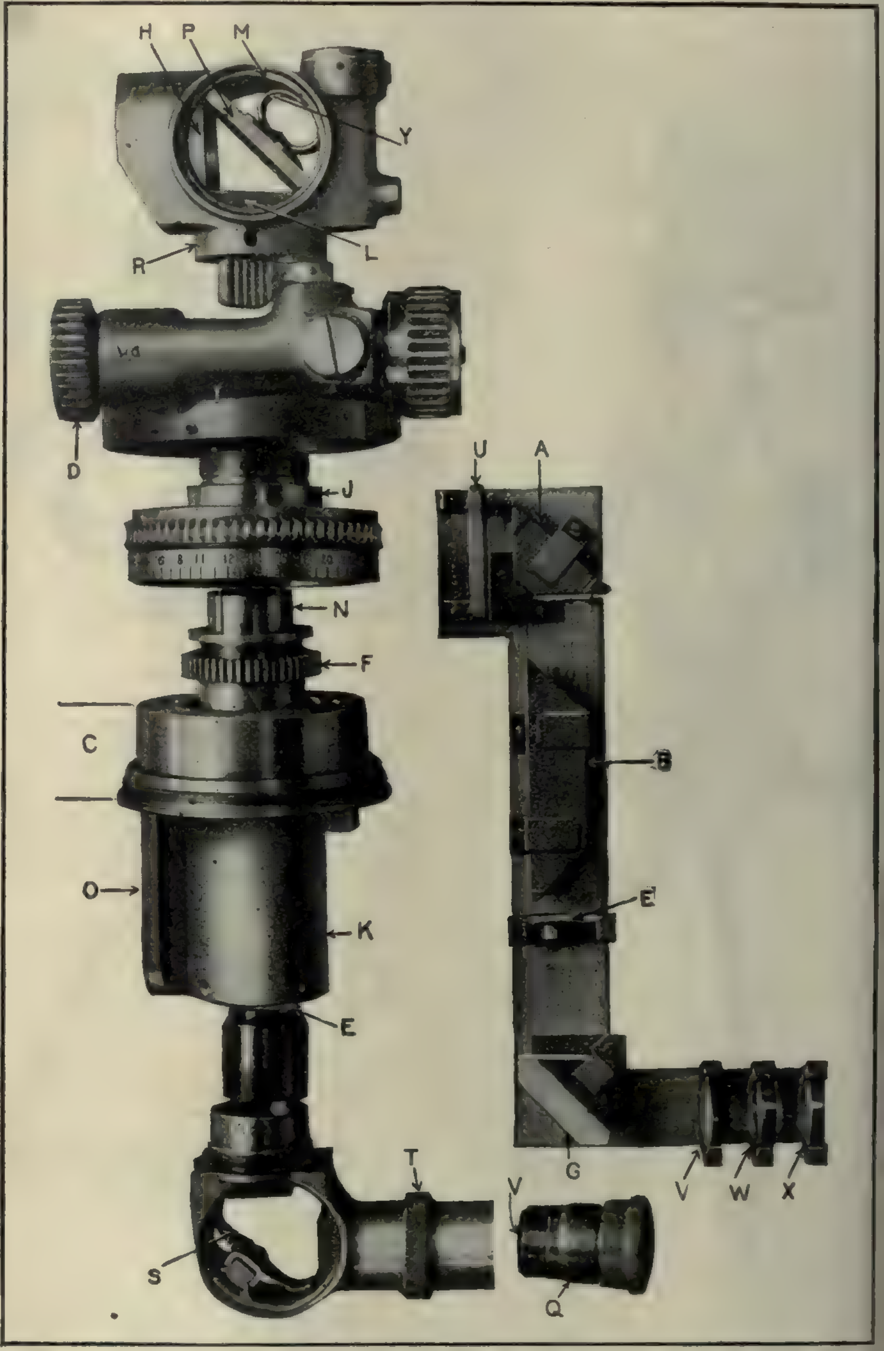


FIG. 6. UNIT ASSEMBLIES OF SIGHT, SHOWING POSITION OF PARTS AND OPTICAL RELATIONS

A, rotating-head prism. B, revolving prism. C, azimuth-circle support. D, worm-mechanism knob. E, objective lens. F, supporting sleeve for revolving prism. G, lower reflecting prism. H, front-prism support. I, hood. J, Azimuth circle. K, shank. L, bottom prism support. M, rotating-head prism holder. N, revolving-prism holder. O, T-lug. P, prism support back. Q, eyepiece. R, rotating head. S, retaining spring for prism G. T, shutter for night illumination. U, prism shield. V, reticule lens. W, field lens. X, eye lens. Y, rotating-head prism spring the speed, the image remaining erect when viewed through the instrument.

The optical parts, as shown in Fig. 6, comprise the rotating-head prism *A*, the revolving prism *B*, the objective lens *E*, the lower reflecting prism *G* and the eyepiece lenses. The rays coming from the object are reflected downward from the prism *A* into the prism *B*, which rectifies them; in passing through the objective lens *E* the image becomes reversed and inverted. In passing through the roof-shaped prism *G* this is corrected, the angular faces of the prism transferring the rays by cross-reflection to opposite sides of the axis, thus presenting a rectified (erect) image to the eyepiece, which the eyepiece magnifies.

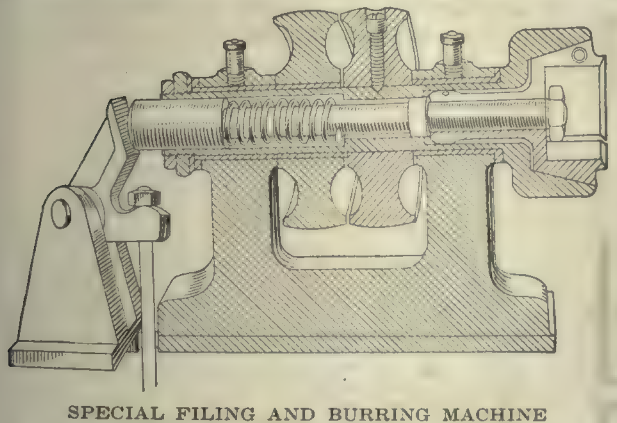
For using the panoramic sight at night, a small slot segment is cut in the elbow, and a corresponding segment is cut in the reticule cell. This slot is covered by the circular shutter *T*, Fig. 6, when night illumination is not required. The slot contains a glass insert for protection from dust or moisture. When used at night, an electric flashlight is held close to the opening, illuminating the graduated crosslines of the reticule.

Special Filing and Burring Machine

By John J. Eyre

Where the production of machine parts runs into large quantities, the designing of special fixtures for reducing costs has become an important factor.

In a munition plant in the East where large quantities of steel bodies for British detonator fuses had to be filed and burred, the machine shown in the illustration was designed to simplify production. As the idea is adaptable to other lines, a description may interest the readers of the *American Machinist*.



SPECIAL FILING AND BURRING MACHINE

The machine was composed of a base casting; a driving member with a tight and a loose pulley thereon; a three-piece draw-in chuck bored to fit work; a push rod that extended through the driving member to release the chuck; a compression spring to close the chuck and a foot-treadle-controlled thrust plate supported by a bracket in the rear of the base casting, the bracket and base being bolted to a $\frac{3}{8}$-in. steel plate fastened to a bench of suitable height.

The base casting was made with two uprights bored in line and bushed to receive the spindle, which was made of machine steel and chambered to receive the push rod, compression spring and ball end of the draw-in chuck, substantially as shown.

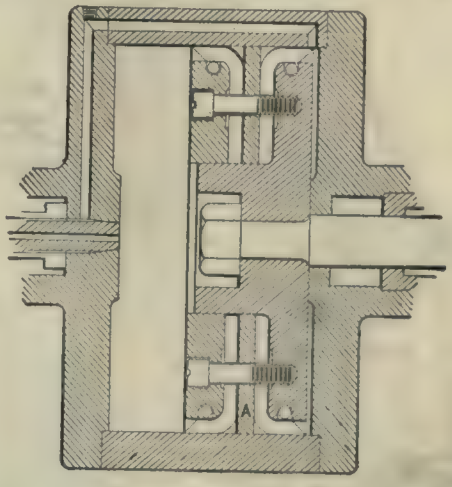
A tight and a loose pulley were located on the driving spindle. The draw-in chuck was made of machine steel bored to receive the work. The outer diameter was turned to fit the seat in the spindle, the rear end being formed to a ball shape with a groove turned on it to receive a split ring for holding the chuck together after it had been sawed in three equal sections. The front ends of the chuck jaws were counterbored, where they had been sawed, to receive three small springs for forcing the jaws open when pushed forward by the foot treadle. A compression spring, located in the chamber of the driving spindle, operated the chuck.

Air-Operated Piston Guide

By George M. Dick

About 75 per cent. of the lathes that we use in the manufacture of shells are equipped with air-operated chucks. The part that we have found to wear out quickest, and which gave us the most trouble, was the leather piston packing. We started out with the cast-iron piston and follower $\frac{3}{8}$ in. smaller than the cylinder and used $\frac{3}{16}$-in. leather packing beveled at the edge. In a few weeks' time, however, the leather became too small for the cylinder, and consequently the air escaped.

We tried $\frac{1}{4}$-in. leather and it worked a little better; but we still had trouble. Then we tried a spring under the outside edges of the leather, which also helped some.



THE PISTON AND ITS GUIDE

But still the piston, when in the rear end of the cylinder—the position which it occupies on all pull-in chucks when the chuck is closed—appeared to move sideways in the cylinder when the lathe was running. No doubt this was due to the piston rod being supported only for a short distance at the cylinder head and having clearance in the spindle. The piston leather packing being to a certain extent elastic, it allowed movement of the piston.

Some months ago we started to use a piston guide, which is cast-iron plate *A* bored to fit the spigot on the piston and turned a snug fit in the cylinder. We found that this served to hold the piston steady in the cylinder and preserved the leather.

Leathers which formerly had to be changed every two or three weeks now last as long as six months. This means quite a saving in leathers, and we find the pistons work much better.

Automatic Machine for Wearing-In Threads

BY CHRISTIAN F. MEYER

SYNOPSIS — *Coarse-pitch acme threads on a shaft are worn-in to a babbitted nut by means of the automatic machine described in this article.*

THE spindle, shown in Fig. 1 at *D*, has a double acme thread and works in a hollow cast-iron nut *B*, into which white metal is poured through suitable openings. The white metal contracts somewhat in cooling down, and it is therefore necessary to grind the spindle into the nut in order to obtain a proper working fit, which work is described in detail.

This work was formerly done by two laborers using a large tap wrench and required from 4 to 5 hours for each spindle. It was very difficult to get men for this job, as the labor was hard. In addition, the work was unsatisfactory, due to the inability to revolve the spindle by hand in a straight line or uniformly. More and more of these spindles, as well as similar work, had to be made, so the automatic device described in this article was designed and built. It has been used for nearly three years with the best results.

The device, as shown in detail in Fig. 2, consists of two cast-iron frames *K*, which were taken from an old machine. Bearings are mounted upon these frames and provided with lathe centers. The work is placed between these centers and revolved by means of a dog, the tail of which is held in a slot provided in the faceplate *G* for that purpose. This faceplate has gear teeth around its circumference.

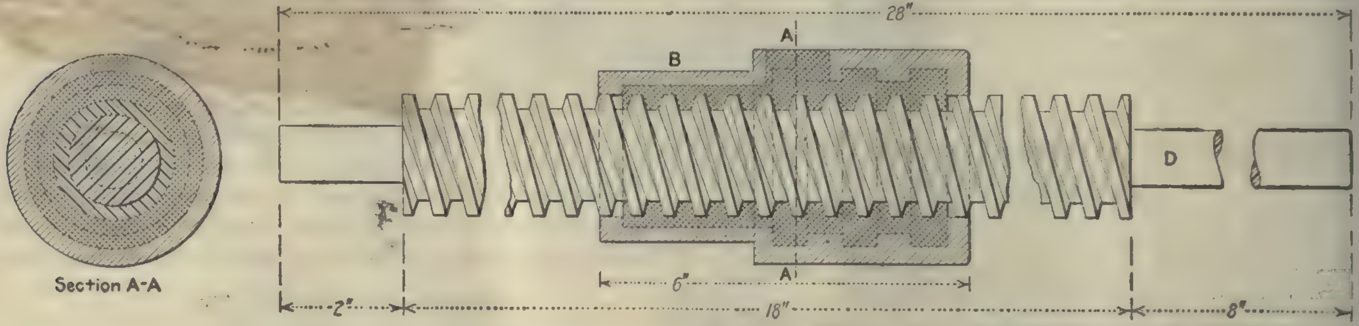


FIG 1. NUT AND SCREW TO BE WORN-IN

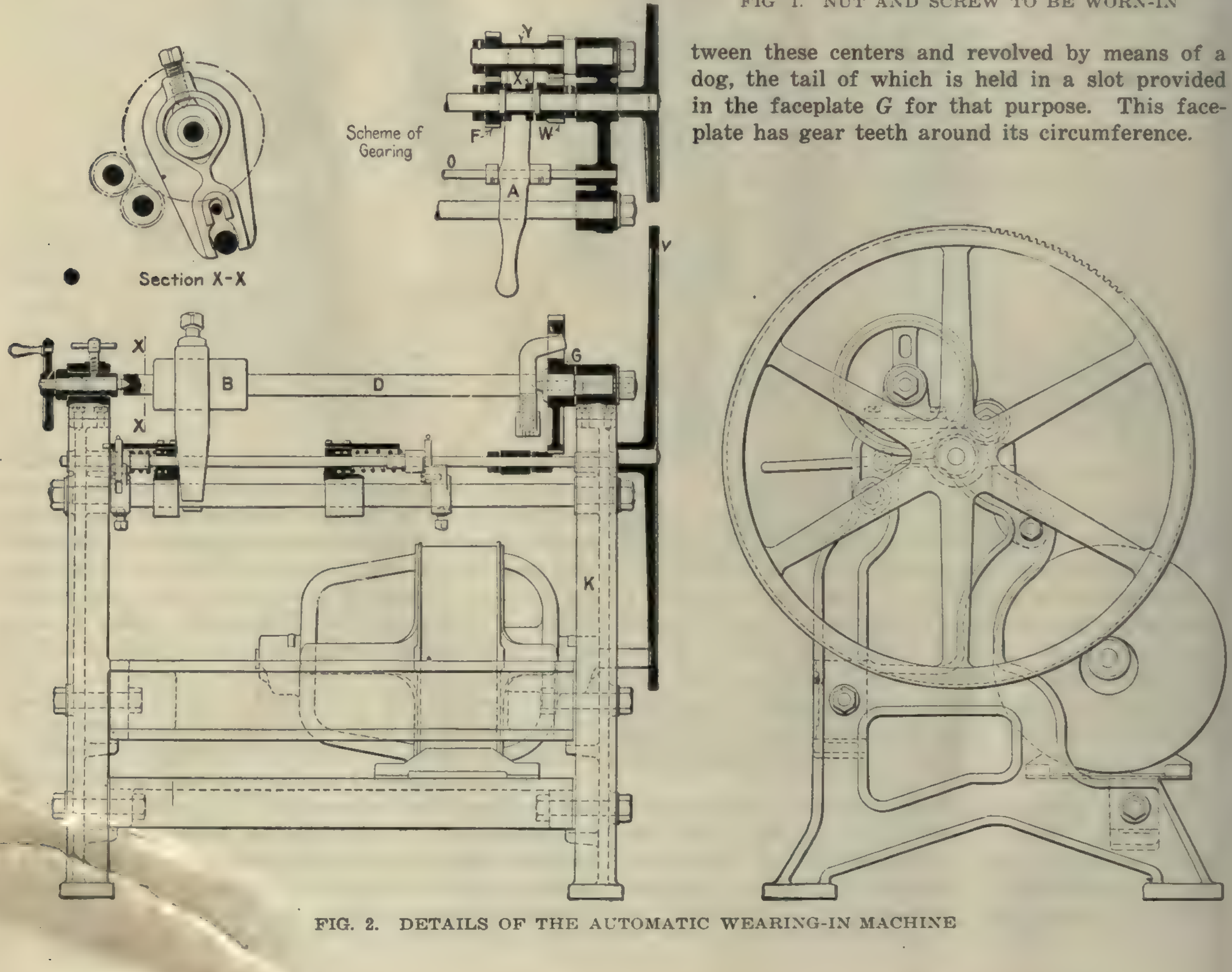


FIG. 2. DETAILS OF THE AUTOMATIC WEARING-IN MACHINE

The device is driven by a motor, the pinion of which drives the large gear *V*. The latter is keyed to a shaft on which two gears *W* and *F* are mounted loosely, held in their respective positions by suitable shoulders on the shaft and collars. Between these two gears slides a toothed coupling which is keyed to the shaft and which may be thrown in or out of connection with either of the gear *W* meshes directly with the teeth of the faceplate *G*, while *F* drives the same plate by means of a pair of solidly connected intermediate gears *Y*. This mechanism provides the reverse drive.

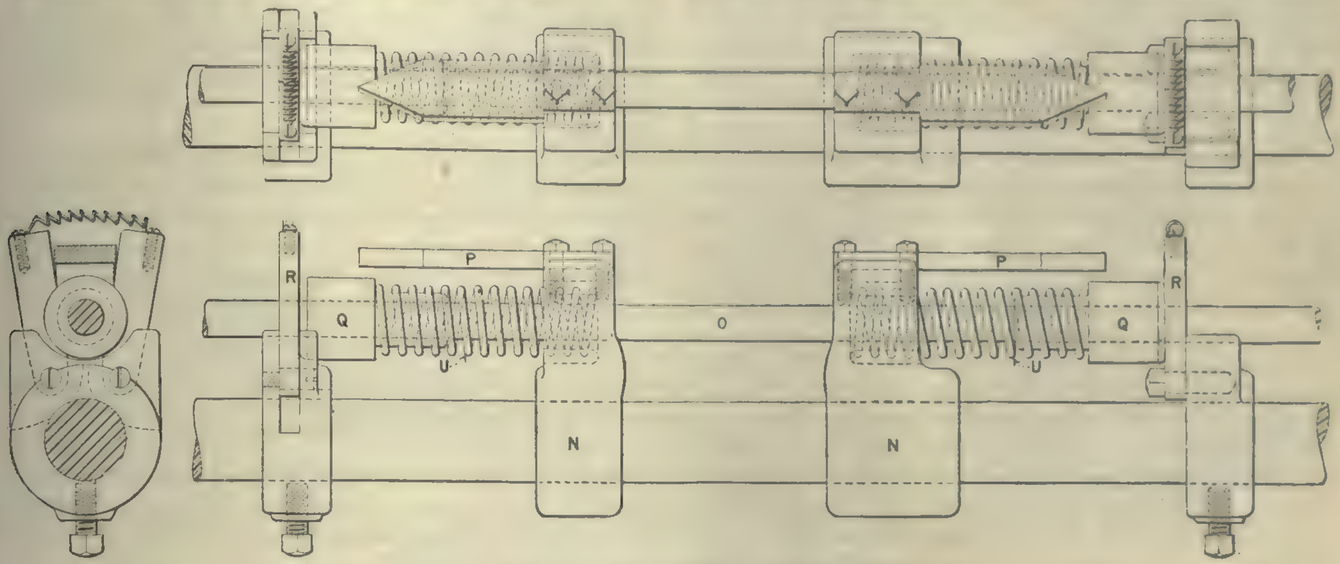


FIG. 3. DETAILS OF THE REVERSING DEVICE

The coupling *X* is operated by a hand lever *A*, thrown over and back by two collars that are fastened to a shifting rod *O*. The nut *B* is prevented from revolving by a dog that likewise slides on the shifting rod *O*.

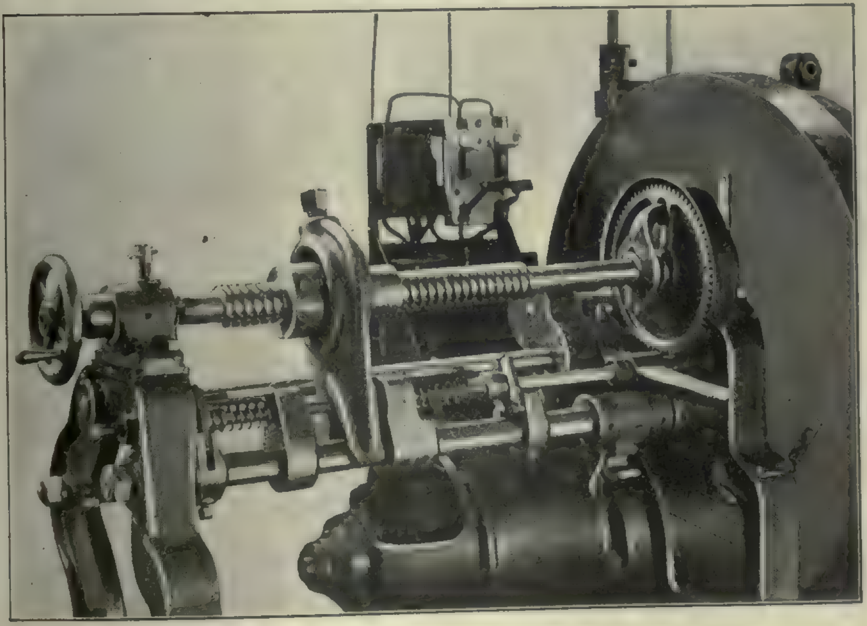


FIG. 4. ASSEMBLED MACHINE WITH WORK IN POSITION

The two sliding brackets *N*, shown in Fig. 3, are pushed along by the dog, Fig. 2, as the nut is moved in either direction by the revolving spindle *X*. These sliding brackets by overcoming the tension of the springs *V* allow the wedge *P* to separate the levers *R*, permitting the collar *Q* to pass and operating the shifting rod *O*.

This device gives excellent results. The work comes out round, straight and uniform, and a laborer running the machine finishes one spindle in about 25 min. He can also be used for some other job, as aside from loading and unloading, the device needs no attention.

Practical Co-operation

By Entropy

In the "good old days" in the East large families were an asset. A farmer and his wife could only clear and cultivate a small patch of land. Every child, soon after it was out of the cradle and regardless of sex, worked. Possibly it was only at washing dishes; but whatever it was, it relieved the mother or father so that just that much more of the 24 hours was available for work. Saving was necessary and automatic. Crops mature in this region but once a year. What the people raised had to carry them until the next harvest. They worked literally by the year, and not by the month, week or day. They had to allow a factor of safety in their planting, because seasons were precarious. Bad years they drew up their belts another hole or two. Good years they had a surplus to exchange across the ocean for the good things of life. With everybody working, there was every inducement to have large and profitable families, since the few boys who cut loose before they were 21 had to buy their time from their parents. With every necessity for forehandedness, it is no wonder that New England prospered, nor is it any wonder that movements for general-health and old-age insurance made slow progress.

It is hard for an Easterner, no matter what part of the country he lives in, to conceive of more than two types of men—one, the forehanded and usually pessimistic type which the surroundings of our ancestors developed; the other, the hardy, reckless day-by-day hunter and adventurer, who asked no odds of anyone and went hungry but cheerful when he did not bag his game, but asked of no one a favor.

Time, however, has brought another type in large numbers—men who cannot see where their daily bread comes from, who are all the time within a week of starvation, but never know it. A man who works at a turret lathe or a drilling machine cannot pile up work against a hard season; neither can he go gunning around the country for the best jobs, though the past year or two has found many who tried it to their sorrow. Modern methods have taken away from him a large part of this opportunity to store up a surplus; and no matter how much good advice we may give him about economical living and the virtues of hard work, the fact remains that the saving that is possible under the best of conditions is more than offset by the pressure to give his children a good education rather than to emulate our ancestors by putting them to work. His employer could, until recently at least, see an opportunity to lay up a store against dull seasons, but even there cut-throat competition has often prevented his doing what he would like.

All of this indicates that saving and thrift are rapidly becoming a matter of coöperation rather than an individual affair. We are all so dependent on each other's actions that we are no longer able to stand by ourselves even in some things that seem like our most private affairs. It is this which is making the mad rush toward government insurance, in which the officials expect to use the small portion that the state contributes as a means for complete control.

It seems as if we should stop, look and listen before we get to this crossing. In abstract principle this is really a matter for the whole community concerned, but as a matter of practical experience the fact remains that as yet there are few places where the administration of our government is even 50 per cent. as efficient as the poorest of our businesses. Before we decide to let such inefficient methods spread to such large proportions as even health insurance alone, we should see if there is not some way in which we can coöperate among ourselves to handle it in a manner satisfactory to all concerned and yet get a dollar's worth of service for each hundred cents invested. There seems to be little question that thrift, to be effective, must be coöperative rather than individual; and the portion of it that may be covered by insurance against loss of wages and cost of medical care seems so directly connected with wage earning and with industry that it probably will before many years have to be paid for by employers, either directly or indirectly.

The more experiments along this line there are, carried out by concerns large enough to stand the cost as an experiment, the more will be known about the necessary cost, if it is carried on by the government, and the better will be the chance of coöperative work, if it is carried on by the employers themselves.

Machining Details for Gasoline Engines

SPECIAL CORRESPONDENCE

In this article are illustrated some of the special tools, jigs and fixtures used by the Gray Motor Co., Detroit, Mich., for machining details for its recently developed truck and tractor engine.

In Fig. 1 is shown the jig used in drilling the flywheel housing. The jig is designed to hold two housings at once, which have been bored and the various surfaces milled prior to the drilling operation. The castings are located against the pads A and against the body of the jig, which is made to suit the bored surface of the housings. The pads B, operated by the screws C, hold the casting in position. When the castings are in position, the latch D is held down by the pins E.

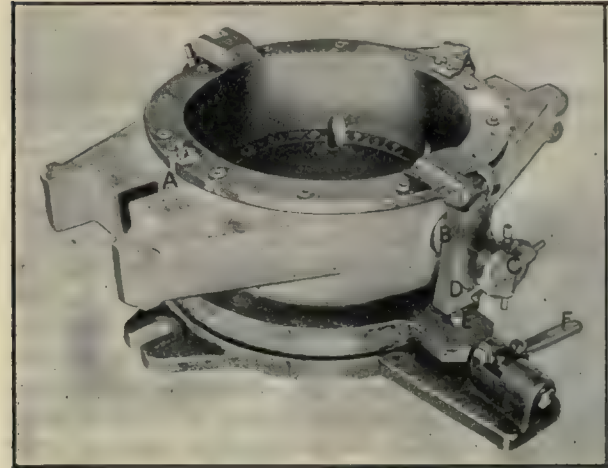


FIG. 1. DRILLING FLYWHEEL HOUSING

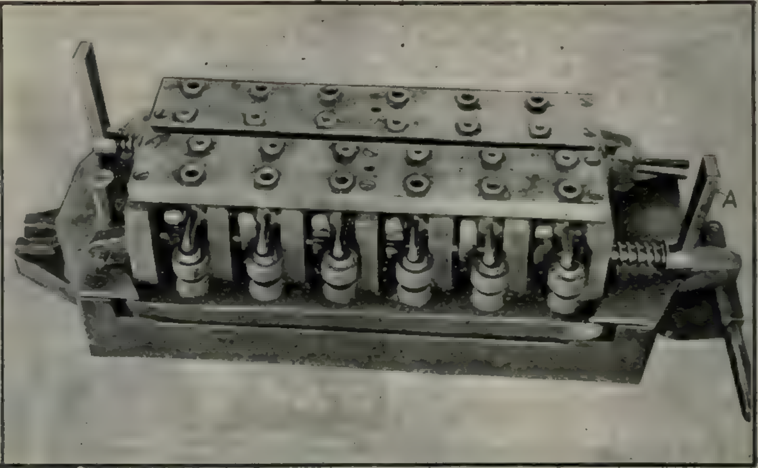


FIG. 2. DRILLING VALVE ROCKER-ARMS

When it is desired to lift the latch, the lever F is drawn back, thus allowing the pin E to drop down. In each flywheel housing six $\frac{5}{16}$-in., eight $\frac{33}{64}$-in. and two $\frac{19}{64}$-in. holes are drilled, and the time required for two housings is three minutes.

The fixture used in drilling the valve rocker-arms is shown in Fig. 2. The parts are placed from the front, being located on height pads. The handle A is then tightened, which draws back the six clamps and holds the rocker-arms in position. Six $\frac{7}{16}$-in. and six $\frac{13}{64}$-in. holes are drilled in the rocker-arms, the time necessary being three minutes. While these six rocker-arms are being drilled, the operator is placing another set of six pieces in the jig at the rear, thus making the machining operation continuous.

In Fig. 3 is illustrated the jig used in drilling the fan brackets. The casting is slid from the front and located in a fixed V-block at *A*. A wire attaches the lever *B* to a treadle. After the operator has placed the casting in the fixed V-block, he pushes down the foot treadle. The lever *B* pushes a sliding V-block against the casting at *C*, thus forcing it into the fixed block and locating the piece.

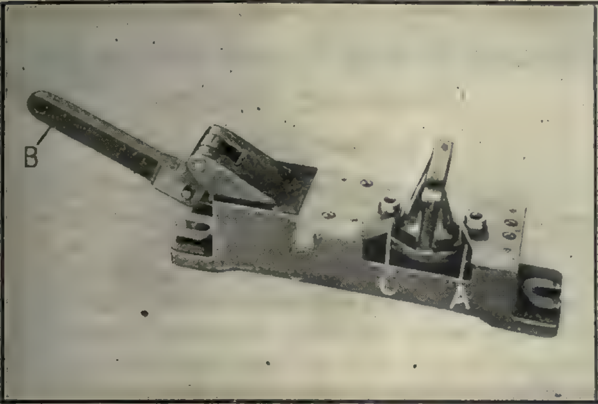


FIG. 3. JIG FOR FAN BRACKET

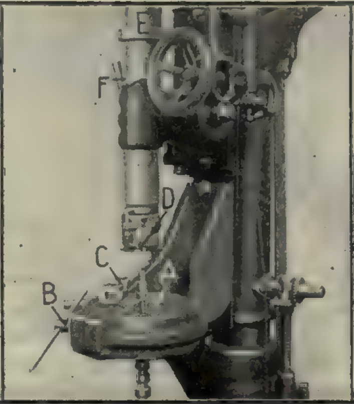


FIG. 4. THREADING

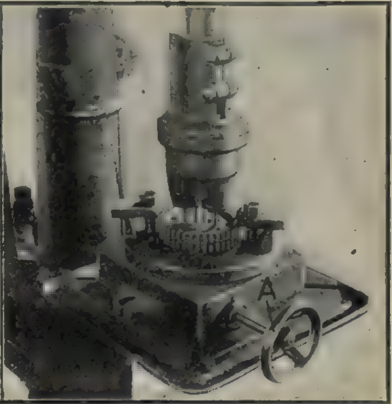


FIG. 5. MILLING SLOT IN GEAR

Two $\frac{13}{32}$-in. holes are then drilled, the time required being about one minute. With this method and type of jig the drilling operation is performed with a small loss of time for putting in and removing the part from the jig.

THREADING END OF CAMSHAFT

The fixture used in threading the end of the camshaft is shown in Fig. 4. The shaft is held in the three-jawed chuck *A*, operated by the handle *B*. The correct setting is obtained with the clamp *C*, which is swung against the camshaft. The shaft is raised until the shoulder comes in contact with the under side of the clamp. The shaft is then tightened in the chuck and the clamp swung back. The die *D* is fed down and the thread cut. The die is opened when the collar *E* comes in contact with the surface *F* of the column, thus preventing damage to either the die or the shaft.

MILLING SLOTS IN CAM GEAR

The fixture used in milling the timing slots in the camshaft gears may be seen in Fig. 5. It holds two gears, which are held down with straps, as shown. The two end mills are driven by gears from the drilling-machine spindle. The revolving cutters are fed down through the gears, which are rotated the desired angle with the handwheel *A*. In this way the proper slots are milled.

Making Graduation Dies

BY DONALD A. BAKER

Considering the high prices charged for the graduating dies used by time-fuse manufacturers for stamping the graduations on time-fuse bodies and timing rings, it must be that some of the manufacturers are not acquainted with the methods of making these dies. Consequently, the following description will be of interest, as the cost of dies produced by these methods should not exceed $60.

The graduations may be cut on a shaper by mounting a good dividing head on the shaper knee and using a single-point tool. A better way, however, is to make a milling fixture such as is shown by Fig. 1. This is simply a casting that is fitted up to fasten to the overarm of the miller. It is held by the two clamping screws at the top, while at the other end it carries the cutter *A*, which with a gear *B* is mounted on the same shaft and is a close fit in the slot in the overarm. Another gear *C* meshes with the gear *B* and is driven by a round belt that passes over the grooved pulley *D*. The graduating die is mounted on the dividing-head faceplate, as shown. After the job is properly set up, dividing and feeding the cutter across the work may be done by unskilled help.

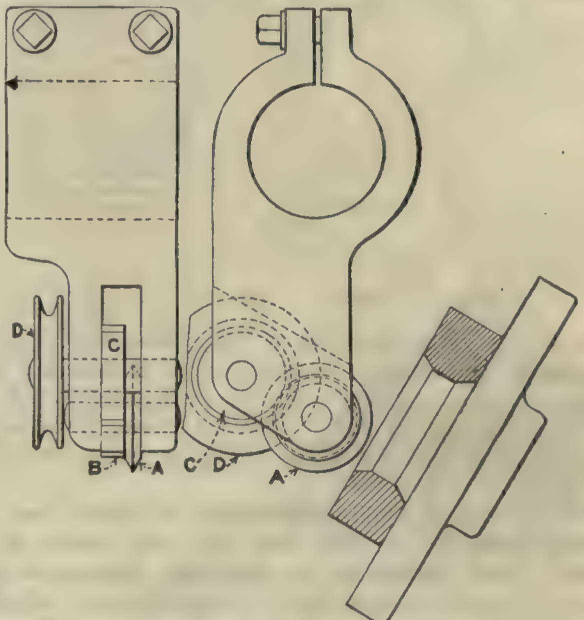


FIG. 1. THE MILLING FIXTURE

The next step is the cutting of the lines to length. On some dies there are three lengths, while on others there are only two. Various methods have been used for this, but the best two will be given here. Fig. 2 shows a hardened tool-steel piece *A*, which serves two purposes: First, that of the gage by which to turn the inside of the dies; and second, after the dies have been graduated, it is again put in place and held by a clamp while the chisel *B* is used to cut into the graduations, as shown by *C*. Four graduations at a time are cut. The piece *A* is indexed by hand, missing the fifth graduation. Another four are cut in like manner, and so on until all have been cut. This method prepares the die so that it can have the surplus parts of the lines removed by hand engraving. The chiseling is simply used as a guide and, of course, leaves the tops of the graduations square and sharp.

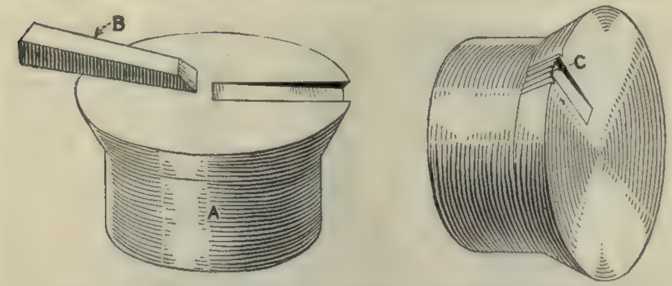


FIG. 2. DEVICES FOR CUTTING LINES TO LENGTH

A better method, and one that does away with handwork on the die, is shown by Fig. 3. The die, after graduating, is again set up on the dividing-head faceplate, with the head tipped a few degrees from the vertical. Then a cutter of proper width is used to cut the short lines to length, simply cutting the tops off as shown by the line *A*. This has an added advantage in that it gives the tops of the lines what might be called a reverse rake; in other words, it does not leave them quite as sharp as the first method described. At *B* is given another view of the cuts, while *C* shows the part that is left, which has the long line on the front of it.

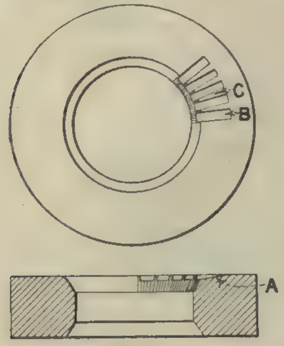


FIG.3

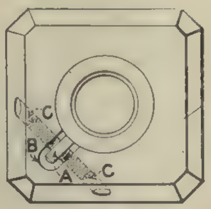


FIG.4

FIGS. 3 AND 4. CHISELING AND ADJUSTING METHODS

Steel used in making dies must be tough, and free from distortion in hardening. For this reason it has been found, regardless of cost, that high-speed steel, pack hardened in bone dust at a temperature of about 1900 deg. F., then dipped in oil and afterward drawn to about 500 deg. F., gives the best results. Dies made in this way wear out, but do not chip off as do various kinds of carbon-steel dies. Also, the packing of them at a comparatively low heat does away with all troubles from distortion. While the dies are not as hard as those done at the higher heat, they are hard enough for the purpose and very tough.

Fig. 4 shows a method of adjusting the dies in their holders—in this case a shoe that was used in a drop hammer. A pin *A* is driven into the side of the die; *B* is a clearance slot in the die shoe, while the screws *C* bear against the sides of the pin *A* and are used to adjust the die to proper position. One of the screws shown has another screw at right angles to it, so that once the die is properly set, this screw is tightened down, retaining the position of the screw under it. The other screw is loosened whenever the die is taken out of its holder for any reason. Putting it back in place then is an easy matter, as the one screw not having been disturbed, the pin in the die can readily be set back against it.

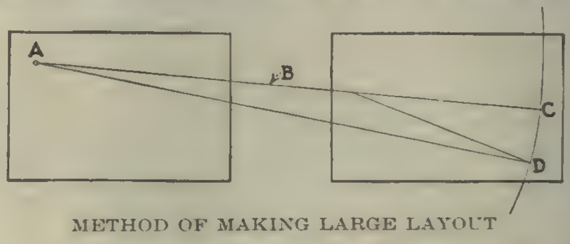
Layouts Versus Computation for Obtaining Angles

BY HARRY KOONTZ

Tool designers consume much time in making calculations to obtain dimensions for cutters, locating blocks in drill jigs and fixtures, form gages, etc. In many cases a calculation including several angles is made, first by the tool designer or detailer and again by the checker. The writer has many times performed or witnessed a day's work to obtain one dimension for a cutter or gage that was drawn in one hour.

These dimensions should be obtained, whenever possible, by a 100 to 1 layout, the required dimension to be scaled within 0.005 in., which allows but one-half thousandth variation in the answer. In many cases an enlarged layout must be made to assist in solving the problem; and it should be made at least 100 to 1 size, so that the checker may scale the dimensions that the designer calculated. The illustration shows a method of making a layout to this scale or larger, when some of the dimensions are beyond the capacity of the drawing board.

A tack *A* is placed in a neighboring board and the thread *B* used to draw the radius *CD*, the chord of which is then measured off by scale. The thread may be fastened temporarily with a thumb-tack, so that the lines *AC* and *AD* may be drawn with a straight-edge aligned to the thread.



METHOD OF MAKING LARGE LAYOUT

In this manner the enlarged layout may be made of the necessary parts only, and the scale of the enlargement need not be limited by the length of the radius. It is obvious that the same method applies to angles and similar problems where no radius exists.

Harry A. McKnight has resigned as superintendent of the plant of the American Car & Foundry Co., Jeffersonville, Ind., to enter the operating department of the Canadian Car and Foundry Co. He is succeeded at Jeffersonville by Charles T. Hertzsch, assistant superintendent of the plant.

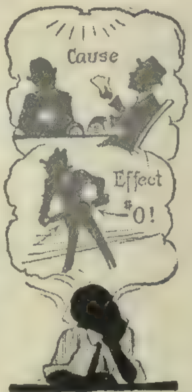
Series for Draftsmen and Designers

Making Opportunities in the Drafting Room*

BY CHARLES M. HORTON

AS YOU know, there is a saying that opportunity knocks once at every man's door. I will go farther than that and declare that it knocks frequently —like a pessimist talking about his neighbors. Indeed, I will make so bold as to say a man can make his own opportunities, just as, in a larger way, he can make his own career. We can all do that, you know. All that is required is a peculiar unyielding desire, the willingness to work toward this desire, a beautiful self-denial in matters apart from the thing wanted, and a modicum of good health. Lacking this last, all the others are of little avail. But having health and having a definite aim in life, one can mount to endless heights. The possibilities in all this are only just being understood.

Back in the old days, when Steve Winthrop had been in the drafting game about three years, he used to do a lot of quiet thinking along these lines. He used to do a lot of quiet thinking along a lot of lines. Drafting permits that, anyway, and of course, at times, demands it in the work itself. Yet there are moments when the work is not exacting, and under these circumstances a man cannot but let himself drift off and away in reflection on things not having to do with mechanical drawing. Past events flood in upon you, as it is said they do upon a drowning man; and all sorts of things troop in upon your thoughts. Sometimes you find yourself wishing that you had quit that poker game the night before when you were even, and again you find yourself wishing you had taken up veterinary surgery instead of drafting. All sorts of things like that, you know! I have in mind now a fellow who at such times kept wishing that he never had begun to chew tobacco—and then would calmly reach into his drawer for his little chunk of "eating." All sorts of things—yep!



Besides doing a lot of quiet thinking, Steve used to do a lot of quiet observing. It was a large drafting room, employing over a hundred draftsmen, and the opportunities around him for extended observations were big. He saw men come and go; he saw men work their way up, and men remain stationary; he saw men, just that—he saw men. But whether they came or went, whether they mounted upward or remained on a dead level, he found them interesting. Man has his foibles; these men had theirs, and Steve saw much that gave him food for thought. Hayner, for instance. Hayner was a man who had willed his way to superb health from a condition of puny physical being, and he believed absolutely in the power of man to project his thought. He liked to prove this. Talking with Steve one afternoon over his board, Hayner said he could make a certain draftsman ahead of them put up his hand to the back of his head. Steve told him to go to it. Hayner relapsed into stolid silence. In a moment the thing was done. The draftsman under the fire of Hayner's psychic guns did actually reach up a hand and scratch the back of his head!

Things like that, you know!

Which brings me around to Jones. I have mentioned Jones in these articles. Jones was that skilled man who could, and did, run up the design of whole engines without making a calculation. Jones rarely mixed with the bunch. Noontime in any drafting room is a time of social intercourse, and it was so in this drawing room; but Jones never made himself one of the several groups usually scattered around among the drawing tables. He seemed to have indigestion, or something, because he spent his whole noon hour, generally, out along the railroad track, sometimes in a half-kneeling position, idly tossing stones about him. When the weather permitted. Rainy days saw Jones seated at his board working as if he liked his job. He did.

Yet he was of those who feel the urge for better things, as was revealed later. But at that time he did a lot of work between the mid-day whistle blasts, which of itself proved that he was following his rightful vocation. Men will do that sort of thing when they have found their right groove. But they're scarce. It is not the individual's fault, however. The trouble lies mostly with our system of education.

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Jones was a good man, and the company recognized the fact. The general manager appeared especially fond of him. He would spend whole hours with Jones over the latter's board, and he was not always talking about the product, either. Steve noticed that. Also, he noticed that when the general manager left Jones, Jones himself seemed more introspective and thoughtful than ever—would stare hard at his drawing without making a line for whole minutes at a stretch. Steve worked almost opposite Jones' tables—he had two, a big one and a little one—and as I have said, Steve was doing much quiet observing and cogitating on his own hook these days.

One afternoon, when Steve had finished detailing an intricate cylinder from one of Jones' designs, Jones came over to see how the thing was working out. Steve talked mechanics for a while, then, as was his habit, a habit almost unconscious with him, he put out a sort of feeling question to Jones, designed to draw out the latter's personality. Jones was something of an enigma, owing to his general reticence and habit of staying by himself, and Steve was a little curious concerning the man. So he shot his question.

Jones blinked at him a moment behind his spectacles. Evidently he was puzzled as to whether to descend upon familiar ground with Steve. Finally, he answered. This led on to other things, things opening out upon life in general, its codes and creeds and conducts; and when Jones went back to his board, Steve believed he had dug in under the man's skin and was rejoicing, for he found that he liked the man and that his earlier estimate of Jones had been a correct one. Jones was thinking, himself, it proved, on the ways of man in this world, with especial reference to one's making a success of life. That is an interesting problem to almost everybody, just as it was to Steve; and it was proving an absorbing one to Jones, as revealed in this conversation.

It was not the last of these conversations. Every evening, just before quitting time, Jones got to sauntering over to Steve's board and talking on matters of moment not having to do with engineering. And the more he came the more Steve liked him and the more frank and open Jones became of his own secret thoughts. This went on for months. Then one evening the conversation took a more personal turn than it had up to that time. It was something like this:

"Speaking of one's making his own opportunities," Jones said, in his quiet, Middle Western drawl, "I confess I have heard of such a thing, but cannot quite get the idea. What is your idea of it Winthrop?"

Steve had an idea on that; and after a moment of hesitation, since he was unable to present it in any other way than as he saw it fitted Jones' case, he answered sort of hypothetically.

"Suppose you were working at a picayune job and wanted something better," began Steve. "And suppose you had the friendship, the interest, of a man in power to do something for you. Do you know what I'd do? I'd bone that man at the very first opportunity for a better job—at least, a chance for a better job—and tell him I was dissatisfied with my present work. I'd do that. And doing it, I'd call that, provided the opportunity was given me, making an opportunity. That is one way. There are others, of course. One is doing the best you know how, and another is getting out when you see things shaping wrong for you. But the best one, to my way of thinking, is to let the boss know you have a hankering for something better. Lots of men in power think that a man, because he remains silent, is lacking in ambition. Stir him a little bit, is what I say."

Jones went back to his boards. And curiously enough, his visits to Steve thereafter tapered off and soon stopped. Steve did not like it and did not understand it, and in consequence he got peeved. But he himself, being as he was a little independent naturally, let it go at that. Sometimes he thought that perhaps he had miffed Jones in that hypothetical answer, and at other times he figured it out that Jones had decided he was descending a little too much in conversing so regularly with a mere detailer. However it was, Jones and these little friendly talks on big subjects suddenly ceased. And then one day Steve was shown the answer.

Glancing up from his work one afternoon, toward the end of the month, Steve saw Jones quietly packing away his books and instruments. Jones was taking his good time about it, and Steve thought he saw in the fellow's eyes, behind his glasses, an expression of decided satisfaction. Steve was a little curious and wondered if Jones was going to quit. He felt a little dispirited at the thought, for he liked the man; and as soon as he could bring it about advantageously, he asked the foreman of the squad. Jones was not quitting the company. He was going downstairs, said the squad foreman, to act as engineering assistant to the vice president! Steve gave a sigh of relief. Also, he felt a bit elated. For had he not shown Jones the way, indirectly to the sure, but nevertheless the way! Of a surety, señor, he had! *Satis, superque.* We are here today and in the general manager's chair tomorrow. No? Well, anyway, it looked good for Jones.

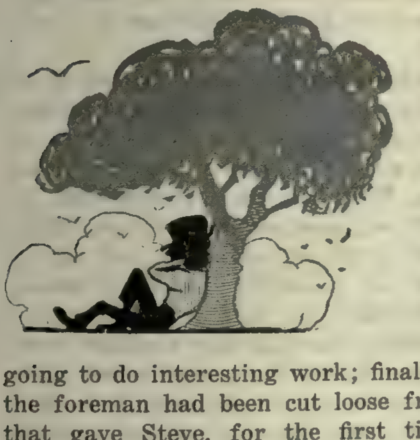
Came another change in Jones. Whenever he appeared in the drafting room after that, he was resplendent in a white vest, creased pants, highly polished shoes and more or less gay cravats. Prosperity certainly is hell. And he would walk through the room with a certain dignity of step not readily apparent in him before, though he was always dignified. But worst change of all—even though up to his going downstairs he had ceased his visits at Steve's table toward the close of day, he never had neglected to bow to Steve whenever he happened to pass him. But not any more. Sometimes he did bow, but always stiffly, and more times he didn't seem to see our hero at all. That's what you get for being a scrub draftsman, oldtimer. Well, things went on that way for a considerable time. Steve ground out his details, with now and then a piece of designing coming his way, and Jones was forgotten, save when orders came up for the draftsmen signed in a big bold hand. As an aside, and as a friendly tip, I wish to inform all and sundry who are reading this that the first thing to do, when advanced to a station in the game where you sign letters, is to purchase a pen of the fountain variety that will make a scratch like a hen—a line about $\frac{1}{16}$ in. thick—and when using it, be sure to cover half the sheet with your signature. It gives the impression of bold power, and that helps, you know, in getting away with the job.

Nevertheless, Jones turned out big, at that. He was just biding his time. Ingratitude was never a part of his make-up—bless his soul. Merely, he couldn't very well tip his hand. Nobody could under the circumstances. It happened this way. Steve took a day off toward the middle of August and spent the whole 16 daylight hours out under a tree in a field about 15 miles from a smoke-stack. He took a car as far as it went and then eased his racked bones by hiking the rest of the distance himself. And he lay down in the shade and cooling zephyrs and silence and there continued his interrupted cogitations—interrupted by the rattle of the trolley car. He enjoyed that day, right you are! But he stole it, which was not fair. Nevertheless, he went in on the job the next morning full of pep and eager to eat it up. But he got a kind of a shock. The squad boss came to him with a look of suppressed animosity in his eye and a small sketch in his trembling hand.

"Winthrop," he began, "you were away yesterday and Jones was up to see you. He was asking for you. Where were you?"

"I was sick," said Winthrop, not lying, because under his breath he added that it was the job that he had been sick of.

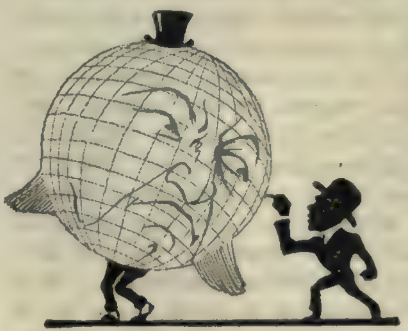
"Well, anyway," went on the boss, "here's a sketch of an engine Jones told me to give to you the first thing this morning. I guess he wants you to work it up. It's one of the Old Man's big ideas. It looks as if they're going to push you along. Jones said if you got stuck to call him up." Humph! And Steve had been lying out under a tree! You never can tell, can you? But he went to it, glad of a number of things. First, he was glad that Jones had proved up to his estimate of him; next, he was glad he was going to do interesting work; finally, he was glad that the foreman had been cut loose from the job—a fact that gave Steve, for the first time, opportunity to spread himself individually.



. . . .

I have taken rather more than my usual space with this one narrative, because it carries a number of points on this opportunity thing, points that in themselves are obvious. But the biggest of all lies a little below the surface. It is this: All circles sooner or later close themselves. Do a man a good turn, and in exact proportion will someone do you a good turn. It may not always be the man whom you yourself have befriended. But it will be somebody—something. You cannot get away from it.

Steve in his personal application of what he thought meant the making of an opportunity for Jones was utterly unselfish. In putting the thing as he did, he thought only of the advancement of Jones. But the circle closed itself. Jones had come back, and in as big a way to Steve as Steve's idea had been big to Jones. For it did not end with that one engine. Steve was given more and more of that sort of thing to do, and it was the beginning of a successful career for him. Something happened later, a matter wholly outside his control, and he eventually quit the company. But that is another story. What I wish to emphasize here, however, is that the way to get a thing is to go after it. The world owes us a living—sure—but frequently we have to dun the world for that living. It has proved so in Steve's case; and it must prove so in yours, since all natural laws apply alike to all mankind.



Be on the dead level with everbody. Be just a bit more than on the dead level with everybody. I once knew a draftsman who was so grimly, defiantly honest that, when he took a day off, as he did with one job, in order to look into a better one, he told the boss so when he came in to work the next morning. He didn't connect with the second job and told the boss that, too. The result of both of these nifty bits of candor was that he got fired. His loss there, however, proved to be a big gain elsewhere. That boss could not understand a frankness like that and, acting on the impulse and probable heat of the moment, fired what to him was a good man as long as he stayed. One finds boneheads on the firing line as well as men vitally courageous, men with a courage to do the opposite from what the average man under similar circumstances would do.

Therefore, to sum up, the way to make opportunities for yourself—one way—is to make opportunities for somebody else. Another way is to perform the work in hand with all the skill and attention at your command. A third way is to mind your own business and keep away from the boss with tales about your neighbor. In connection with this last, the foreman who will even listen to this sort of thing is not worth his floor space, and the sooner a man of this kind heaves you out the better off you are. Then too, always remember the rules of the company as set down in its booklets or posted on its bulletin boards, and live up to them. A man may be an efficient man; but if he continually ignores rules, he will be, in the eyes of the organization, a poor man and can expect little consideration when the openings are being handed out. Still another thing to do in a case like this is to prepare yourself for the next job above you. Understudy the man holding that position as much as you can, and you will be ready to fill his shoes when he in turn is boosted a peg.

But the greatest of all—and I emphasize this purposely—is a daily habit of thinking well of your draftsman neighbor; cutting out the jealousy; doing a good turn for him whenever and wherever you can. In all Steve's career he met only two men who proved to be, in the language of the drawing room, punks. One man, Steve asked a question that was troubling him about mathematics. The man replied that it cost money for him to get his education, and for Steve to go and pay for his own education. The other proved to be an even worse type of human being. This greasy individual informed Steve one day, when Steve asked him about a certain job the other had worked upon, that he would not answer, because Steve wanted to take the information and embody it in his own design. Steve did not hit him, because he had respect for the company employing both himself and the other; but he felt like it.

Fine, generous, understanding natures! Still, it takes all kinds to make a world, and Steve knew that he himself was only one of his kind. But this he would wager today: That neither of those men has got anywhere, and that neither ever will get anywhere. It is the old, old law of compensation at work, here, as in every walk of life. Be big, and you will grow into big things. It always works.

From Jack to Bill—Learning To Be a Specialist

By Guy H. Gardner

Deer Bill—I wouldent wunder if you mitent be sum surprized at a gettin a letter from this berg wen you thort dident you Bill that I was a way out in Misshergun abildin ortermobils for 5$ a dey but Ile tell you Bill how it is. On the trane I met up with a man who says why dont you be a speshlist. Then he tells me that he has a shop ware thay makes speshlists and you no yourself he says you can maik moar munney by beeing a speshlist. Then he tells me that out in Misshergun thay pays any dub 5$ and skild masheenists the same, but speshlists gets regular salleries and 5$ beside. So I cums to his shop witch is why I aint in Misshegun Bill. I dont have to pay nothin for beein lurned but get 10$ a weak just for lurnin pretty good aint it Bill. Im gonta bee too or three kinds of speshlist and no one noes how big a sallerie Ile dror down wen I gets to Misshergun.

Ime sure gonta go thare finerlie Bill for thayre willin to pay for reel skil there and then thay dont nevver have no strikes thare and Ime leary of strikes evver since we had one in the old shop and that fat slob of a cop you no Bill he pinched me for just nothin but only taping a strikebreaker with a litle peace of one and sevn sixteen steal. I had to pay a guy 5$ to bale me out so I could taik Eliza to that piknik and a wad to a loryer and that geezer you no Bill what kepes the hokshop ware you got your 28 jewel wotch for 2$ and sevnteen sents wen the loryer ast him to cum and sware to my good caracter he said not for no sent less than 10$ moar. So I wants to kepe away from strikes Bill. Well Bill furst I lurns to bee a drill speshlist. I dident have no trouble atall only wuns wen thay sent a peace what thare wasent no jigg for and the payper said to dril it three forths.

Well thare was a prikpunch mark and a hole surcle of uther prikpunch marks round it and any blaim fool could of seen thare was sum mistaik for if I drilld em all 3 fourths what would the job look like all the hoals would of ran together so I new it was a mistaik and drild em all 3 thurtysecunds witch was moar reezonable but the bos kikd and I just aked to jak up and leev but thort o no if you leev how will you get to be a speshlist so I stuk.

Now Ime lurnin to bee a laithe speshlist on the grabholt masheen and beleev me Bill its well naimed for you just has to grab holt with both your too hands. Ime maikin fine proggres for you no Bill Ime strong beside all my skil. What I dont see is why thay pays the laithemen in the old shop fortifive sents an our for when thay can't begin to role off chips like I do on my grabholt.

Yistiddy I was taikin off my grabholt for a time to reem sum hoals and the bos cawled them blind hoals and I gess he was rite. I had a meen litle plug gaij and the bos said to reem em so a shoalder on the gaij would hit the peace but the reemer wouldent go in that far so I took the gaij to a nemmery weel and fiksed it so it went in bully. I like reemin Bill.

Now Ime back on the grabholt and the bos kikd about him havin to have the hoals all reemed over and the plug gaij beein lost because I chukd it in the scrap but he doesent no that and what he doesent no wont nevver hert him none will it Bill.

You no Bill how them slo poaks of laithemen yused to kepe atryin thare work with callipers well Ive lurned thares a beter way the good old grabholt looks out for all that and why aint it a beter way Bill and no litle niblin chips neether but mebbe them guys bak thare aint huskey enuf to run a grabholt and mebbe the boses aint wise yet too thare beein no grabholts the eest is a way behind.

Well Bill I aint tutched of that munny I boroed off of you but only for my fair here and too beers and Ile pay you bak from my furst weaks speshlist sallerie in Misshergun. After I get all the laithe buziness lurned Ime thinking of leting them lurn me a plainer what do you think Bill would it be a good sceem. Dont you think a skild man like I am ort to get rawnchin good pay in Misshergun if he gets too be sevverall kinds of speshlist? And wen I gets thare Ime fiksd for life for thay nevver fires noboddy and if thay did thay wouldent want to fire me and who noes Bill but I may get to bee a bos thare tho I wouldent care so much to be one if I couldent fire nobudy. Well Bill Ime hoaping you will cum to Misshergun too and Ile try all I can to get you a job but I wish you was a speshlist too Bill. So no moar this time from **Jack.**

P S—Bill would it pay to lurn ottermattic screw masheens? Them fellers gets good pay. The bos hear doesent think I could lurn all about all them kams in a weak. All the boses gets jellus of a good man thayre afrade he will no more than what thay do and in most cases ain't so fur off?

The Panama Canal Foundry at Balboa

By Frank A. Stanley

SYNOPSIS — *It is a long step from the temporary foundry and shop equipment of the Canal Zone in the early days to the permanent and modern foundry shown herewith. It gives one some idea of the real value of the canal to the world at large to know that such a foundry is now necessary to handle repairs.*

THE foundry building in the group of structures forming the permanent shops of the Panama Canal at Balboa consists of a high section with monitor roof, with a lean-to along each side of the building. The structure measures 316 ft. in length; the main section is 61 ft. in width and the lean-to at each side has a width of 29 ft., so that the total width is 119 feet.

This building houses the iron, steel and brass foundries, there being two iron cupolas with capacities of 7 tons and 10 tons per hour respectively, a steel converter of 5 tons and three tilting brass smelting furnaces.

There are two 25-ton electric traveling cranes over the main bay of the foundry. The runways for these cranes are extended from the west end of the building clear across a 100-ft. yard space between the foundry and the pattern-storage building. In the north lean-to there is a 10-ton crane for handling castings for the cold saws, for the sand blast car, for the weighing scales and also for loading work on cars for shipping out of the building to whatever point they may be destined.

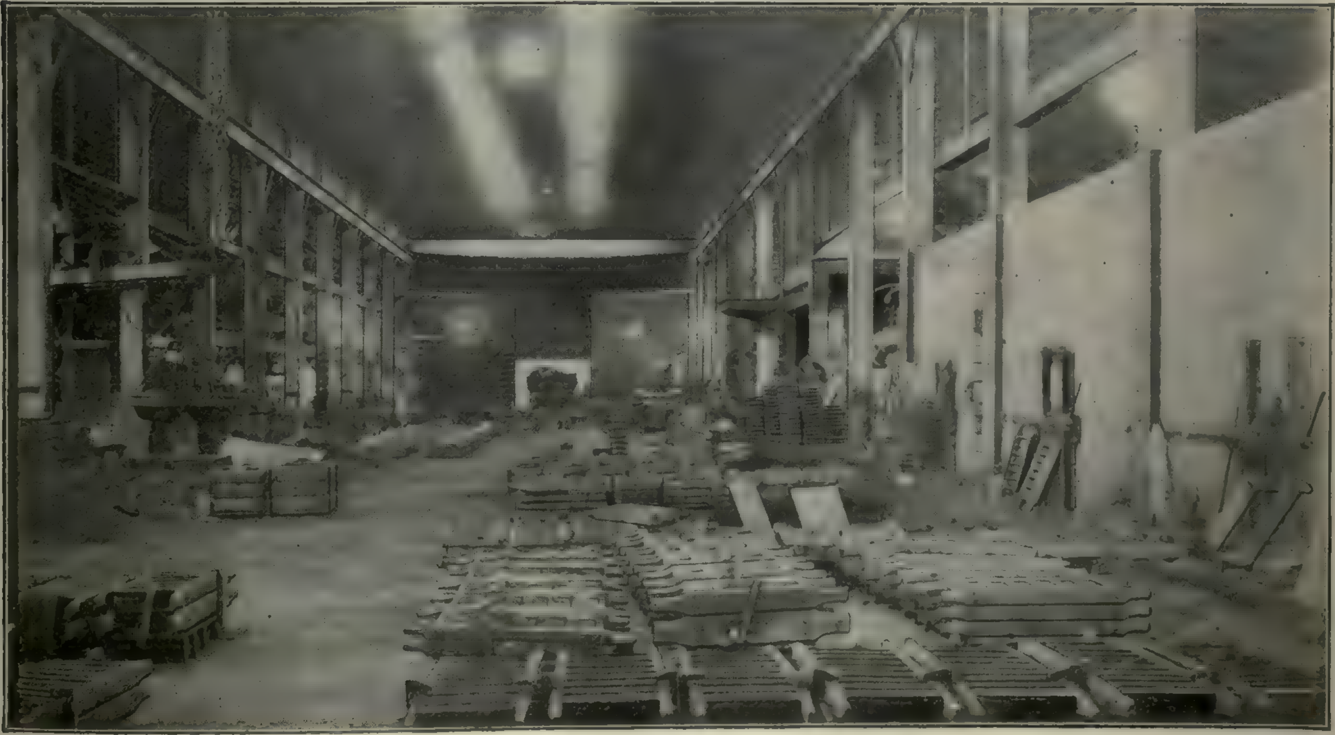


FIG. 1. GENERAL INTERIOR OF FOUNDRY BY ARTIFICIAL LIGHT

The interior of the foundry is shown in Fig. 1, which is reproduced from a photograph made by artificial illumination at night. The building is closed in the main with movable metal louvers, as indicated in the illustration, and there are steel rolling doors over the crane openings at the ends of the main aisle and over the east end of the lean-tos.

Layout of Equipment

Fig. 2 is a plan view of the foundry floor, showing the entire equipment, including cupolas, steel converter, brass foundry plant, molding pits, molding machines, benches, industrial track, etc. Referring to this drawing, it will be seen that the charging platform behind the cupolas is provided with an elliptical track, which is adapted to receive narrow-gage cars that run into the building on industrial tracks and which are used for conveying coke and iron to a dumping point immediately in front of the cupola, the cars being carried up to the charging-platform level by a pneumatic elevator. The list of equipment is given in Table I.

The location and construction of the charging platform are best shown in Fig. 3, which is a view taken immediately in front of the cupolas. This platform is built up with steel plate carried on heavy girders and located at the same height as the charging doors at the rear of the cupolas. It will be noticed that the platform is constructed with extensions, which project sufficiently over the main aisle of the foundry so that in case the elevator is temporarily out of use pig iron and coke may be landed on the platform by means of one of the overhead traveling cranes.

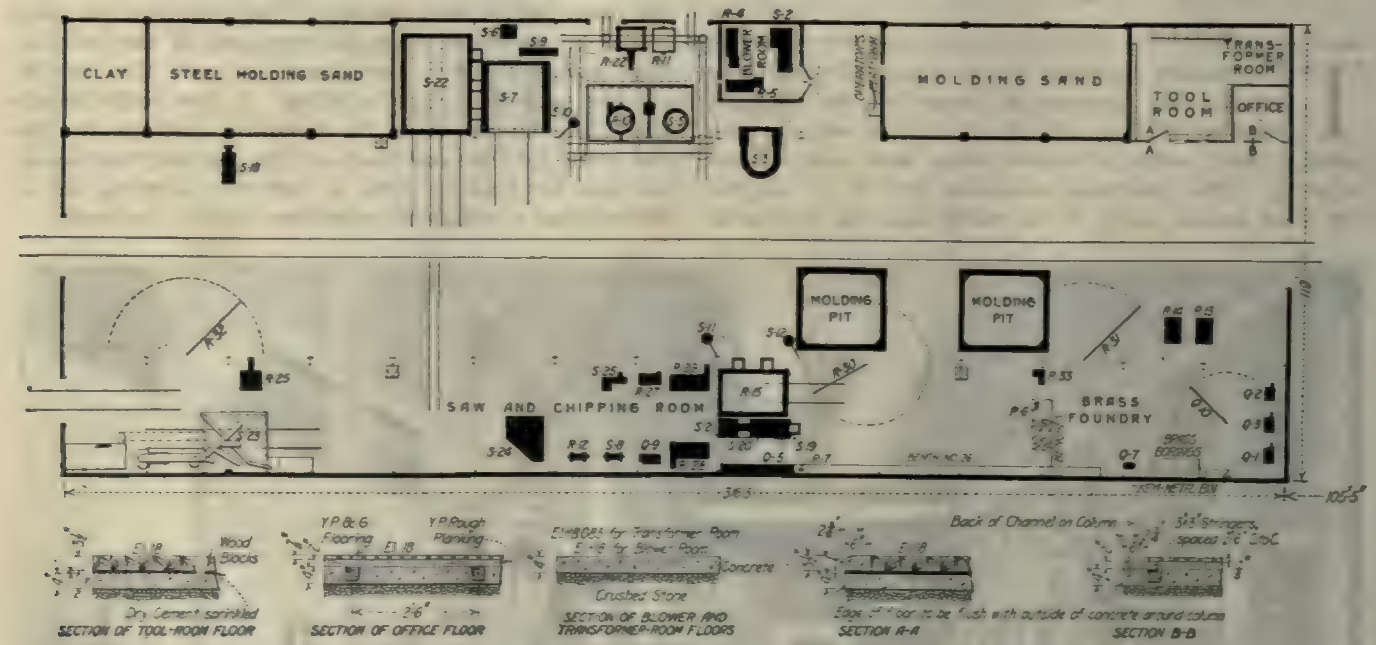


FIG. 2. LAYOUT OF FOUNDRY

The cross-section, Fig. 4, and the exterior view, Fig. 5, are of interest as showing important structural features, including the principal building members themselves, the system of movable louvers for closing the sides and ends of the building, the monitor lights and the extended crane runways connecting foundry and pattern storage. The drawing gives the dimensions of the principal column girders, roof chords and trusses, and Fig. 5 brings out conspicuously the advantages of the extended runways, which enable the traveling cranes to handle patterns between the two buildings and to carry heavy flasks in and out of the foundry. As will be seen from this view, a goodly share of the open space under the craneway is utilized as a place for flask storage.

Fig. 6 shows the pattern-storage building in the distance with one of the cranes midway between the two buildings. It also brings out the ample area of opening at the end of the building made possible by the system of rolling steel doors and by the movable metal louvers.

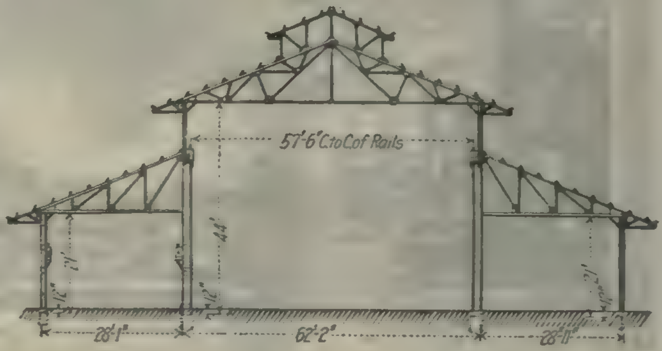
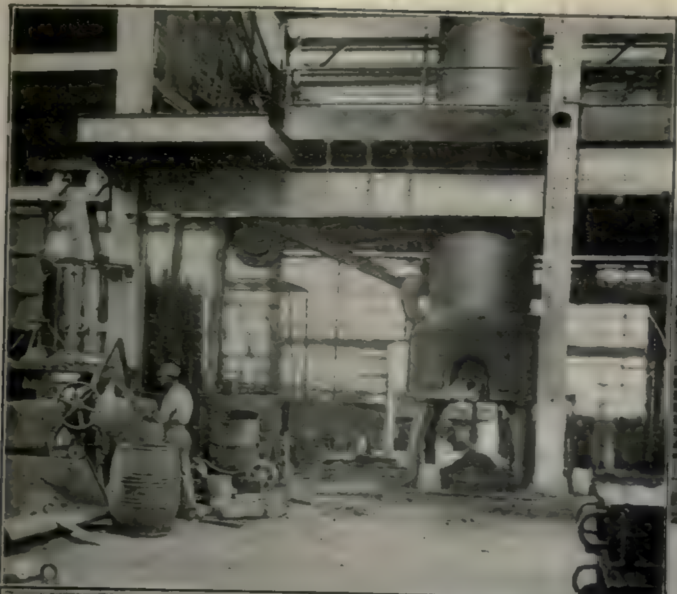


FIG. 4. CROSS-SECTION OF FOUNDRY

Fig. 7 is a view looking east in the north lean-to, showing the core ovens in the background and a large variety of corework on the floor and benches in front. The large core oven shown open is 12 ft. wide by 18 ft. 6 in. deep, and immediately to the left of the main oven are the three ovens for small cores. Just beyond the set of ovens are located the grinders, tumblers, cold saws, etc.

The arrangement of the steel converter is clearly shown in Fig. 8, and some of the steel foundry products will be seen in Fig. 9. At the left side of this view there is shown a very heavy cold saw, and beyond this the sandblast equipment; the 10-ton overhead traveling



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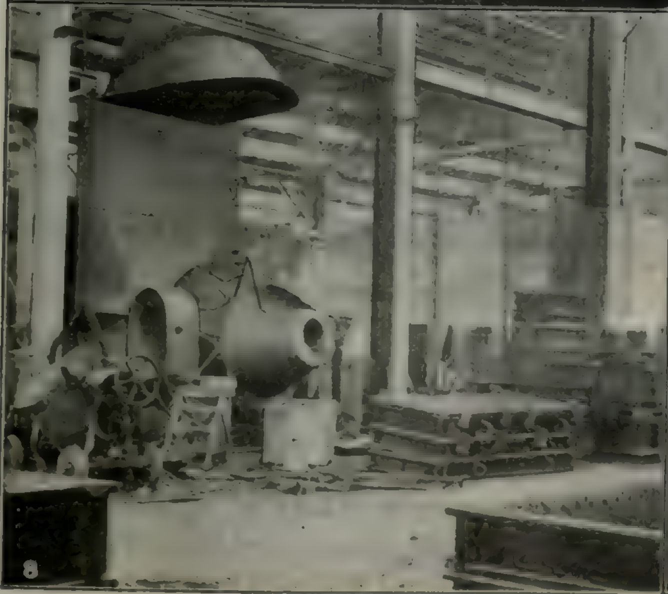

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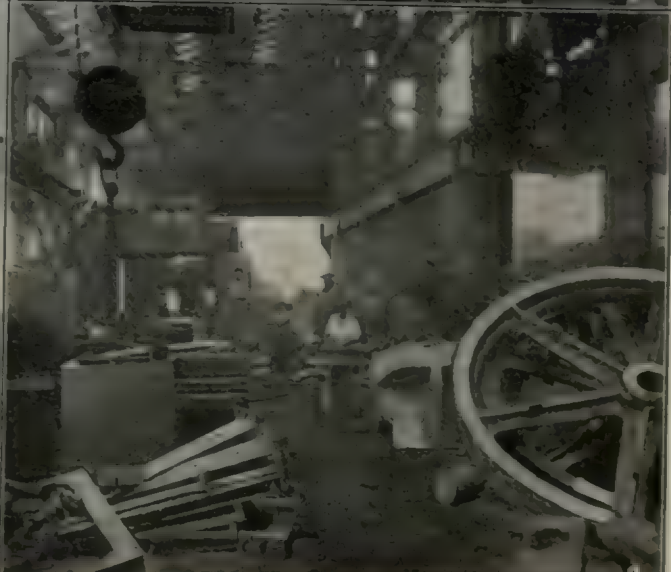

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FIGS. 3, 5, 6, 7, 8 AND 9. VARIOUS VIEWS IN AND ABOUT THE FOUNDRY

Fig. 3—Cupola and charging platform. Fig. 5—Crane running over yard. Fig. 6—Open end of foundry toward pattern storage. Fig. 7—Ovens and core department. Fig. 8—Arrangement of steel converter. Fig. 9—Cold saws and sandblast

crane which serves this section of the foundry may also be seen.

The brass foundry contains three brass-melting furnaces in operation. These are equipped with large sheet-metal hoods connected to a pipe system.

The floors for office, toolroom and blower room received careful attention. All had a foundation of crushed stone covered with 4 in. of concrete. The office had 3 x 3-in. stringers laid in the concrete and 2-in. rough planking on top of this, the real floor being ⅞-in. yellow pine, tongued and grooved. The toolroom floor has ½ in. of dry cement sprinkled on the concrete and is paved with wood blocks 3½ in. long set on end.

TABLE I. LIST OF FOUNDRY EQUIPMENT

No.	Description of Machines	Manufacturer
Q-1	Furnace, brass, tilting, fuel oil	Monarch Engineering Co.
Q-2	Furnace, brass, tilting, fuel oil	Monarch Engineering Co.
Q-3	Furnace, brass, tilting, fuel oil	Monarch Engineering Co.
Q-4	Ladle, bull, 1½-ton	Old French
Q-5	Rack, core-drying, electrically heated	Shop made
Q-6	Scales, platform, 2,000-lb. portable	Osgood
Q-7	Separator, magnetic No. 2	John Paxon Co.
Q-8	Squeezer, molding machine	Tabor Manufacturing Co.
Q-9	Tumbler, 20x30 in	S. Obermayer Co.
Q-10	Crane, jib; 1-ton 14-ft. rad	Shop made
Q-11	Scales, counter, 250-lb	Standard
R-1	Breaker, scrap, tripod mounted	Shop made
R-2	Boiler, 42-in. dia., 92 two-inch tubes, 37 in. long	....
R-3	Engine, 2-cyl., 6-in. dia. by 8-in. stroke; 18-in. dia. drum	....
R-4	Blower, cupola, 13 cu.ft. per rev., No. 4	P. H. & F. M. Roots & Co.
R-5	Blower, cupola, 13 cu.ft. per rev., No. 4	P. H. & F. M. Roots & Co.
R-6	Machine, core, hammer type	Brown Specialty Machine Co.
R-7	Machine, core, hammer type	Brown Specialty Machine Co.
R-8	Crane, traveling, 25-ton	Cleveland Crane and Engineering Co.
R-9	Crane, traveling, 10-ton	Old French
R-10	Cupola Colliau, 45 in., 10 tons per hr., No. 12	Byram Foundry and Machine Co.
R-11	Elevator, 3-ton	Pedrick & Ayer
R-12	Grinder, double dry, 26x4x1 in	Diamond Machine Co.
R-13	Machine, molding, 24-in. roll-over	Tabor Manufacturing Co.
R-14	Machine, molding, 24-in. roll-over	Tabor Manufacturing Co.
R-15	Oven, core, large, including 2 trucks	Tate, Jones & Co.
R-16	Ladle, crane, 2-ton, spur gear	Whiting Foundry Equipment Co.
R-17	Ladle, crane, 2-ton, worm drive	Old French
R-18	Ladle, crane, 2-ton, worm gear, on truck	Old French
R-19	Ladle, crane, 2-ton, spur gear	Whiting Foundry Equipment Co.
R-20	Ladle, crane, 5-ton, worm and bevel gear	Morgan Engineering Co.
R-21	Ladle, spout, 1-ton, on truck	....
R-22	Scales, charging, 10,000-lb. capacity, cupola	Standard Scale Supply Co.
R-23	Scales, platform, 2,000-lb. capacity	The Standard
R-24	Sifter, sand, shaker	Fox Bros. Co.
R-25	Scales, platform, 10,000-lb. capacity	Osgood
R-26	Scales, platform, 2,000-lb. capacity	Osgood
R-27	Tumbler, 24x36 in	Whiting Foundry Equipment Co.
R-28	Tumbler, 42x72 in	Whiting Foundry Equipment Co.
R-29	Tumbler, 42x72 in	Whiting Foundry Equipment Co.
R-30	Crane, jib, 10-ton, 16-ft. 4-in. rad	Shop made
R-31	Crane, jib, 10-ton, 20-ft. 0-in. rad	Shop made
R-32	Crane, jib, 10-ton, 20-ft. 0-in. rad	Shop made
R-33	Shears, vertical, rapid-acting, 1-in. stroke, 18 in	Rock River Machine Co.
R-34	Heater, electric	....
R-35	Heater, electric	....
S-1	Blower, fan, under charging platform, No. 6	B. F. Sturtevant
S-2	Blower, rotary converter, No. 15	P. H. & F. M. Roots Co.
S-3	Converter, Tropenas, 2-ton	Tropenas Converter Co.
S-4	Crane, traveling, 25-ton	Niles-Bement-Pond Co.
S-5	Cupola, 42-in., 7-ton per hr., No. 4	Whiting Foundry Equipment Co.
S-6	Engine, hoisting, air, annealing furnace	....
S-7	Furnace, annealing, including trucks	Tate, Jones & Co.
S-8	Grinder, double dry, 26x4x1 in., No. E	Diamond Machine Co.
S-9	Heater, bull ladle	R. S. Newbold & Sons
S-10	Heater, ladle, 4-ton, near cleaning room	Tropenas Converter Co.
S-11	Heater, ladle, 2-ton, near coreroom	Tropenas Converter Co.
S-12	Heater, crane ladle	R. S. Newbold & Sons
S-13	Ladle, crane, 2-ton, spur gear	Whiting Foundry Equipment Co.
S-14	Ladle, crane, 2-ton, spur gear	Whiting Foundry Equipment Co.
S-15	Ladle, crane, 5-ton	Whiting Foundry Equipment Co.
S-16	Ladle, crane, 10-ton, spur gear	Whiting Foundry Equipment Co.
S-17	Scales, counter, 25-lb. capacity	....
S-18	Mixer, sand	Tropenas Converter Co.
S-19	Oven, core, small	Tate, Jones & Co.
S-20	Oven, core, small	Tate, Jones & Co.
S-21	Oven, core, small	Tate, Jones & Co.
S-22	Oven, mold, including 2 trucks	Tate, Jones & Co.
S-23	Blast, sand	Pangborn Corporation
S-24	Saw, cold, 13 in., 40-in. dia	Espen-Lucas
S-25	Saw, cold, 10 in., 28-in. dia., No. 3B	Railway Appliance Co.

Chart for Equivalent Twisting Moments

By Brent C. Jacob

The accompanying chart is used to obtain the equivalent twisting moment when the twisting and bending moments are known. Its usefulness may best be shown by two examples:

1. Given, bending moment $B = 600{,}000$ in.-lb.; twisting moment $T = 1{,}000{,}000$ in.-lb. Find the equivalent twisting moment T_e.

From $B = nT$, it follows that

$$n = \frac{B}{T} = \frac{600{,}000}{1{,}000{,}000} = 0.6$$

Then reading from the chart, $n = 0.6$ and $a = 1.76$. Then

$$T_e = aT = 1.76 \times 1{,}000{,}000 = 1{,}760{,}000 \textit{ in.-lb.}$$

2. Given, twisting moment $T = 600{,}000$ in.-lb.; bending moment $B = 1{,}000{,}000$ in.-lb. Find the equivalent twisting moment T .

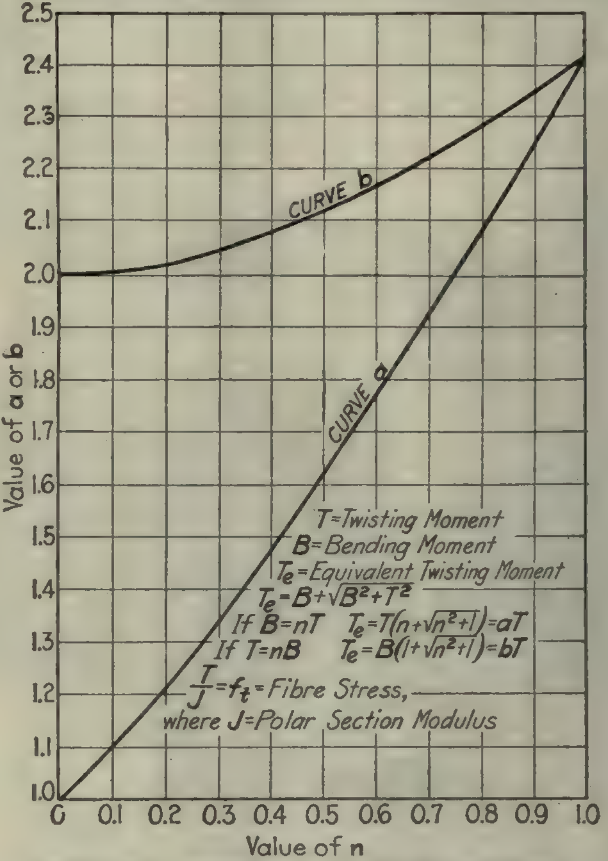


CHART FOR EQUIVALENT BENDING MOMENT

From $T = nB$, it follows that

$$n = \frac{T}{B}\,\frac{600{,}000}{1{,}000{,}000} = 0.6$$

Then reading from the chart, $n = 0.6$ and $d = 2.18$. Consequently,

$$T_e = bB = 2.18 \times 1{,}000{,}000 = 2{,}180{,}000 \textit{ in.-lb.}$$

Machinery Club of Chicago Establishes Clubrooms

At a meeting of the Machinery Club of Chicago, held July 2, the board of directors was authorized to take the necessary steps to secure permanent quarters. As a result the fourth floor of Machinery Hall has been leased, the probable date of opening being Sept. 15.

Helping the Foreman To Get Results

By GEORGE A. SAWITZKE
Superintendent, The Osborn Manufacturing Co.

SYNOPSIS — *This article outlines some essentially practical principles on the philosophy of successful foremanship. It is not an example of practice based on theory, but of theory derived from experience.*

There are three important principles which, if followed, I know from my own experience will help foremen to secure results. These are the study of human nature, the proper education of the workman and a real conception of practicability. This man study, or the study of human nature, is one of the big problems that confront the foreman today. With this knowledge he can dominate his men and help them, because he understands their ability and limitations. To claim this, you must study your men, study their habits and strong points, temperament and adaptability. Watch their work and mannerisms. To use a slang expression, "Get next to your men."

With this knowledge you will be surprised at the ease with which your men take hold of your orders, because you have gaged their ability and know how to approach them. The foreman who knows human nature fires the enthusiasm of his workmen and shapes them out of their old habits into line with his plan. Take the matter of tardiness. It is up to the foreman as a student of human nature to think up and apply some scheme that will put a stop to this nuisance and yet retain the good will of his men.

One way of doing this is to keep a careful record of tardiness as well as the total number of days absent by each employee. Then, whenever an increase is requested, a statement is obtained from the timekeeper showing the punctuality average of the man and the total hours absent for a given period. If the workman's record shows that he has been late or absent frequently, even unusual ability will not earn him advancement, because of the fact that, even with this unusual ability, he does not produce as much as the average workman. Your man will quickly see your side and will appreciate your viewpoint, if approached in this way. This is one of the many things the progressive foreman must overcome to insure success in his department, and a study of human nature is required for the overcoming.

It was a study of men that caused a foreman to replace an undersized man who was working on his tiptoes by a worker who was well over six feet tall and whose work necessitated much bending over. By simply switching these men, greater production was obtained from each of them.

Again, a character student noticed in a certain factory a worker who was very nervously inclined, yet doing his work as if half asleep. The work this man was doing was such that, after the job was rigged up, the machine required very little watching, the job taking three to four hours to complete. Here was a man who needed activity in order to get his full production. By putting him on a machine that required action, not only was this man himself benefited, but more work was produced. There are hundreds of similar cases where the foreman must adapt the man to the job.

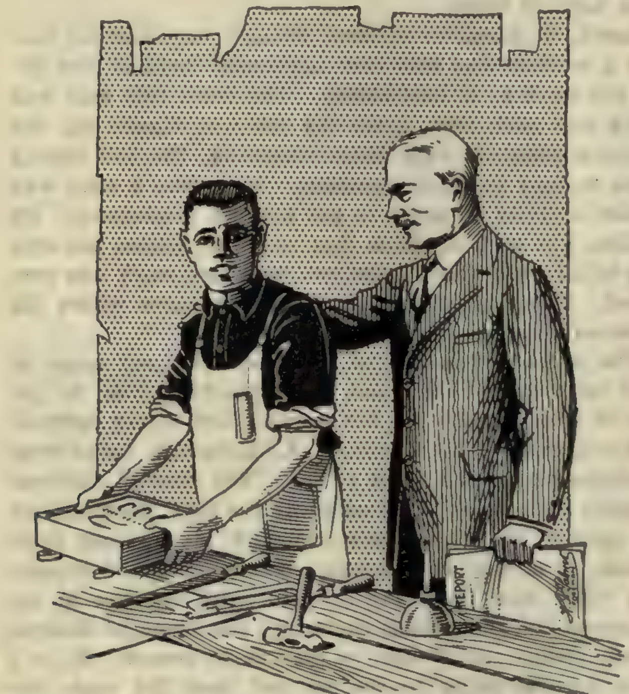
The proper education of workmen does not mean to take an unskilled man and, after teaching him, to put him on a mechanic's job, but to teach him better methods of doing the job he is doing. A blacksmith never tries to shape his iron until it is hot. The shrewd foreman handles and shapes his workers to the task, the plan and the spirt of the shop. He works with, not against, their habits. It is only the trouble makers whom he breaks. The other men he carefully heats with the fire of enthusiasm and then molds them into the shape he desires, which means the results he wishes to secure. It is a most natural thing to respect and obey the man who is teaching you. It is natural to obey the man who knows more about your job than you do. Combine all these three traits in the foreman or superintendent—the ability to show, the ability to teach and the ability to control—and you have a combination that will work wonders.

A Workman's Education

The real foreman is a man who has advanced to his position because of his ability. The successful foreman must be a man who knows just how much he can mix with his men without losing the authority that he needs. He must be a man who has poise, which is the greatest asset of authority. Many aggravating instances arise where the foreman needs poise and tact. It may be a case where the workman feels that a job should be set up or done a certain way. Immediately before your mind, you picture the way that the job should be done; and it is up to you, not by might of authority, but by reasoning, to dissolve the incorrect view from your workman's mind and substitute your own for it. Here is where patience, courage of purpose and diplomacy are taxed to the greatest degree. Such things as these secure obedience through education.

THE DIFFERENCE IN FOREMEN

The proper conception of practicability is the factor that differentiates the mere "bossy" foreman from the real foreman. It is just this quality that marks the growing foreman from the foreman who is just hanging onto his job. The successful foreman must see past the present job into the next, so that the work he has accomplished blends with the work yet to be done. If a certain machine or part is to be put out on time, it is the foreman's duty, not only to do his part in the time allotted, but to try to improve upon the job and get it out quicker if possible. This he can do by not only knowing the machine, but the man doing the work. He must know to a certainty which of his men, being speeded up to meet the schedule, will spoil the work and which of them, when speeding up, merely put forth increased effort in getting out the desired work in as perfect a manner as is possible under the normal gait.



The foreman can assist his men in many ways toward this end, by placing the material to better advantage, by personal attention in instructing the men and by having all tools, etc., in perfect condition for them to work with. No foreman can secure this added coöperation from his men, this point of securing real obedience (for it is really asking a man to obey your orders by making him speed up) unless the workmen are in perfect accord with him. In order to do this, the foreman must meet his men in a spirit of fairness, but he should be the boss and never allow one workman to consult another regarding how certain tasks are to be done. He should see that the men know and respect his authority as foreman. The foreman, however, should not always be contrary to his men, as many good ideas are gathered from the rank and file and it is to the foreman's best interests to bring out the best that is in his men. It is to the foreman's best interests to accept the best and use it to the shop's betterment.

Insure teamwork by working with and not against your men. Do not threaten discharge at every outbreak; use tact instead. The trouble maker will break himself when he finds he cannot start trouble. Impart to your men the fire of your own ambition to succeed, and you will have an even-pulling force. Pat your men on the back for good work. If yours is a department of skilled workers, heart-to-heart shop talks will bring the best out of them. Make it a point to confer with the other foremen at least once a week—their viewpoint will help yours. Remember, your work is your life—so make it a success.

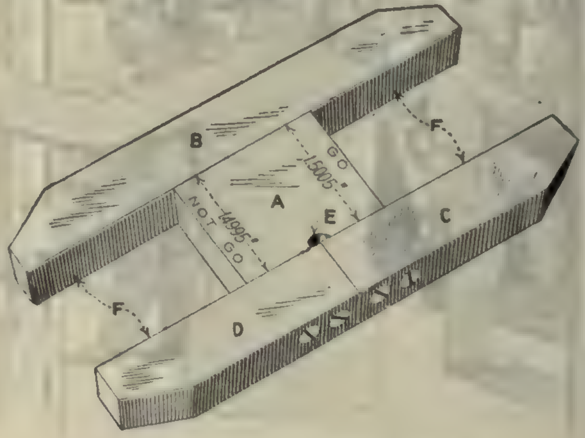
Built-Up Limit Snap Gage

By Hugo F. Pusep

Several sets of snap gages of different sizes ranging from 1½ to 4 in. were wanted in the machine shop. The company had taken a medium-sized order for screw-machine products; and as this was a special rush job, the necessary limit snap gages were needed in a hurry.

After due consideration a design was determined upon which gave a serviceable tool that could be made in a fraction of the time usually required in making the conventional limit snap gages. The illustration shows the construction of one of these gages. Although it is rather homely in appearance, it is just as accurate as any high-class snap gage.

The gage itself is made of four pieces—the sizing block *A* and the side pieces *B*, *C* and *D*—all of which are made of tool steel hardened and ground on their contact surfaces. The long side piece *B* is secured to the sizing block with three fillister-head screws, while the short pieces *C* and *D* are each held by two screws to the block *A*. The groove *E* in the sizing block is for the purpose of facilitating grinding to size. The gaging surfaces *F* of the side pieces were lapped smooth on a flat lap after grinding.



BUILT-UP LIMIT SNAP GAGE

These gages were found to be satisfactory in every respect. They were accurate and durable; and when worn, all that was necessary in order to correct the error caused by wear was to remove the seven screws holding the various parts together, and lap the surfaces *F* straight and smooth.

United States Munitions*

The Springfield Model 1903 Service Rifle

The Bayonet

SYNOPSIS — *The three types of bayonets, the operations on which are started in this installment, involve a considerable number of interesting operations.*

THERE are three kinds of bayonets made for the United States Army—the knife, or regular, bayonet and two bolo bayonets, the large and small sizes, which were developed for the native troops in the Philippine Islands. These correspond closely to the famous bolo knife, which, like the Cuban machete, is used as a knife for cutting underbrush and firewood as well as a weapon for fighting. The regular bayonet has a comparatively slender blade, as shown in Fig. 2152, and is machined all over. The handle grip is held to close limits for proper attachment to the end of the barrel and the stud on the upper band. The operations on the straight blade follow:

0. Cutting off stock
A. Blocking from bar
B. Drawing
C. Dropping and hot-trimming
E. Annealing
F. Pickling

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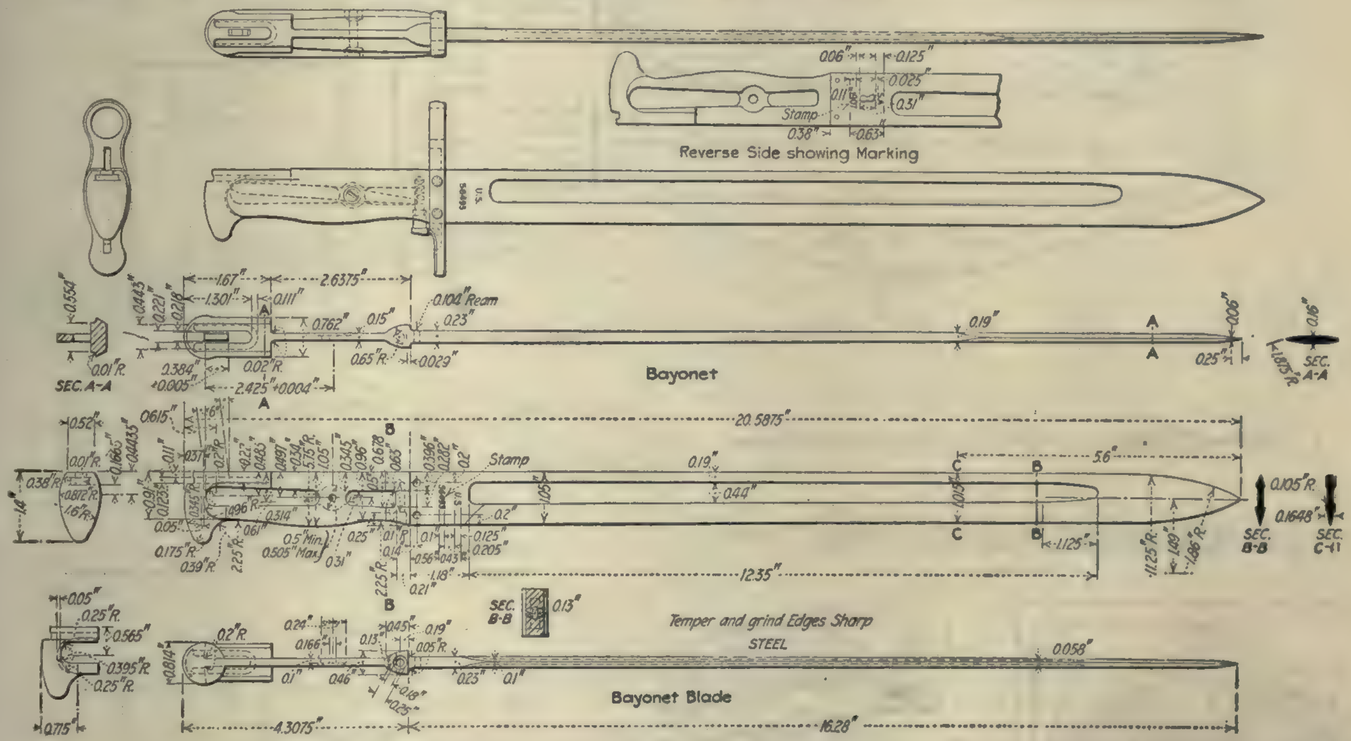


FIG. 2152

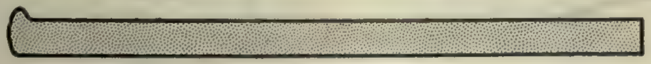


FIG. 2153 OP. A

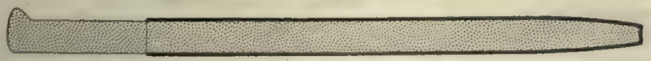


FIG. 2154 OP. B

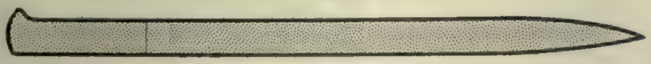


FIG. 2155 OP. C

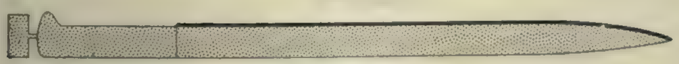


FIG. 2156 OP. 1A

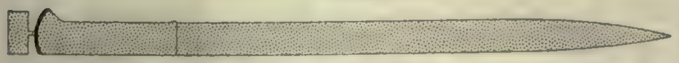


FIG. 2157 OP. 1B

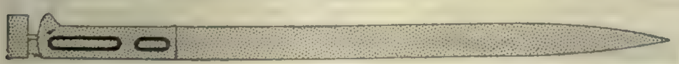
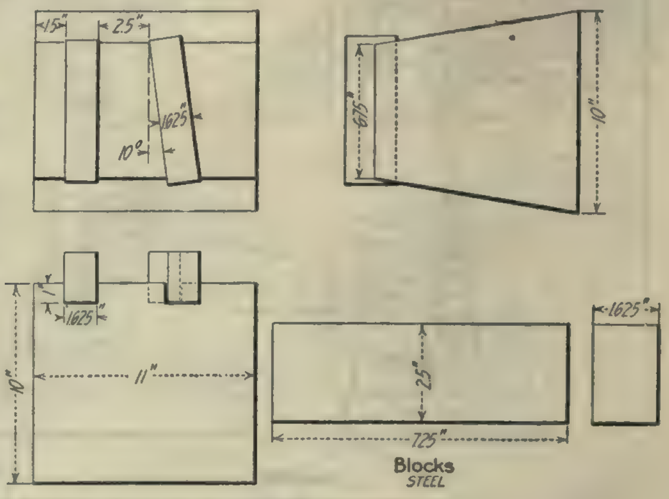


FIG. 2158



OPERATION D

FIG. 2159

D.	Trimming bayonet-catch slots
1.	Straightening forging
1-A.	Correcting
1-B.	Grinding pommel
2-3.	Milling back and edge
AA.	Removing burrs left by operation 2
4-5.	Milling side of tang
5-A.	Burring
25.	Hand-milling front of bolster
7.	Milling edges of point
8.	Milling bevel and groove
8-A.	Filing to match
9.	Milling sides of point
9-A.	Straightening
20.	Milling sides of pommel
20-A.	Burring
10.	Profiling right side of tang, upper cut
11.	Profiling left side of tang, upper cut
12.	Profiling right side of tang, under cut
13.	Profiling left side of tang, under cut
14.	Milling slot for band lug, roughing
15.	Profiling slot for band lug to finish
16.	Profiling slot for band lug, under cut
18.	Drilling and bottoming scabbard-catch hole
22.	Profiling slot for bayonet catch
19.	Punching for hook of bayonet catch
28.	Hand-milling groove in tang
GG.	Removing burrs left by operation 28
26.	Drilling rivet and screw holes
27.	Counterboring for bayonet catch

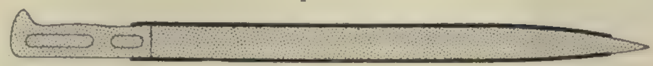


FIG. 2160

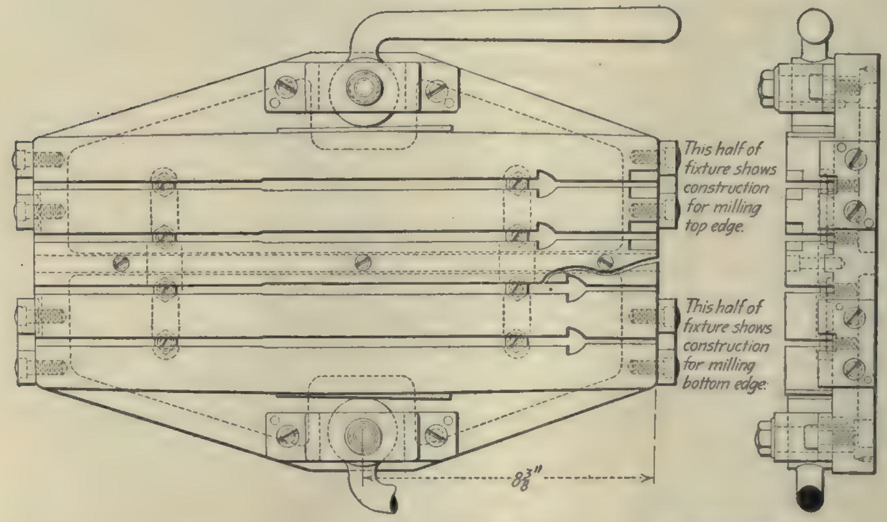

This half of fixture shows construction for milling top edge.
This half of fixture shows construction for milling bottom edge.
8 3/8"

FIG. 2161

OPERATION 2 & 3

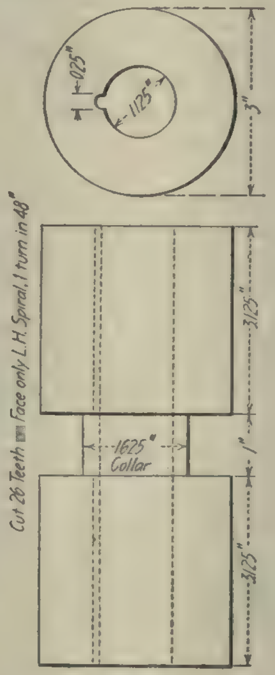


FIG. 2162

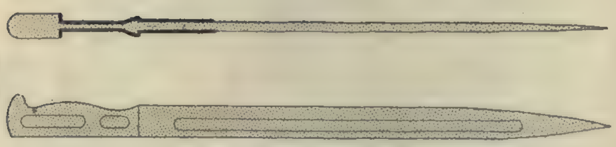


FIG. 2163

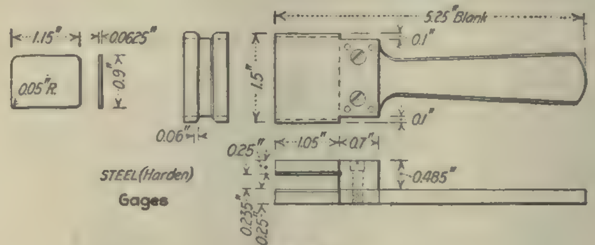


FIG. 2165

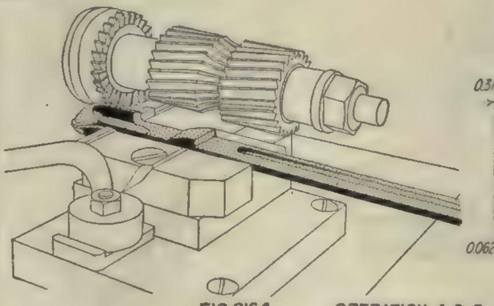


FIG. 2164

OPERATION 4 & 5

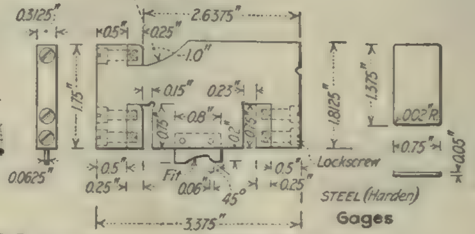


FIG. 2166

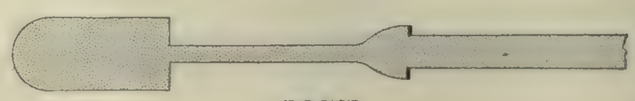
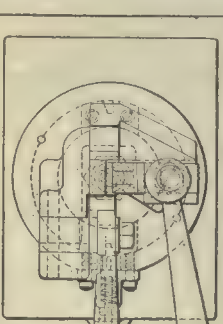


FIG. 2167



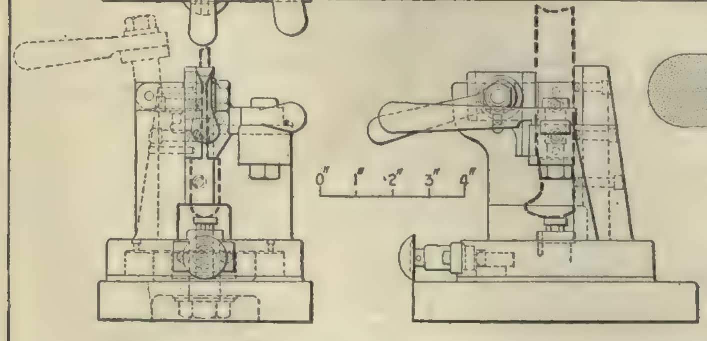


FIG. 2168

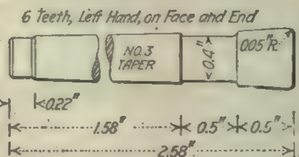


FIG. 2169

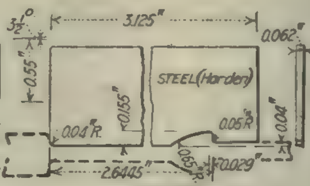


FIG. 2170

OPERATION 25

26-A. Burring
24. Milling lower edge of tang
24-A. Burring
31. Profiling end and under side of pommel
33. Stamping U. S. and "ball and flame"
33-A. Reaming and pressing
34. Stamping serial number
I. Hardening
M. Drawing to temper
J. Straightening
K. Grinding to finish
35. Polishing blade (roughing) and tang to finish
36. Reaming rivet holes in guard and blade, countersinking rivet and scabbard-catch holes and assembling with guard
37. Riveting and burring
38. Polishing edge of guard
39. Browning guard and tang of blade
40. Polishing blade to finish
41. Assembling with bayonet and scabbard catches and grip
42. Third polishing

OPERATION 0. CUTTING OFF STOCK

Number of Operators—One. Description of Operation—Cutting the bar in half. Apparatus and Equipment Used—Hilles No. 2 stock shears. Production—700 pieces per hr.

OPERATION A. BLOCKING FROM BAR

Transformation—Fig. 2153. Number of Operators—One. Description of Operation—Blocking or shaping handle from bar; blade is left about 3½ in. long from the tang, which is drawn to length in next forging operation. Apparatus and Equipment Used—Billings & Spencer 400-lb. drop hammer. Production—50 pieces per hr.

OPERATION B. DRAWING

Transformation—Fig. 2154. Number of Operators—One. Description of Operation—Drawing out block to proper length. Apparatus and Equipment Used—Bradley 60-lb. helve hammer. Production—35 pieces per hr.

OPERATION C. DROPPING AND HOT-TRIMMING

Transformation—Fig. 2155. Number of Operators—One. Description of Operation—Dropping to finish and hot-trimming; after trimming, it is given two or three blows under the drop at the same heat; this leaves a slight flash, which is ground off in the next operation. Apparatus and Equipment Used—Billings & Spencer 1400-lb. drop hammer and Bliss press. Production—40 pieces per hr.

OPERATION E. ANNEALING

Number of Operators—One. Description of Operation—Packed in iron pots with powdered charcoal, heated to 850 deg. C. (1562 deg. F.) and left over night to cool. Apparatus and Equipment Used—Brown & Sharpe annealing furnace, oil burners, cast-iron pots and powdered charcoal.

OPERATION F. PICKLING

Number of Operators—One. Description of Operation—Placed in wire baskets and put in the pickling solution, which consists of 1 part sulphuric acid to 9 parts water, and left in this from 10 to 12 min. Apparatus and Equipment Used—Wire baskets, wooden pickling tanks and hand hoist.

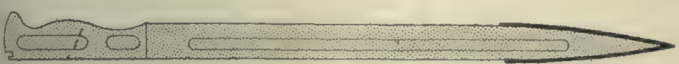


FIG. 2171

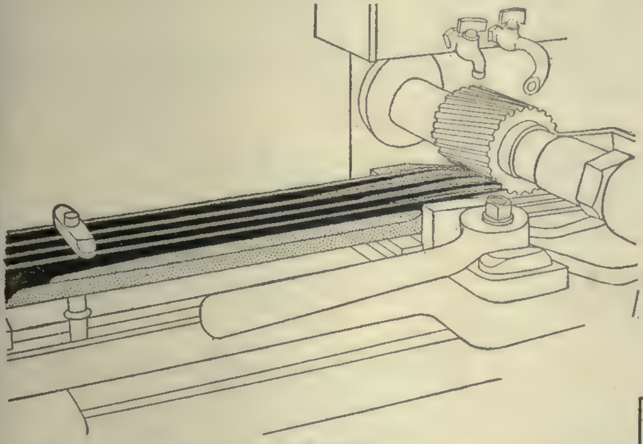
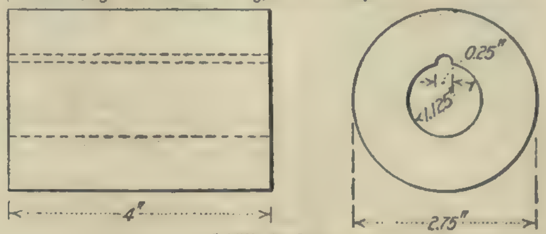


FIG. 2172

Cut 28 Teeth, Right Hand on Face only, Left-hand Spiral. 1 Turn in 48 Inches



2 Mills in Set
FIG. 2173

OPERATION 7

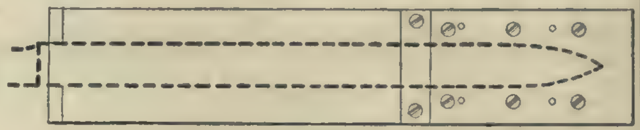


FIG. 2174

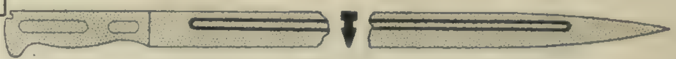


FIG. 2175

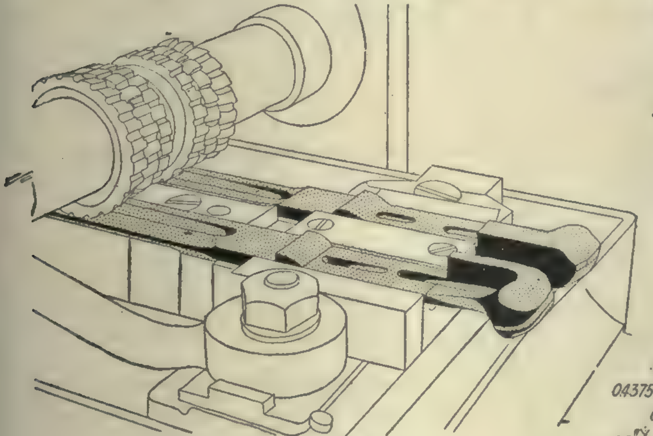
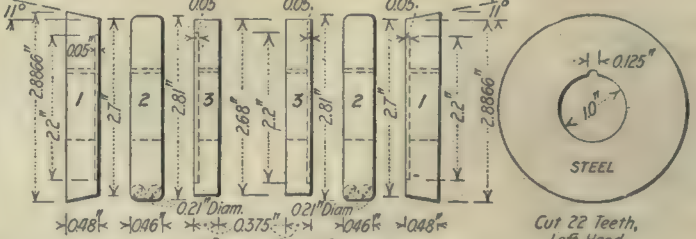


FIG. 2176



No.4 Step, 0.007" Feed, 55° and 0° large Fillet

Cut 22 Teeth, Left Hand

FIG. 2177

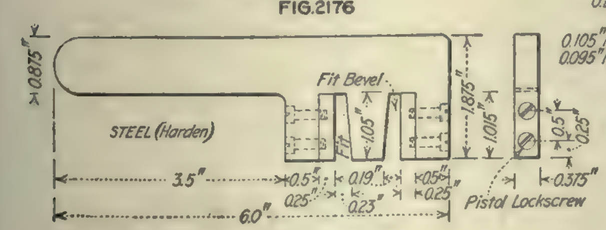


FIG. 2178-A

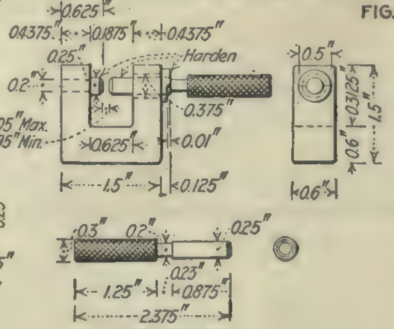


FIG. 2178-B

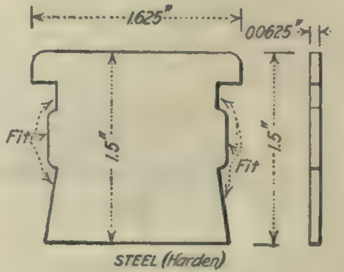


FIG. 2178-C

OPERATION 8

OPERATION D. TRIMMING BAYONET-CATCH SLOTS

Transformation—Fig. 2158. Machine Used—Perkins No. 19, 1½-in. stroke. Number of Operators per Machine—One. Punches and Punch Holders—Square shank. Dies and Die Holders—In shoe, by setscrew. Stripping Mechanism—Two pieces of stock screwed to side of shoe. Average Life of Punches and Dies—15,000 pieces. Production—350 pieces per hr.

OPERATION 1. STRAIGHTENING THE FORGING

Number of Operators—One. Description of Operation—Straightening after forging and trimming, previous to machining. Apparatus and Equipment Used—Cast-iron block, Fig. 2159, hammer and straight-edge. Production—45 pieces per hr.

OPERATION 1-A. CORRECTING

Transformation—Fig. 2156. Number of Operators—One. Description of Operation—Grinding flash on cutting edge. Apparatus and Equipment Used—Grindstone. Production—120 pieces per hr.

OPERATION 1-B. GRINDING POMMEL

Transformation—Fig. 2157. Number of Operators—One. Description of Operation—Breaking off end from pommel and grinding pommel end. Apparatus and Equipment Used—Hammer and grindstone. Production—125 pieces per hr.

OPERATIONS 2 AND 3. MILLING BACK AND EDGES

Transformation—Fig. 2160. Machine Used—Pratt & Whitney No. 2 Lincoln miller. Number of Machines per Operator—Four. Work-Holding Devices—Vise jaws hold four at a cut, Fig. 2161; two are held in each position. Tool-Holding Devices—Standard arbor. Cutting Tools—Spiral mills, Fig. 2162. Number of Cuts—One. Cut Data—70 r.p.m.; ⅜-in. feed. Coolant—Compound, ¼-in. stream. Average Life of Tool Between Grindings—5000 pieces. Gages—None. Production—20 pieces per hr., one machine.

OPERATION AA. REMOVING BURRS LEFT BY OPERATIONS 2 AND 3

Number of Operators—One. Description of Operation—Removing burrs left by operations 2 and 3. Apparatus and Equipment Used—File. Production—Grouped with operations 2 and 3.

OPERATIONS 4 AND 5. MILLING SIDE OF TANG

Transformation—Fig. 2163. Machine Used—Pratt & Whitney No. 2 Lincoln miller. Number of Machines per Operator—Five. Work-Holding Devices—Held in vise jaws, Fig. 2164. Tool-Holding Devices—Standard arbor. Cutting Tools—Gang of forward cutters (see Fig. 2164). Number of cuts—One. Cut Data—70 r.p.m.; ⅜-in. feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—5000 pieces. Gages—Fig. 2165, thickness of blade; Fig. 2166, form and thickness of tang. Production—25 pieces per hr.

OPERATION 5-A. BURRING

Number of Operators—One. Description of Operation—Burring from operations 4 and 5. Apparatus and Equipment Used—File. Production—Grouped with operations 4 and 5.

OPERATION 25. HAND-MILLING FRONT OF BOLSTER

Transformation—Fig. 2167. Machine Used—Whitney hand miller. Number of Operators per Machine—One. Work-Holding Devices—Indexing fixture, work held by jaws, Fig. 2168. Tool-Holding Devices—Taper shank. Cutting Tools—End-milling cutter, Fig. 2169. Number of Cuts—Two. Cut Data—450 r.p.m.; hand feed. Coolant—None. Average Life of Tool Between Grindings—5000 pieces. Gages—Fig. 2170. Production—125 pieces per hr.

OPERATION 7. MILLING EDGES OF POINT

Transformation—Fig. 2171. Machine Used—Pratt & Whitney No. 2 Lincoln miller. Number of Machines per Operator—Five. Work-Holding Devices—Held in block clamped by vise jaws, on a bridge-milling fixture, Fig. 2172. Tool-Holding Devices—Standard arbor. Cutting Tools—Milling cutters, Fig. 2173. Number of Cuts—Two. Cut Data—70 r.p.m.; ⅜-in. feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—5000 pieces. Gages—Fig. 2174, length of point from bolster and shape of point. Production—40 pieces per hr. per machine.

OPERATION 8. MILLING BEVEL AND GROOVE

Transformation—Fig. 2175. Machine Used—Pratt & Whitney No. 2 Lincoln miller. Number of Machines per Operator—Five. Work-Holding Devices—Held in a block, clamped by vise jaws; two at a time, one each way, Fig. 2176. Tool-Holding Devices—Standard arbor. Cutting Tools—Gang of milling cutters, Fig. 2177. Number of Cuts—Two. Cut Data—60 r.p.m.; ⅜-in. feed. Coolant—Compound, ¼-in. stream. Average Life of Tool Between Grindings—5000 pieces. Gages—Fig. 2178; A, angle of blade; B, thickness at bottom of groove; C, contour. Production—40 pieces per hr. per machine.

OPERATION 8-A. FILING TO MATCH

Number of Operators—One. Description of Operation—Blending cuts together. Apparatus and Equipment Used—File. Production—75 pieces per hr.

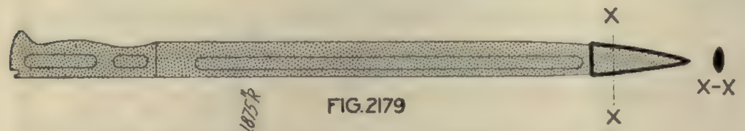


FIG. 2179

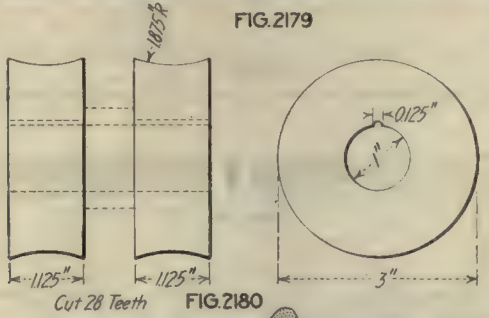


FIG. 2180

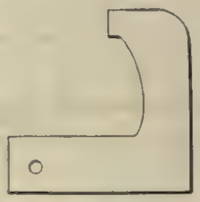


FIG. 2184

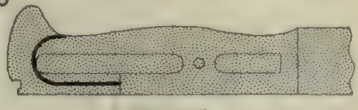


FIG. 2185

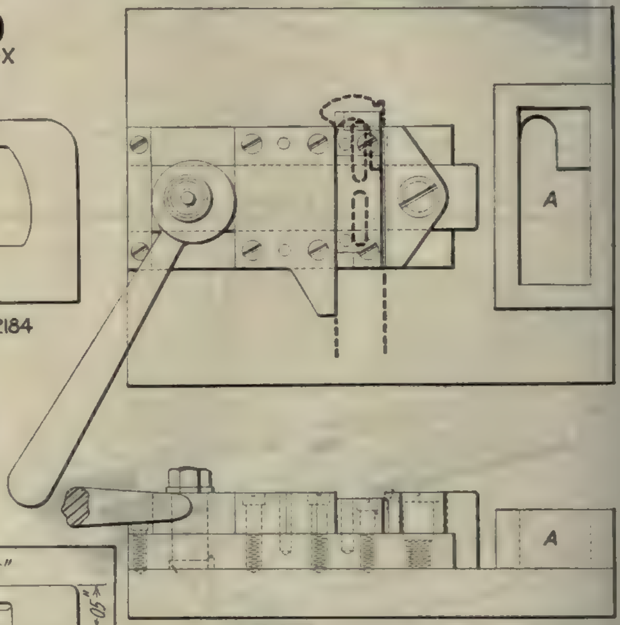


FIG. 2186

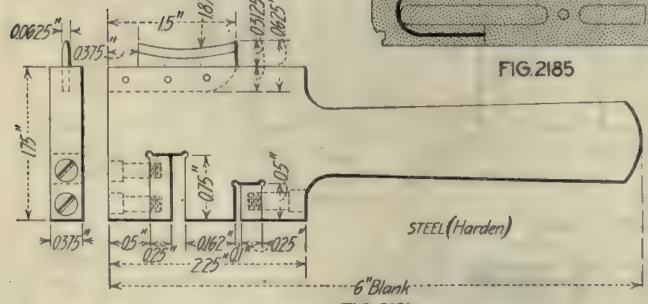


FIG. 2181

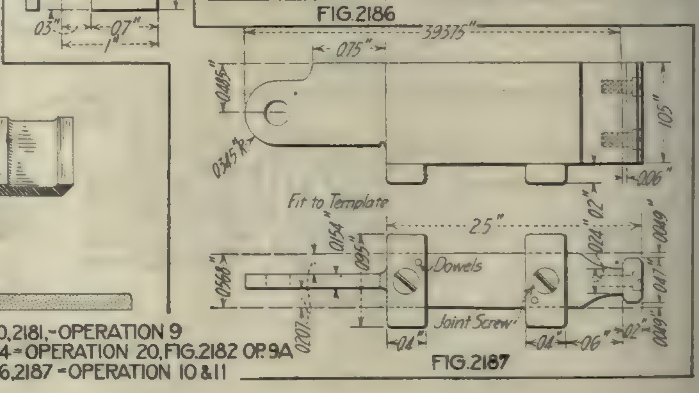


FIG. 2187

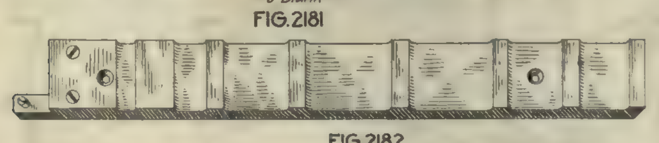


FIG. 2182

FIG. 2183

FIG. 2179, 2180, 2181,-OPERATION 9
FIG. 2183, 2184 = OPERATION 20, FIG. 2182 OP. 9A
FIG. 2185, 2186, 2187 = OPERATION 10 & 11

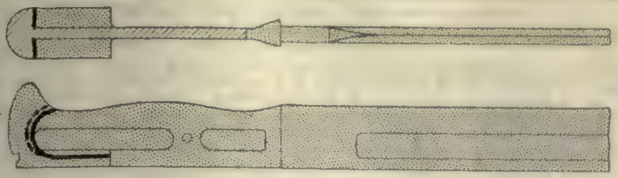
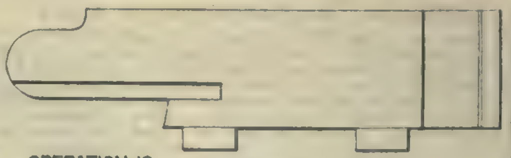


FIG. 2188



OPERATION 12

FIG. 2190 A

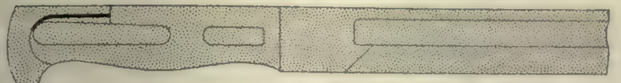


FIG. 2189

OPERATION 13

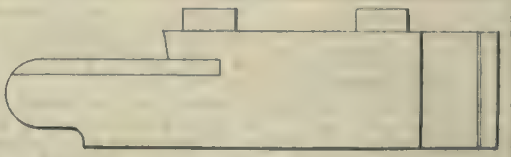


FIG. 2190 B

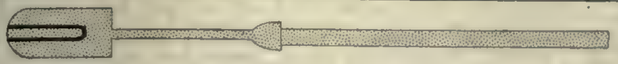


FIG. 2191

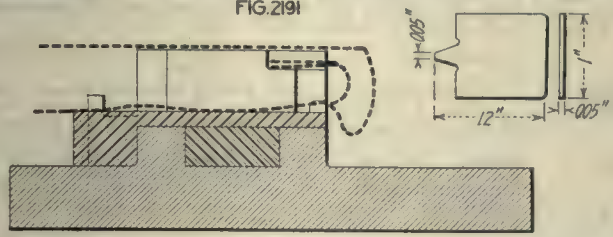


FIG. 2192

OPERATION 14

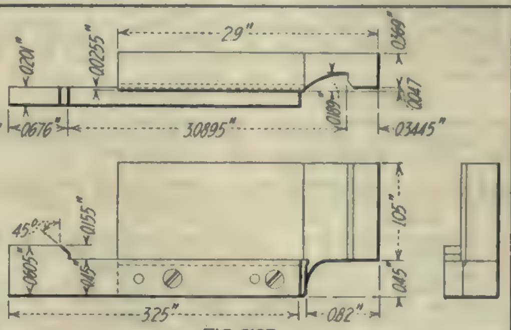


FIG. 2193

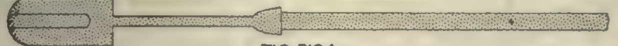


FIG. 2194

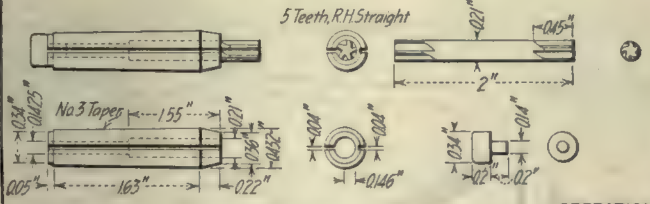


FIG. 2195

OPERATION 15

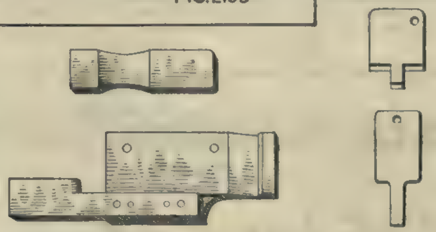


FIG. 2196

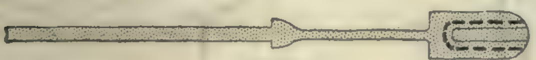


FIG. 2197

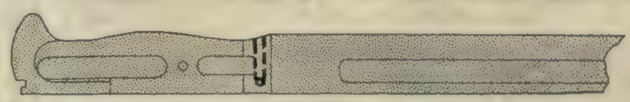


FIG. 2201

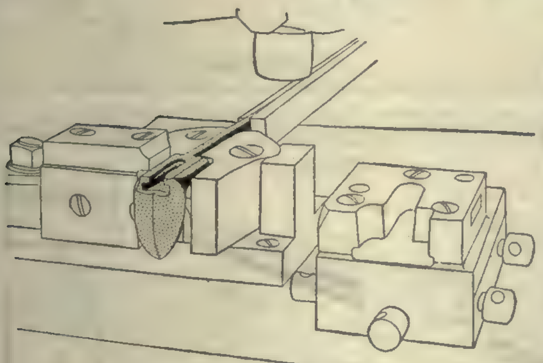


FIG. 2198

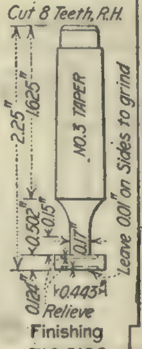


FIG. 2199

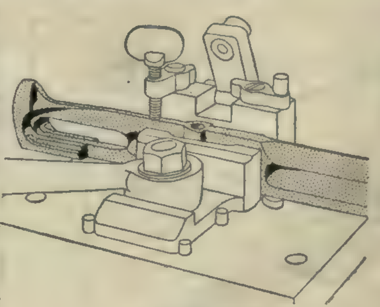


FIG. 2202

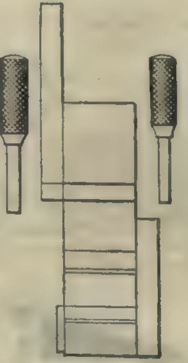
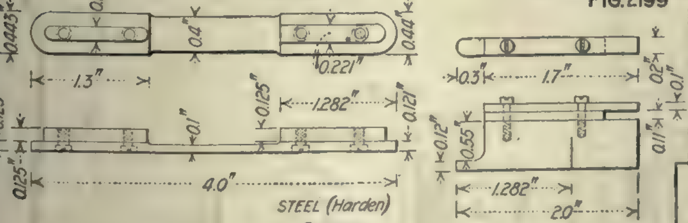


FIG. 2204-A

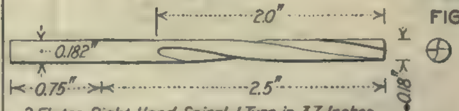


STEEL (Harden)

Gages

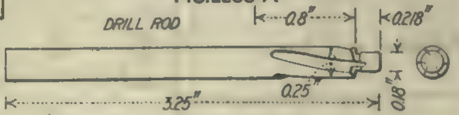
FIG. 2200

OPERATION 16



2 Flutes Right Hand, Spiral 1 Turn in 3.7 Inches

FIG. 2203-A



3 Flutes Right Hand, 1 Turn in 3.72 Inches

FIG. 2203-B

OPERATION 18

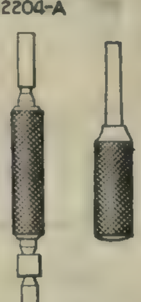


FIG. 2204-B

OPERATION 9. MILLING SIDES OF POINT

Transformation—Fig. 2179. Machine Used—Pratt & Whitney No. 2 Lincoln miller. Number of Machines per Operator—Five. Work-Holding Devices—Held in block, clamped by vise jaws, same as operation 8. Tool-Holding Devices—Standard arbor. Cutting Tools—Milling cutters, Fig. 2180. Number of Cuts—Two. Cut Data—70 r.p.m.; ⅜-in. feed. Coolant—Compound, ¼-in. stream. Average Life of Tool Between Grindings—5000 pieces. Gages—Fig. 2181, curve of sides. Production—40 pieces per hr. per machine.

OPERATION 9-A. STRAIGHTENING

Number of Operators—One. Description of Operation—Straightening after milling. Apparatus and Equipment Used—Cast-iron block, hammer and straight-edge. Gages—Fig. 2182; a plate with ridges or spots that show whether blade is straight. Production—80 pieces per hr.

OPERATION 20. MILLING SIDES OF POMMEL

Transformation—Fig. 2183. Machine Used—Pratt & Whitney No. 2 Lincoln miller. Number of Machines per Operator—Five. Work-Holding Devices—Held in block, clamped by cam-operated vise jaws; similar to other previously shown. Tool-Holding Devices—Standard arbor. Cutting Tools—Milling cutters. Number of Cuts—One. Cut Data—70 r.p.m.; ⅜-in. feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—5000 pieces. Gages—Fig. 2184, form. Production—40 pieces per hr. per machine.

OPERATION 20-A. BURRING

Number of Operators—One. Description of Operation—Removing burrs from operation 20. Apparatus and Equipment Used—File. Production—300 pieces per hr.

OPERATION 10. PROFILING RIGHT SIDE OF TANG UPPER CUT. OPERATION 11. PROFILING LEFT SIDE OF TANG, UPPER CUT

Transformation—Fig. 2185. Machine Used—Pratt & Whitney No. 2 profiler. Number of Operators per Machine—One. Work-Holding Devices—Held on block clamped by vise jaws, Fig. 2186; profiling form at A. Tool-Holding Devices—Taper shank. Cutting Tools—Profiling cutter. Number of Cuts—Two. Cut Data—1200 r.p.m.; hand feed. Coolant—Compound, ¼-in. stream. Average Life of Tool Between Grindings—250 pieces. Gages—Fig. 2187, form, from edge of handle. Production—40 pieces per hr.

OPERATION 12. PROFILING RIGHT SIDE OF TANG, UNDER CUT. OPERATION 13. PROFILING LEFT SIDE OF TANG, UNDER CUT

Transformation—Figs. 2188 and 2189. Machine Used—Pratt & Whitney No. 2 profiler. Number of Operators per Machine—One. Work-Holding Devices—Held in block, clamped by vise jaws, same as before. Tool-Holding Devices—Taper shank. Cutting Tools—Undercut profile cutter. Number of Cuts—Two. Cut Data—1200 r.p.m.; hand feed. Coolant—Cutting oil, ¼-in. stream. Average Life of Tool Between Grindings—200 pieces. Gages—Fig. 2190; A and B, right and left, for under cut. Production—40 pieces per hr.

OPERATION 14. MILLING SLOT FOR HAND LUG, ROUGHING

Transformation—Fig. 2191. Machine Used—Pratt & Whitney No. 2 Lincoln miller. Number of Machines per Operator—Five. Work-Holding Devices—Held by cam-operated, double vise jaws, Fig. 2192. Tool-Holding Devices—Standard arbor. Cutting Tools—A pair of milling cutters, 2.25 in. in diameter; 0.202 thick; 24 teeth, on face and sides. Number of Cuts—One. Cut Data—70 r.p.m.; ⅜-in. feed. Coolant—Cutting oil. Average Life of Tool Between Grindings—5000 pieces. Gages—Fig. 2193, length and width of slot. Production—40 pieces per hour per machine. Note—Same style fixture as used in operation 20.

OPERATION 15. PROFILING SLOT FOR BAND LUG TO FINISH

Transformation—Fig. 2194. Machine Used—Pratt & Whitney No. 2 profiler. Number of Operators per Machine—One. Work-Holding Devices—Held by vise with formed jaws, similar to previous operations. Tool-Holding Devices—Taper shank. Cutting Tools—End-milling cutters, Fig. 2195. Number of Cuts—One. Cut Data—1200 r.p.m.; hand feed. Coolant—Cutting oil, ¼-in. stream. Average Life of Tool Between Grindings—250 pieces. Gages—Fig. 2196, width and length. Production—35 pieces per hr.

OPERATION 16. PROFILING SLOT FOR BAND LUG, UNDER CUT

Transformation—Fig. 2197. Machine Used—Pratt & Whitney No. 2 profiler. Number of Operators per Machine—One. Work-Holding Devices—Held by special vise jaws, Fig. 2198, profile form at right. Tool-Holding Devices—Taper shank.

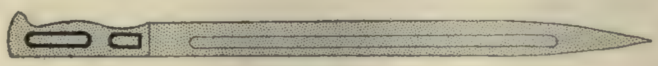


FIG. 2205

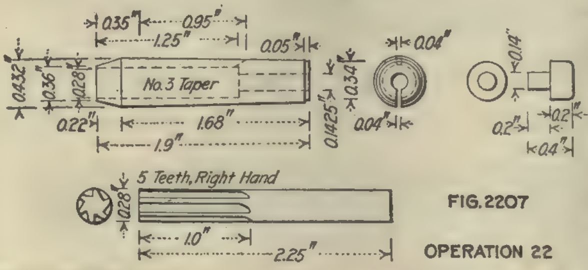


FIG. 2207

OPERATION 22

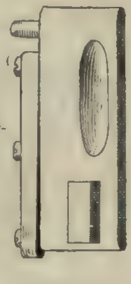


FIG. 2208

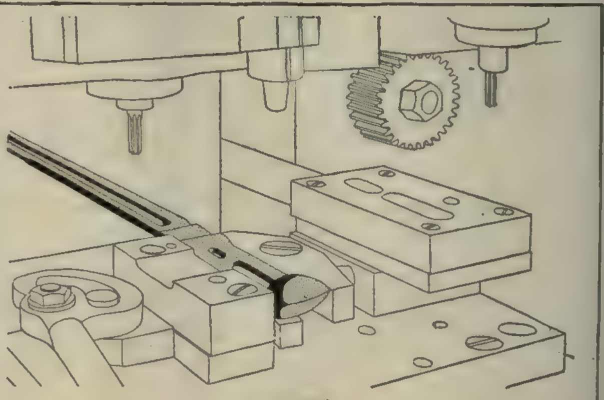


FIG. 2206

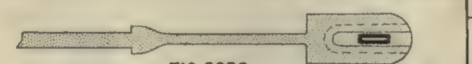


FIG. 2209

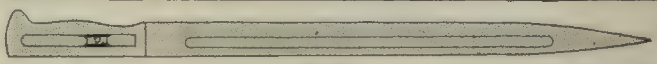


FIG. 2212

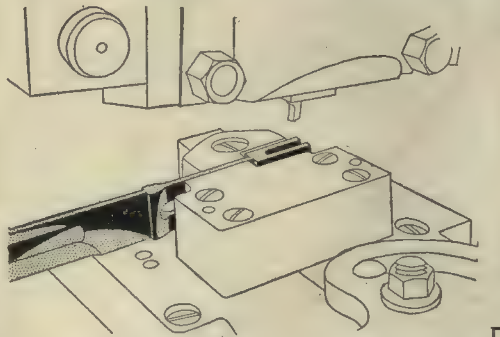


FIG. 2210

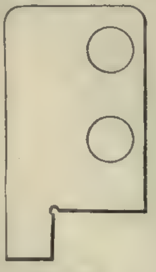


FIG. 2211

OPERATION 17

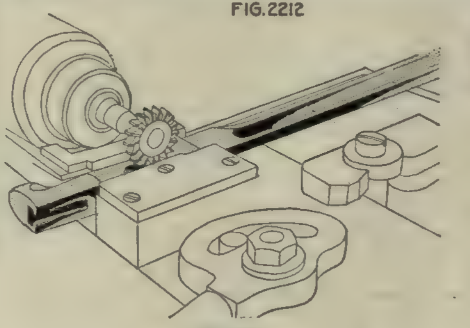


FIG. 2213

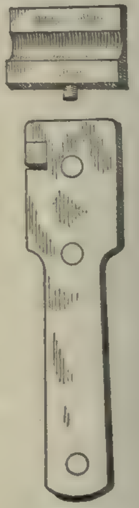


FIG. 2215

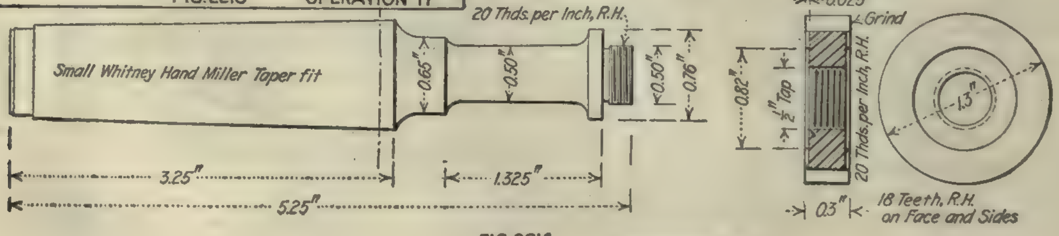


FIG. 2214

OPERATION 28

Cutting Tools—Undercutting profile cutter, Fig. 2199. Number of Cuts—Two. Cut Data—1200 r.p.m.; hand feed. Coolant—Cutting oil, ¼-in. stream. Average Life of Tool Between Grindings—200 pieces. Gages—Fig. 2200, form and size. Production—35 pieces per hr. Note—Same style fixture used as in operation 15.

OPERATION 18. DRILLING AND BOTTOMING SCABBARD-CATCH HOLE

Transformation—Fig. 2201. Machine Used—Ames 16-in. three-spindle drill. Number of Operators per Machine—One. Work-Holding Devices—Drill jig, Fig. 2202. Tool-Holding Devices—Drill chuck. Cutting Tools—Fig. 2203-A, drill bottoming and counterbore. Number of Cuts—Two. Cut Data—650 r.p.m.; hand feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—250 pieces. Gages—Fig. 2204; A, location of hole; B, size of hole and counterbore. Production—35 pieces per hr.

OPERATION 22. PROFILING SLOT FOR BAYONET CATCH

Transformation—Fig. 2205. Machine Used—Pratt & Whitney No. 2 profiler. Number of Operators per Machine—One. Work-Holding Devices—Held in block, by vise jaws, Fig. 2206; profile form at right. Tool-Holding Devices—Taper shank. Cutting Tools—Milling cutter and holder, Fig. 2207. Number of Cuts—Two. Cut Data—1200 r.p.m.; hand feed. Coolant—Cutting oil, ¼-in. stream. Average Life of Tool Between Grindings—250 pieces. Gages—Fig. 2208; a pin fits in screw hole, a block in slot and a projection gages from back of handle. Production—20 pieces per hr.

OPERATION 19. PUNCHING FOR HOOK OF BAYONET CATCH

Transformation—Fig. 2209. Machine Used—Snow No. 2, ⅜-in. stroke. Number of Operators per Machine—One. Punches and Punch Holders—In holder with square shank; punch is 2 in. long, 0.27 in. wide and 0.221 in. thick. Dies and Die Holders—Fig. 2210. Stripping Mechanism—None. Average Life of Punches and Dies—300 pieces. Lubricant—Cutting oil, put on with brush. Gages—Fig. 2211, size of slot. Production—60 pieces per hr. Note—Work held in fixture bolted to bed of press.

OPERATION 28. HAND-MILLING GROOVE IN TANG

Transformation—Fig. 2212. Machine Used—Whitney hand miller. Number of Operators per Machine—One. Work-Holding Devices—Vise jaws, Fig. 2213. Tool-Holding Devices—Taper shank. Cutting Tools—Small milling cutter on threaded arbor, Fig. 2214. Number of Cuts—One. Cut Data—650 r.p.m.; hand feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—5000 pieces. Gages—Fig. 2215, thickness of web. Production—100 pieces per hour.

OPERATION GG. REMOVING BURRS LEFT BY OPERATION 28

Number of Operators—One. Description of Operation—Removing burrs thrown up by operation 28. Apparatus and Equipment Used—File. Production—400 pieces per hour.

OPERATION 27. COUNTERBORING FOR BAYONET CATCH

Transformation—Fig. 2219. Machine Used—Ames 16-in. single-spindle upright drilling machine. Number of Operators per Machine—One. Work-Holding Devices—Cam-operated drill jig. Tool-Holding Devices—Drill chuck. Cutting Tools—Counterbore, Fig. 2220. Number of Cuts—One. Cut Data—650 r.p.m.; hand feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—500 pieces. Gages—Fig. 2221, diameter and concentricity of counterbore. Production—120 pieces per hr.

OPERATION 26. DRILLING RIVET AND SCREW HOLES

Transformation—Fig. 2216. Machine Used—Ames 16-in. three-spindle upright drilling machine. Number of Operators per Machine—One. Work-Holding Devices—Drill jig, Fig. 2217; swinging leaf carries drill bushings. Tool-Holding Devices—Drill chuck. Cutting Tools—Twist drills. Number of Cuts—Two. Cut Data—750 r.p.m.; hand feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—250 pieces. Gages—Fig. 2218, location of rivet holes. Production—40 pieces per hr.

OPERATION 26-A. BURRING

Number of Operators—One. Description of Operation—Burring operation 26-A. Apparatus and Equipment Used—File. Production—300 pieces per hr.

OPERATION 24. MILLING LOWER EDGE OF TANG

Transformation—Fig. 2222. Machine Used—Pratt & Whitney No. 2 Lincoln miller. Number of Machines per Operator—Five. Work-Holding Devices—Work held in vise jaws, same style as in operations 4 and 5. Tool-Holding Devices—Standard arbor. Cutting Tools—Formed milling cutter, Fig. 2223. Number of Cuts—One. Cut Data—70 r.p.m.; ⅜-in. feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—5000 pieces. Gages—Fig. 83, contour. Production—40 pieces per hr.

OPERATION 24-A. BURRING

Number of Operators—One. Description of Operation—Removing burrs from previous operation. Apparatus and Equipment Used—File. Production—90 pieces per hr.

OPERATION 31. PROFILING END AND UNDER SIDE OF POMMEL

Transformation—Fig. 2225. Machine Used—Pratt & Whitney No. 2 profiler. Number of Operators per Machine—One. Work-Holding Devices—Held in block, by vise jaws, Fig. 2226; profile form at right. Tool-Holding Devices—Taper shank. Cutting Tools—Forward cutter, Fig. 2227. Number of Cuts—One. Cut Data—1200 r.p.m.; hand feed. Coolant—Cutting oil, ¼-in. stream. Average Life of Tool Between Grindings—200 pieces. Gages—Form, Fig. 2228. Production—60 pieces per hr.

OPERATION 33. STAMPING "U. S." AND "BALL AND FLAME"

Machine Used—Stiles No. 2 press. Number of Operators per Machine—One. Punches and Punch Holders—Round

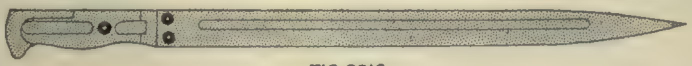


FIG. 2216

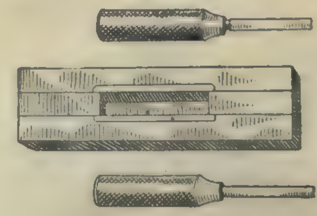


FIG. 2218

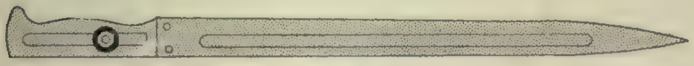


FIG. 2219

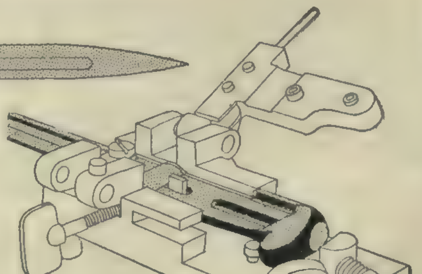


FIG. 2217

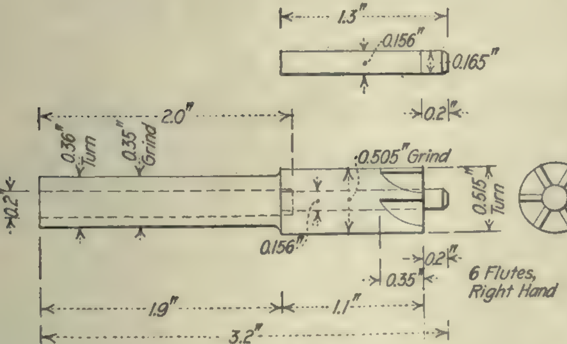


FIG. 2220

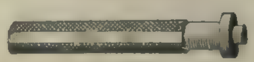


FIG. 2221

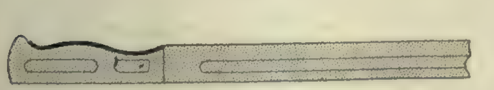


FIG. 2222

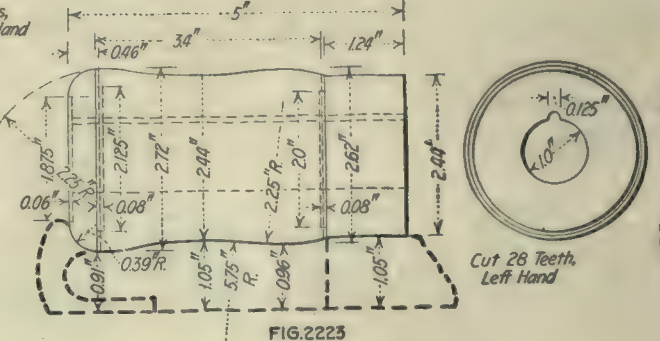


FIG. 2223

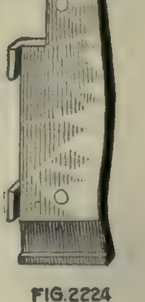


FIG. 2224

FIG. 2216, 2217 & 2218 OPERATION 26
" 2219, 2220 & 2221 " 27
" 2222, 2223 & 2224 " 24

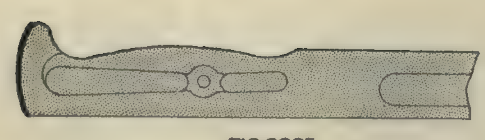


FIG. 2225

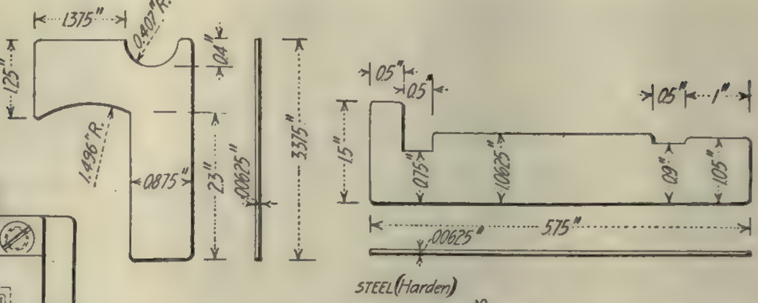


FIG. 2228

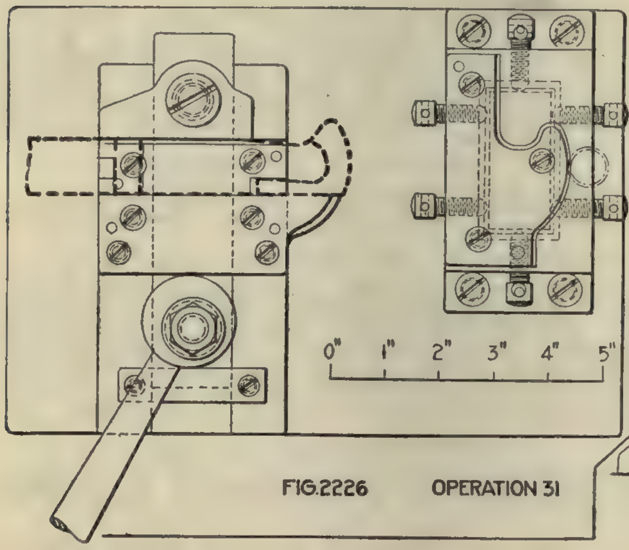


FIG. 2226 OPERATION 31

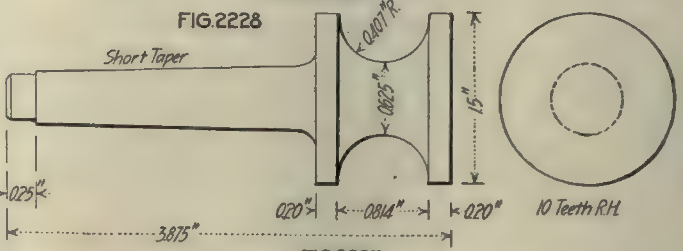
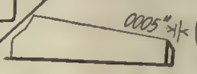


FIG. 2227



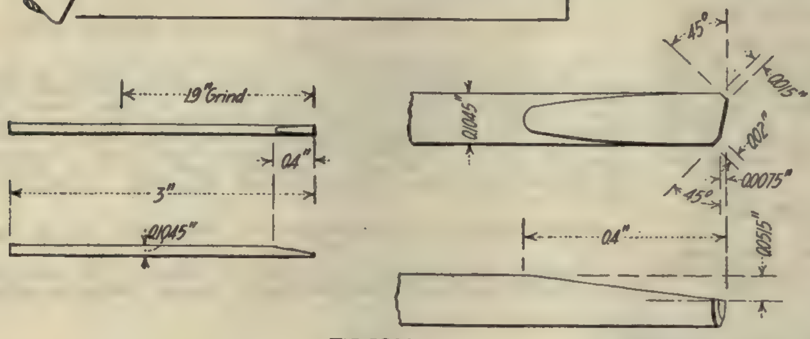


FIG. 2229

OPERATION 33 A

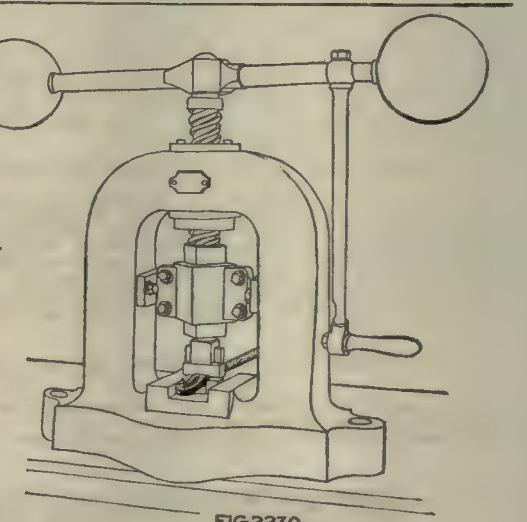


FIG. 2230

shank. Dies and Die Holders—Fixture bolted to bed of press; stamps are set in die. Production—350 pieces per hr. Note—Dies stamp "U. S." on one side and "ball and flame" on the other.

OPERATION 33-A. REAMING AND PRESSING

Number of Operators—One. Description of Operation—Straightening blade for stamping operation and reaming pin holes after stamping. Apparatus and Equipment Used—Hand press, Fig. 2230; bench lathe and reamer, Fig. 2229. Gages—Plug. Production—350 pieces per hr.

OPERATION 34. STAMPING SERIAL NUMBER

Transformation—Fig. 2231, number at A. Number of Operators—One. Description of Operation—Stamping serial number by using special stamp holder. Apparatus and Equipment Used—Fixture for holding work and spacing letters; hand stamps and hammer; slide A carries stamp at B and is advanced by ratchet with latch C, Fig. 2232. Production—120 pieces per hr.

OPERATION 1. HARDENING

Description of Operation—Bayonet blades are hardened in a semi-muffle oil-burning furnace, laid on the backs with the cutting edge up; they are heated to 800 deg. C. (1472 deg. F.) and quenched in sperm oil; they are first dipped slowly at a slight angle to the required depth and then hung in a rack at the side of the tank, as in Fig. 93-A; they hang here until the rack is full, then the first is removed, and so on; the oil is cooled by the surrounding water, being kept at about 80 deg. F. Production—About 100 blades per hr.

OPERATION M. DRAWING TO TEMPER

Description of Operation—The temper is drawn in a bath of niter to a temperature of 450 deg. C. (842 deg. F.) and quenched in water.

OPERATION J. STRAIGHTENING

Number of Operators—One. Description of Operation—Straightening after hardening; the blades are straightened by bending as required, using the apparatus shown in Fig. 2234, and tested by the eye; they are heated over a flame in a small muffle furnace just sufficient to bend without breaking; long bends are removed by placing over blocks A and B and using the rod F with one end under the loop D; edge bending is done by the foot lever E with the bayonet laid edge up on blocks B and C; when twisting is necessary, the fixed post G and the hand-wrench twister H are used. The table is mounted on a bench. Apparatus and Equipment Used—Special straightening device, Fig. 93-B. Production—35 pieces per hr.

OPERATION K. GRINDING TO FINISH

Number of Operators—One. Description of Operation—Grinding point and shaping edge. Apparatus and Equipment Used—Grindstones, mounted as shown in Fig. 2235. Production—15 pieces per hour.

OPERATION 35. POLISHING BLADE (ROUGHING) AND TANG TO FINISH

Number of Operators—One. Description of Operation—Polishing blade (rough) and tang to finish. Apparatus and Equipment Used—Polishing jack and wheel. Production—4 per hr.

OPERATION 36. REAMING RIVET HOLES IN GUARD AND BLADE, COUNTERSINKING RIVET AND SCABBARD-CATCH HOLES AND ASSEMBLING WITH GUARD

Number of Operators—One. Description of Operation—Reaming rivet holes and countersinking after guard is assembled to blade. Apparatus and Equipment Used—Reamer, Fig. 2236; countersink, Fig. 2237; and bench lathe. Production—40 pieces per hr.

OPERATION 37. RIVETING AND BURRING

Number of Operators—One. Description of Operation—Riveting guard and blade together, as in Fig. 2238. Apparatus and Equipment Used—Hammer and file. Production—70 pieces per hr.

OPERATION 38. POLISHING EDGE OF GUARD

Number of Operators—One. Description of Operation—Polishing edges of guard. Apparatus and Equipment Used—Polishing jack and wheel. Production—35 pieces per hr.

OPERATION 39. BROWNING GUARD AND TANG OF BLADE

Number of Operators—One. Description of Operation—Same as other brownings, except care is taken to keep the blade bright; same apparatus as in other browning operations.

OPERATION 40. POLISHING BLADE TO FINISH

Number of Operators—One. Description of Operation—Finish-polishing blade. Apparatus and Equipment Used—Wheel and polishing jack. Production—5 pieces per hour.

OPERATION 41. ASSEMBLING WITH BAYONET AND SCABBARD CATCHES AND GRIP

Number of Operators—One. Description of Operation—Assembling scabbard and catch and grip (see Fig. 2152). Apparatus and Equipment Used—Screwdriver, pinchers and hammer. Production—40 pieces per hr.

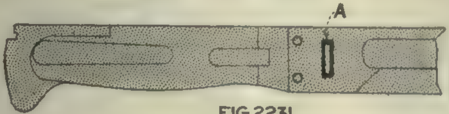


FIG. 2231

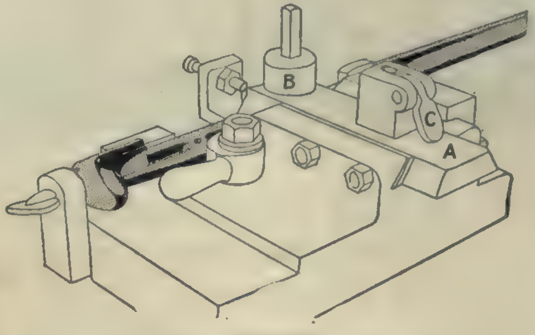


FIG. 2232

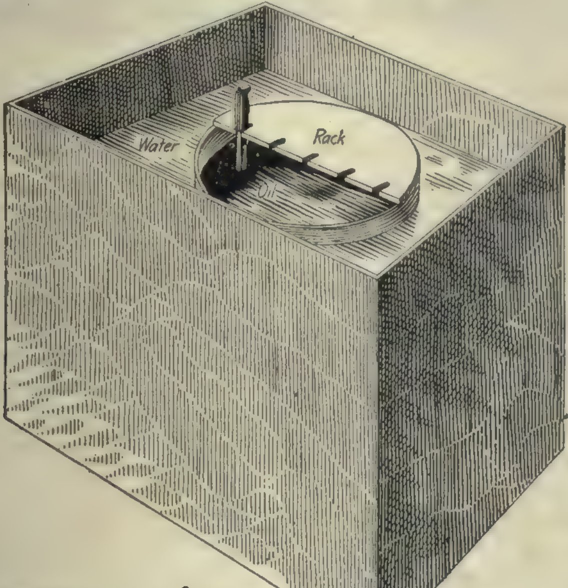


FIG. 2233

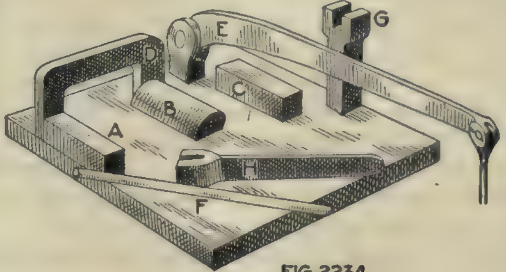


FIG. 2234

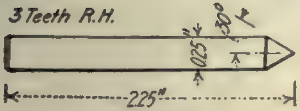


FIG. 2237

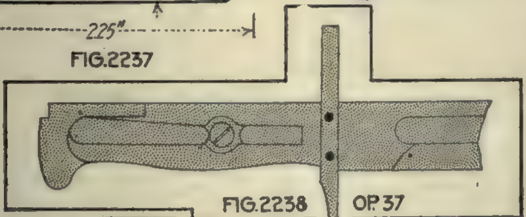


FIG. 2238 OP. 37

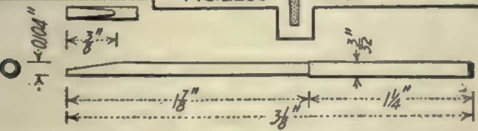
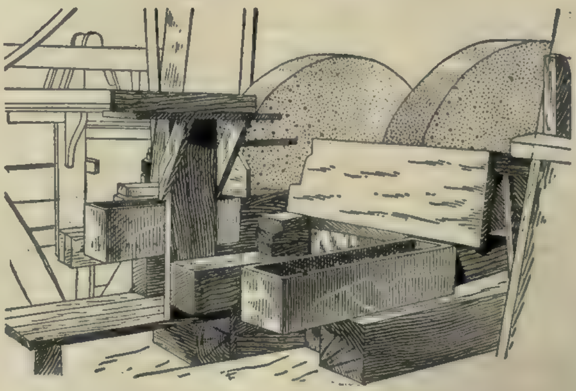


FIG. 2236



OPERATION 34 FIG. 2235

OPERATION 42. THIRD POLISHING

Number of Operators—One. Description of Operation—Final polishing all over blade. Equipment and Apparatus Used—Same apparatus as other polishing. Production—About the same as for second polishing.

Future of Railways in Russia

Sir George Bury, vice president of the Canadian Pacific Ry., since his return from Russia has expressed himself very fully in regard to the future of railways in Russia. He states that there is no doubt whatever that, after the war, Russia will have to build several hundred thousand miles of railway. Canada has ten times more railway mileage per unit of population than has Russia. Then, again, Russia made the mistake of patterning her railway transportation after that of Europe. Traffic in Russia moves vast distances in great bulk. The country lends itself to low grades and easy curvature. Americans should succeed here.

Moving a Blast Furnace

Moving a blast furnace is something new in the iron and steel industry, but this has been undertaken by the Algoma Steel Co., which has purchased the No. 2 furnace of the former Canada Iron Corporation, Midland, Ont., and is now moving the entire furnace, including stoves, boilers and buildings, in fact everything but the foundations, from Midland to Sault Ste. Marie, a distance of about 400 miles.

The steel company purchased this unused furnace because it expected that it could dismantle the plant and reërect it in much quicker time than a new furnace could be built under present conditions. This is a 275-ton stack.

The contract for moving the furnace and supplying additional material required for its reërection and enlargement has been placed with Arthur G. McKee & Co., consulting and contracting engineers, Cleveland.

Arthur Krohn has been appointed assistant superintendent of motive power of the Missouri, Kansas & Texas, with office at Parsons, Kan., and A. E. Voight, has been appointed electrical engineer at Topeka, Kan.

IDEAS FROM PRACTICAL MEN

Thread Rolling in the Automatic Screw Machine

By Raymond Grant

The article on page 1016, Vol. 45, by George H. Hamilton, regarding the rolling of threads with circular rolls, impels me to give my knowledge of this class of work. In my case, experience is confined entirely to brass, and chiefly to fine threads that were produced entirely by the roll, without any previous threading. The work was threaded on one end with a male thread and on the other with either a male or a female thread. The rolling process was resorted to on the male-thread end, to avoid a second handling.

It has always seemed to me that theoretically the production of threads by this method should be impossible, and for this reason: The angle of the top of any thread is always less than the angle of the bottom, so that no matter what relation the diameter of the roll bears to the diameter of the work, it is impossible to make the two threads track or match at more than one point in the depth of the thread.

This inevitably results in a sidewise crowding or strain between the threads of the roll and the work. Conditions are further aggravated by the fact that it is the top or weakest part of the roll thread that must sink the deepest into the work and form the bottom or strongest part of the thread on the work.

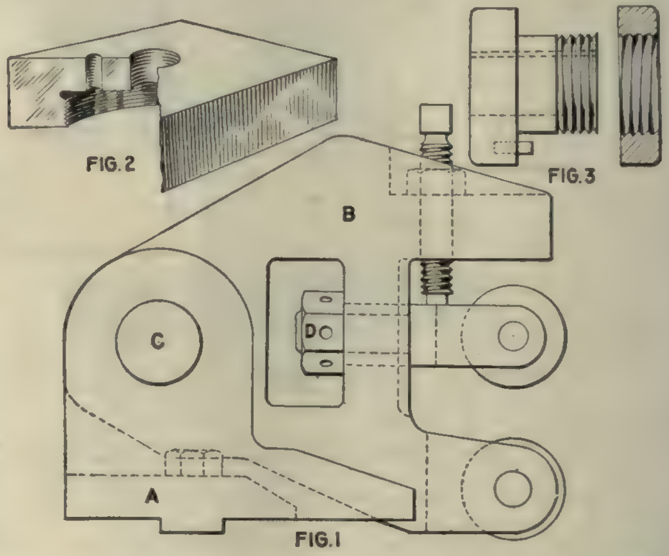
We were able to obtain little definite information as to the proportions of rolls, but the rule most favored seems to be to consider the pitch diameter of the work and to make the pitch diameter of the roll a multiple of it, adding the single depth of thread. The rolls that we made were two, three or four times the size of the work and correspondingly threaded double, triple or quadruple, as the case might be, while the roll must be cut left hand to produce right-hand results.

This method was followed for a number of years, but was finally changed to rolls in which the top of the thread had the same helical angle as the bottom of the thread on work, so as to decrease as much as possible the sidewise crowding at the top of the roll thread, transferring it to the base of the thread. This was an improvement.

It is exceedingly difficult to get a roll tempered so that it will be hard enough to stand up to the work and soft enough not to break. We had no hardening refinements beyond a lead bath (no pyrometer) and an oil tempering bath, and we did not grind the rolls after hardening. With the utmost care it seemed impossible to get any two of a lot of rolls to produce the same results as to length of service. We tried many brands and grades, but obtained the best results when we used Firth's Best Tool Steel, No. 4 temper.

The first, and for years the only, way in which rolls were used was to hold them in a rigid holder on the cross-slide at the same height as the work and, after the work has been formed, advance the roll at high speed to its full depth and as quickly withdraw it, allowing it to remain in contact with the work for only an instant.

A longer dwell on the high point of the cam would result in the side motion of the roll, previously mentioned, and then the whole thread would be stripped from the work, leaving the root diameter.



FIGS. 1 TO 3. THE FIXTURE, DRILL JIG AND ROLL HOLDER

When we were so fortunate as to get a roll "just right" we could produce as high as 100,000 pieces with it before it wore out, but the process was very hard on the front spindle boxes, wearing them oblong in a comparatively short time, due to the sharp rise of the cam and resulting blow when roll and work came in contact.

Eventually we got some new Brown & Sharpe automatics and tried to develop a process that would give less pressure on the front bearing. We worked along the line of a holder in which could be two rolls capable of being adjusted to and from each other and clamped in position, the holder carrying the two rolls to have a slight oscillation to allow the rolls to center themselves on the work. The rolls were to straddle the work, one passing over it and the other under.

In Fig. 1 is given an idea of the first fixture made. It consisted of the base *A*, which was bolted to the cross-slide, and *B*, which held the rolls and had a limited movement on the pin *C*. As will be seen, the upper roll was carried in a fork which was tongued and grooved vertically to the part *B*, clamped by the nut *D* and held up to the work by the setscrew, as shown. The lower roll fitted the holder closely, but the upper one was free to move sideways on its pin about $\frac{1}{32}$ in., with the idea that it would crowd into the thread made by the lower roll as soon as a thread began to be formed and by dividing the work between two rolls would tend to more accurate work and longer service from the rolls.

Curiously enough it worked from the start for several thousand pieces, but the second time we attempted to set it up for a thread-rolling job it would not work at all.

A month or so later we tried it again, with the same result. As extended trial failed to disclose any reason, we gave it up as a failure.

The fixture just described was made as strong as the rather limited space on the cross-slide of a No. 0 B. & S. would permit, but was quite plainly not rigid enough to resist the side thrust of the rolls. At about this stage it became desirable to make this class of work on multiple spindle machines, where we had previously done so, using the method first described—that is, feeding a roll directly against the side of the work. It had worked very well when the machines were new, but the spindles and bearings had become worn, some more than others, and this made it impossible to secure work anywhere near the required limits from the different spindles, so we fell back on the double-roll idea, but with the following changes:

Having plenty of room on the cross-slide, we made a holder of machine steel that was many times stronger than the first one; in fact it was very heavy, but trial showed that it was none too strong. It is my recollection that the pin on which the oscillating member moved was about 1½ in. in diameter and everything else in proportion.

We also abandoned the upper thread roll for a plain roll, which the nature of the work permitted. This roll did not, of course, take bearing on the thread but on each side of it, and served to hold the thread roll up to its work. This arrangement worked after a fashion, but did not meet expectations.

We next altered the holder to accommodate two threaded rolls, which were keyed to their spindles and these in turn geared together so that the two rolls were always in a fixed relation to each other.

The gears were inclosed in a tight case to keep out dirt, and by means of an adjustable idler between them it was possible to get a limited amount of adjustment between the rolls. This proved the best combination and produced better work than any of the others, with longer life to the rolls.

The threads we were to produce were 27 per inch, and the rolls were made with a quadruple thread, 6¾ threads per inch being cut several at a time on a gang arbor.

After chasing, they were screwed into the drill jig, Fig. 2, and a hole drilled. This hole located the thread always in the same place on the roll-holder bushing, Fig. 3, and these bushings in turn were keyed to the geared spindles, which were made in one piece and rotated in hardened bushings.

In fitting up the holder we were careful to get the keys located in these two spindles so that the same roll could be placed either on the top or bottom spindle and be in correct relation to the other roll. The gears were marked in their proper timing to avoid trouble when replacing them in the holder.

This would seem like an expensive thing to make. However, I believe the results will justify it wherever such work must be done in large quantities, for it will produce more accurate work, will do this on a multiple spindle machine with worn bearings, and the work being divided between two rolls, which are held in positive relation to each other, the rolls will last longer.

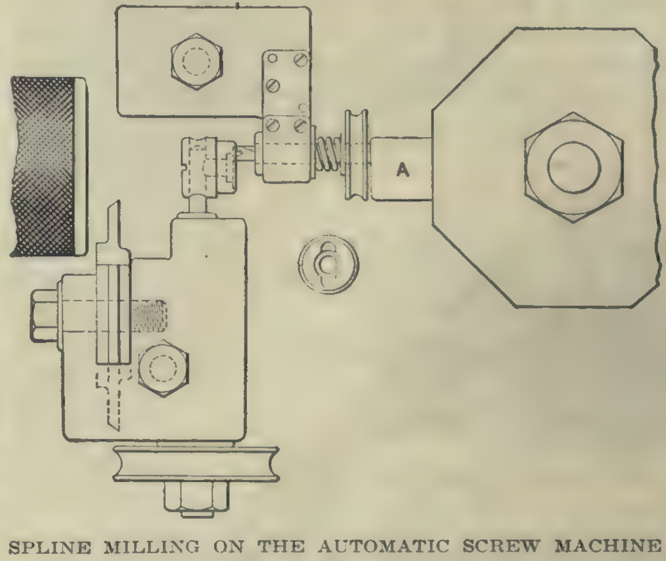
These advantages will surely appeal to any one who has been up against this proposition.

Spline Milling in the Automatic Screw Machine

By Elam Whitney

The illustration shows a seat bushing, for a machine gun, made from carbon steel in a No. 2 Brown & Sharpe automatic screw machine. The features of the tool equipment are the special spline-milling attachment shown on the rear cross-slide and the combination toolpost and cross-drilling attachment shown on the front cross-slide.

The advantages of this method of production are increased output and more accurate work resulting from completing the parts in one setting of the tools. The spline-milling and cross-drilling were formerly done as separate operations.



SPLINE MILLING ON THE AUTOMATIC SCREW MACHINE

The cut showing the combination toolpost and cross-drill is self-explanatory, and the spline-mill attachment consists of a belt-driven spindle carrying a fish-tail cutter. The spindle runs in a bearing mounted to the rear slide by the hexagon screw shown. The cutter is fed into the work at the end of each stroke (which is a forward or backward movement of the cross-slide) by the pusher *A* in the turret and withdrawn from the work by the light coil spring shown.

In operation the rear slide comes forward and dwells with the splined-milling cutter in line with the end of the slot to be cut; the turret then advances the cutter into the work 0.005 in. and dwells while the cross-slide moves rapidly forward the length of the slot to be cut and dwells slightly while the turret advances another 0.005-in. feed; in this way the slot is completed and the cutter withdrawn.

The time required to make one piece is 135 sec., giving a net production of 240 parts in 10 hours. The gears are 36 driver, 72 first on stud, 40 second on stud, and 90 on wormshaft. The maximum surface speed of stock is 72 ft. per min., for drilling 47 ft. per min., and for counterboring 63 ft. per minute.

The cams are of the usual type except the lobes provided for operating the splining cutter; this part of the cam provides a rise and a drop on the rear cross-slide cam equal to the length of slot to be spline-milled, and a dwell on the lead cam for the same number of cam hundredths; when the spline cutter reaches the far end of the slot the cross-slide cam provides a slight dwell while the lead cam advances the cutter forward a few thousandths of an inch, and so on until the slot is completed.

Referring to the specially constructed toolpost and cross-drilling attachment, the drill is located far enough from the cutoff tool to pass the end of the piece when the front slide moves forward to separate the work from the bar, and to do this the work is first fed to the length shown in the cut for drilling and then pushed back toward the spindle to locate for cutting off.

Although the tool layout greatly increased the production on this piece, the most noticeable improvement was in finishing the work in one setting, which allowed greater accuracy and eliminated the trucking, inspection and other delay relative to separate operations.

TABLE GIVING ORDER OF OPERATIONS

	Spindle Speeds R.P.M. 277	R.P.M. 640
Feed stock to stop	...	20
Revolve turret	...	20
Center 0.100-in. throw at 0.005-in. feed	...	20
Revolve turret	...	20
Drill ($\frac{7}{32}$-in. diameter) 0.250-in. throw at 0.005-in. feed	...	50
Revolve turret	...	20
Ream 0.250-in. throw at 0.006-in. feed	...	420
Revolve turret	...	20
Counterbore 0.070-in. throw at 0.005-in. feed	...	14
Revolve turret, stop spindle, advance spline cutter to position	...	20
Cross-drill 1.080-in. throw at 0.004-in. feed, at 960 r.p.m. (spline mill while cross-drilling)	...	180
Withdraw both cross-slides	...	10
Push stock back and start spindle	...	20
Cut-off 0.520-in. throw at 0.002-in. feed	...	596
Clearance	...	10
Total number of revolutions to make one piece	...	1,440

Cross-Slide Indexing in the Automatic Screw Machine

By David Koontz

The indexing attachment shown was designed to increase production on the piece *A*, Fig. 1, by completing it in one setting of the tools in a No. 0 Brown & Sharpe automatic screw machine. The part is made from 0.500-in. diameter machine steel. The three holes are 0.250 in. in diameter and have a tolerance of 0.004 inch.

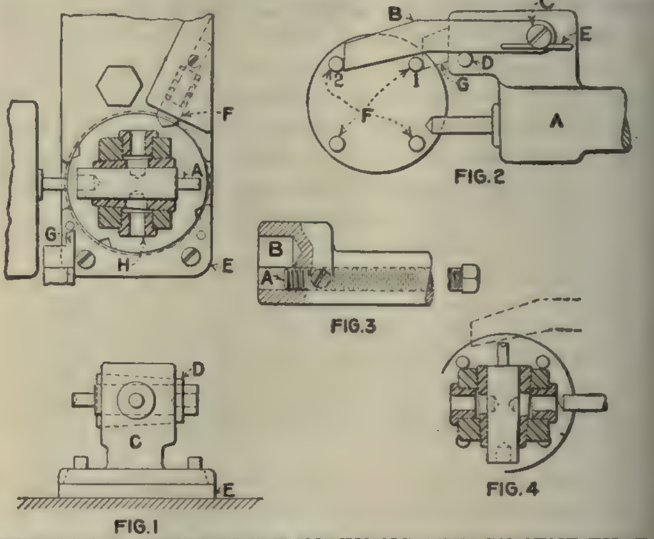
The attachment consists of the base, in which is mounted the chuck *D*, similar to those used in transferring and drilling parts with the regular drilling and burring attachments. The holder *C* also carries the two drill bushings shown and is retained in the base by the plate *E*. Four notches are evenly spaced in *C* to allow it to be located by the spring plunger *F*.

The special drill holder *A*, Fig. 2, is used to index the auxiliary chuck by means of the arm *B*, which swings from the shoulder screw *C* and is held in contact with the stop pin *D* by the coil spring *E*.

In operation the work is fed through the open spring chuck *D*, Fig. 1, against the adjustable stop *A*, Fig. 3. While the special holder *B* is caused to dwell by the turret advancing cam, the rear cross-slide cam causes the slide and special chuck to withdraw sufficiently for the work to pass out of line and clear of the cutoff tool *G*, Fig. 1, and in line with the chuck closing hole *B*, Fig. 3. The turret then advances slightly, closing the chuck.

The turret is now indexed to bring into position the tool shown in Fig. 2, which when advanced brings the end of the arm *B* into contact with the upright pin *F*, four of which are mounted in the bottom of the holder. The position of the arm is illustrated by the dotted lines *G*, and the holder and chuck are indexed from position 1 to position 2, Fig. 2.

When the holder is withdrawn, the lever *B* rides around the pin shown at position 1; hence, the coil spring *E*. After the work has been indexed, it is advanced with the cross-slide to clear the indexing arm and to bring the work into alignment with the drill, as shown in Fig. 4. The drill is revolved by the turret drilling attachment, and the work is ejected by means of an extra setting of the stock-feeding dogs.



FIGS. 1 TO 4. CROSS-SLIDE INDEXING ATTACHMENT THAT INCREASES PRODUCTION

In conclusion, the reader's attention is called to the adaptability of the device in that the notches (for locating the holder in a radical position) may be irregularly spaced and the tool for indexing may be placed on one of the cross-slides, if occasion requires. A varied number of degrees of indexing may be obtained by changing the amount of throw on the cross-slide, or the lead cam lobe may be used for this purpose.

At a recent meeting of the Executive Committee of the Board of Directors of the American Locomotive Co. David Van Alstyne was appointed assistant vice president in charge of manufacture, effective July 1, 1917.

Editorials

An Opportunity for Mechanics To Render Valuable Service

ONE of the great problems of successful flying, either at a training camp or at the front, is to secure a sufficient number of skilled mechanics to keep engines and planes in proper shape, repair minor breakages, replace parts and keep as many machines as possible in first-class flying condition. For the engines, both as to care and repairs, excellent men can be drawn from such automobile factories as can spare them, and from such repair shops or garages as can boast of men who are qualified to handle high-grade engine work This, unfortunately, does not represent as large a number as ought to be available for this purpose.

The rest of the machine, consisting of the framework and the cloth covering, is divided among woodworkers, riggers and those who have had experience in handling cloth. The woodworkers are recruited from the ranks of pattern makers, cabinet makers, piano woodworkers, automobile-body builders and men who have a natural aptitude for fine woodwork. The clothworkers are sailmakers, overall makers, tentmakers; in fact, any one who understands the sewing machine and the handling of cloth can be made available.

Then there is a larger amount of sheet-metal work on the modern airplane than most of us realize. There are tanks holding gasoline for the engine, water for the radiator and, in some cases, lubricating oil in addition to that in the engine crank case. There are the hoods and other housings for the engine, the metal covering around the cockpits, pontoons in the case of hydroairplanes, and other metal parts. These frequently need replacement or repair and are hardly in the field of the ordinary machinist.

The foregoing workers have to do with repairing machines that have been damaged, but there are two other important positions to be filled—those of the men who look after each machine while it is in use. These men are called "fitters" and "riggers" at the Canadian and English camps, the former being about equivalent to our "machinists," which such a man would probably be called in the United States service. Two of these men—a fitter and a rigger—are attached to each aviator, or to whatever airplane he is using, and it is their duty to keep the machine in the best of condition at all times.

The fitter, or machinist, looks after the engine, which includes propeller, radiator, gasoline tank and all connections, while the rigger sees to it that the planes, body, rudder, rear planes, elevators and all control wires are as they should be. The life of the aviator as well as the success of the work he is to perform is in the hands of these men, and they must be skillful and reliable.

The first-class rigger should have a fairly good idea of the theory as well as the practice of modern airplane construction in order to keep his machine or machines in their best condition. He must be able to know that the fuselage is straight and true, and how to line it up if it is not; he must be able to test the wings for proper dihedral angle, for sweepback, for stagger and for angle of incidence, if he has any reason to believe any undue stresses may have disarranged the original adjustments.

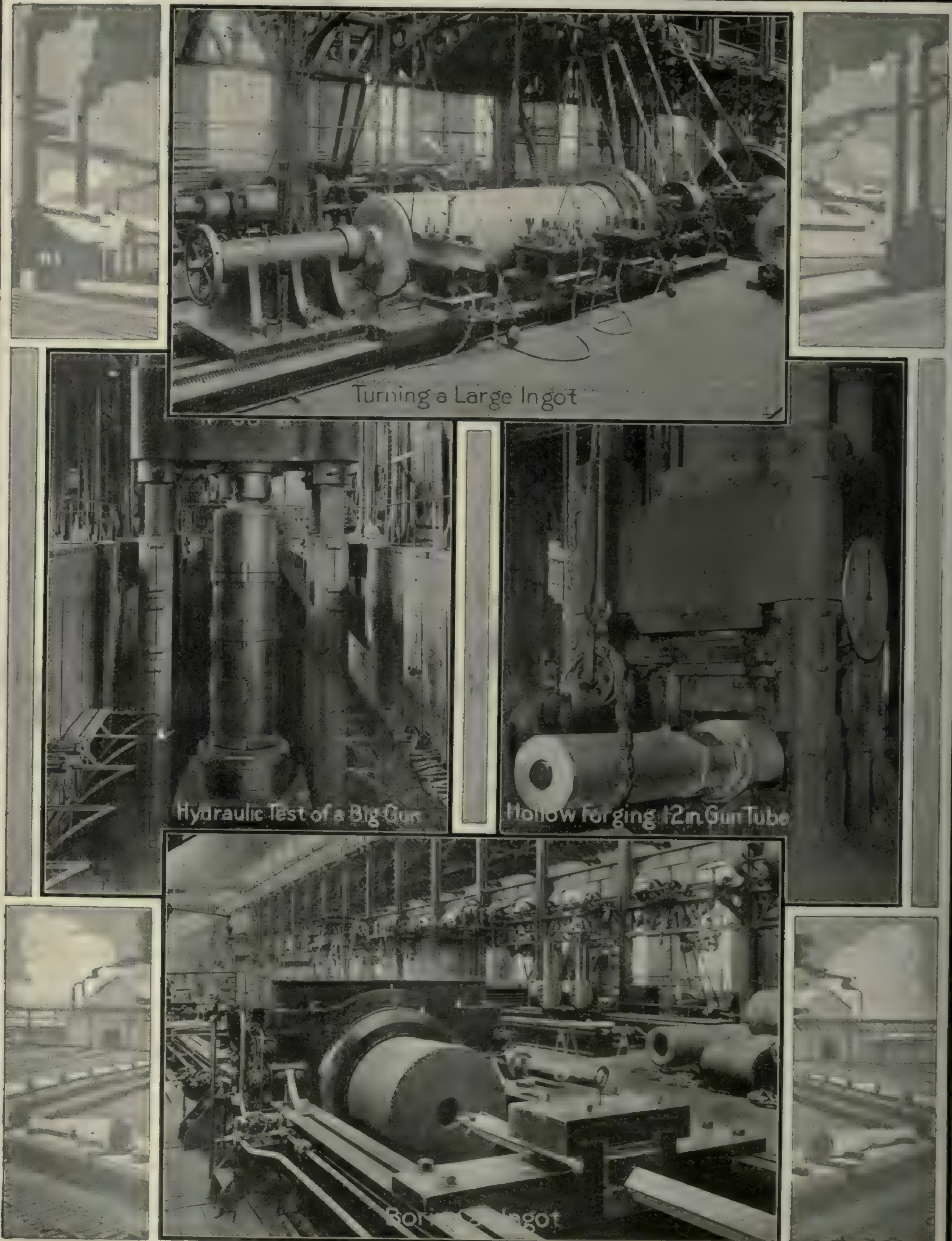
Then there is a field for men who understand pneumatic tires and wire wheels, for these form a very essential part of the landing gear and are an important item when it comes to upkeep of the machines. Tires and tubes are vulcanized in the repair shops connected with the hangars, thus making an opening for still other men who want to do their bit in some direct way.

It is for this reason that mechanics of all grades must be enlisted into the service, so that each man can be held entirely responsible for his work. The work must not only be done right, but it must be done at the proper time if it is to be of value. Then, too, the keeping of the same men on the same machine, and with the same aviator, develops a personal interest which is of great value and adds materially to the quality of the service rendered.

The men who are assigned to each aviator must be trained especially for this work, coming from repair shops or directly from the factories where the particular type of airplane is manufactured and receiving their training in fieldwork by serving time in the shops where engines and planes are repaired. In the case of Canada this would probably begin in the shops in Toronto where general repairs are made and finish at one of the advanced flying fields where only the lighter repairs are made. Here the engines are taken down after 50 hours' run for cleaning carbon, etc., and other field inspection and repairs take place. There is no better place to learn to do work of this kind than the shops which are now working under conditions similar to those that will be encountered on the other side.

Mechanics who want to do their part in one of the most essential branches of the service will do well to learn something about aviation motors and their repair. To this should be added a knowledge of the various kinds of light machine guns, airplane instruments, landing gears and all the various airplane attachments and accessories. They should familiarize themselves with the different types of motors, magnetos, carburetors and distributors, so as to know the peculiarities and ailments of each. A little "know how" about the behavior of different kinds of apparatus often saves hours of work when time is of the utmost importance and makes an airplane mechanic much more valuable in every way.

Big Gun Work in the Shops



Turning a Large Ingot

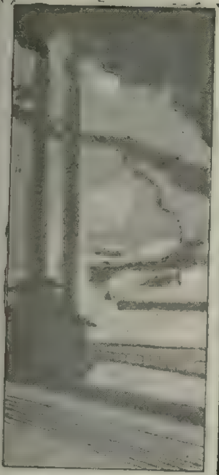
Hydraulic Test of a Big Gun

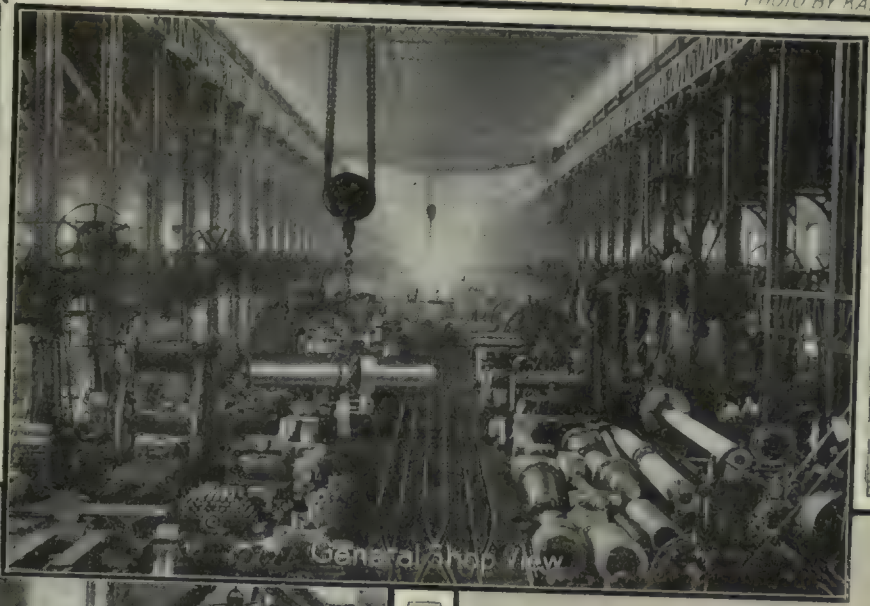
Hollow Forging 12 in Gun Tube

Bor[illegible]ngot

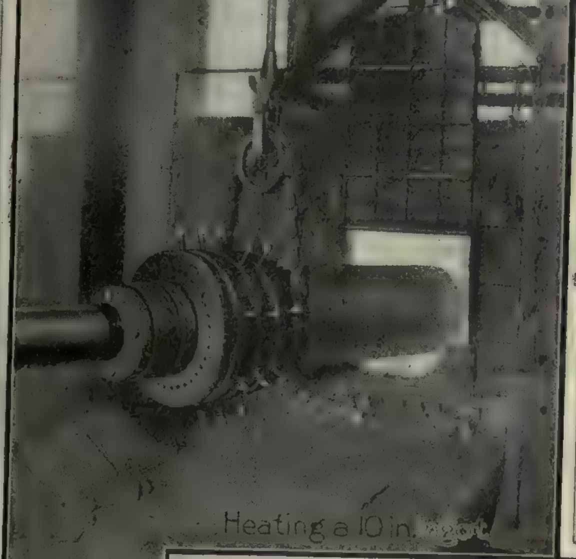
# of the Bethlehem Steel Co.

PHOTO BY KADEL & HERBERT. N.Y.

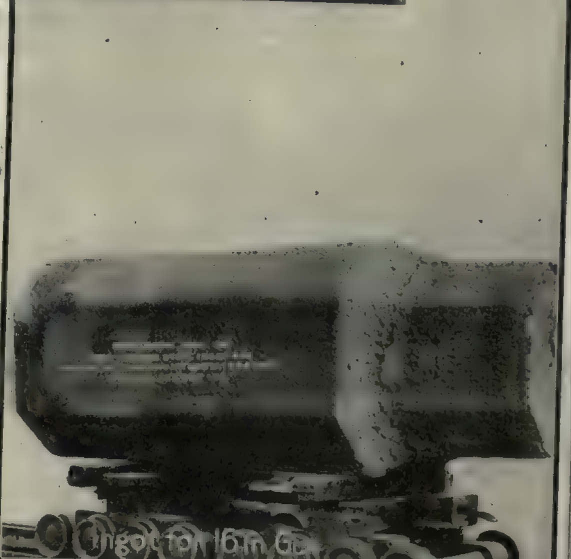




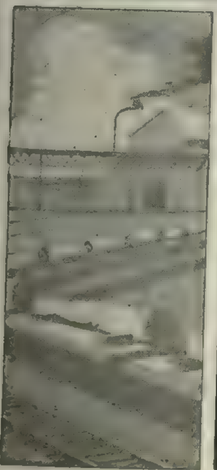
General Shop View

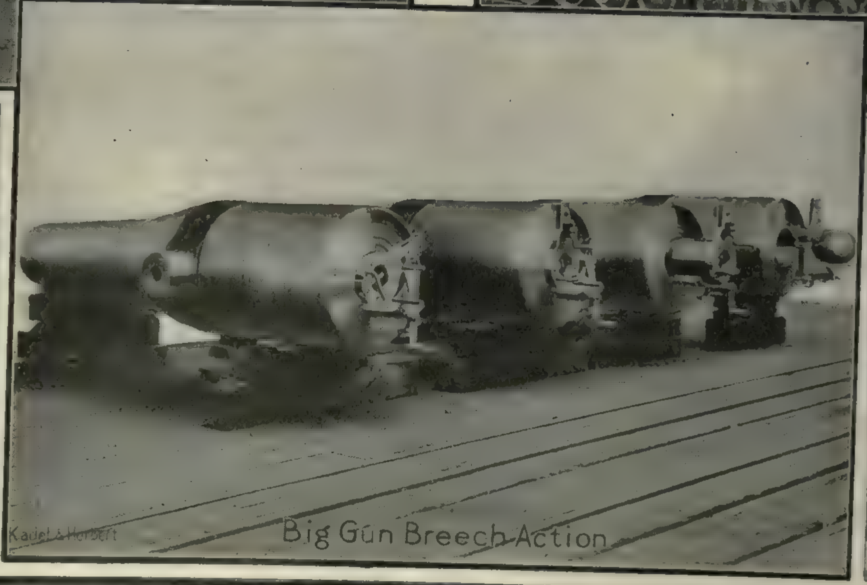


Heating a 10 in. Ingot



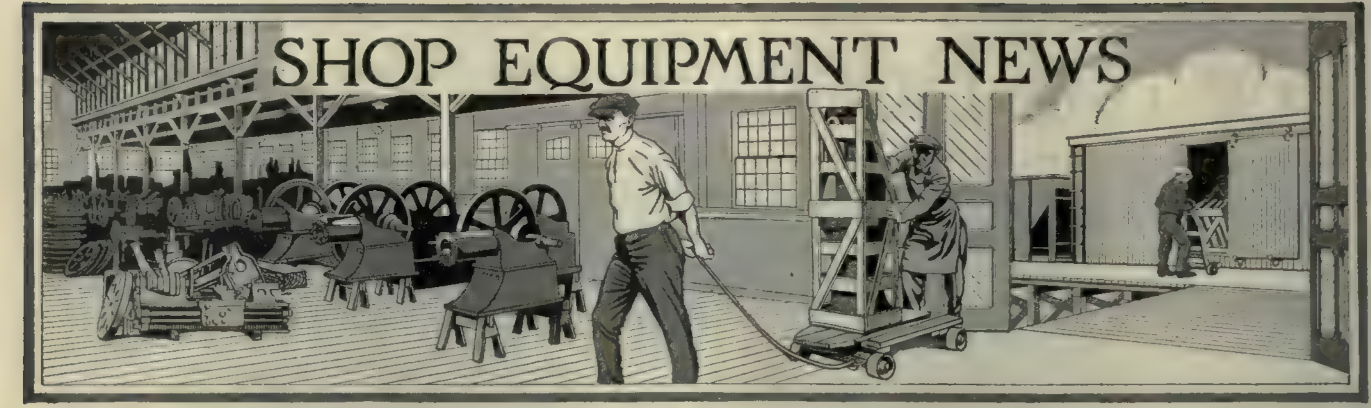
Ingot for 16 in. Gun





Kadel & Herbert

Big Gun Breech Action

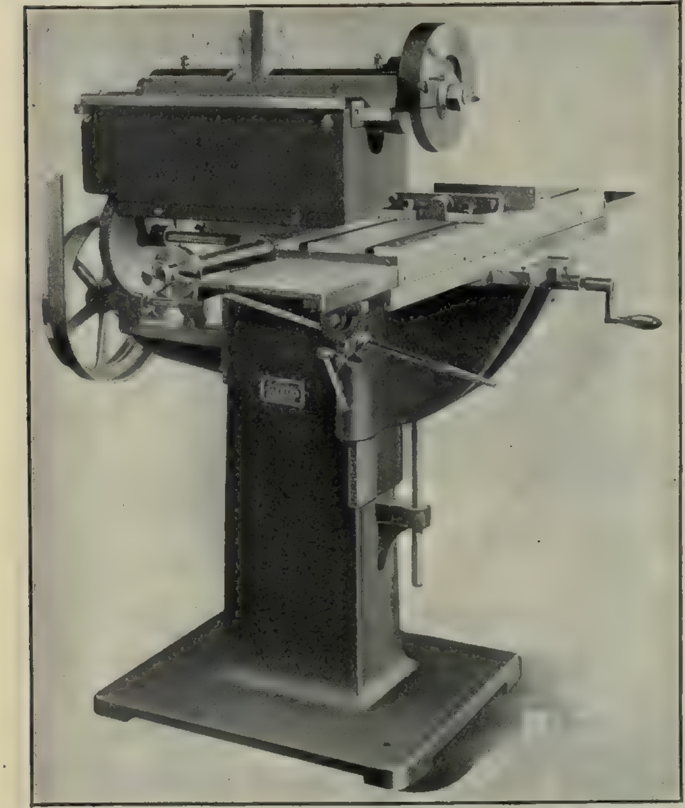


SHOP EQUIPMENT NEWS

Hartford Surface Grinder

The machine illustrated is made by the National Machine Co., Hartford, Conn., for general use and especially for finishing flat surfaces on dies, punches and hardened parts of machinery. It is simple in construction, has few parts and is convenient and easy to operate, requiring but little power.

The column is cast in one piece, and the four-point base, being flat and drilled for floor bolts, prevents tipping or swaying. The knee casting is dovetailed and gibbed to fit the face of the column. The binder screws lock the knee and hold the table in a horizontal position.



HARTFORD SURFACE GRINDER

Grinding wheel, maximum 8 in. in diameter, 1-in. face and 1¼-in. hole; surface of table or platen, 8 x 37 in.; traversing distance of grinding wheel, 10 in.; movement of table, longitudinal, 30 in.; traverse, 4 in.; vertical without wheel, 14 in.; distance center of spindle to table with table at lowest point, 16 in.; spindle speed, 2000 r.p.m.; spindle pulley diameter, 2¼ in.; driving pulley, 13 in. in diameter by 12-in. face; height to center of spindle, 47 in. from floor; countershaft speed, 350 r.p.m.; tight and loose pulleys, 6 x 3½ in.; floor space required, 42 x 49 in.; weight of machine, net, 1200 lb.; crated, 1400 lb.; boxed for export, 1500 lb.; weight of countershaft, net, 130 lb.; crated, 200 lb.; boxed for export, 250 lb.; dimensions, boxed for export, machine, 31 x 52 x 56 in.; countershaft, 19 x 21 x 52 in.; cubic feet boxed, machine, 52¼; countershaft, 12.

The table is 8 x 27 in., and is dovetailed and gibbed to fit the top of the saddle. The table moves automatically in either direction and its maximum movement is 0.062 or $\frac{1}{16}$ in. to each complete stroke of the ram. This movement of the table takes place when the ram has completed its stroke, and is reducible by adjustments of eighths to zero if a finer finish is desired. The ram strokes are 16 per min., and to move over a piece, say 18 in. long, would take 18 min. The width of the piece could be anything up to 12 in. wide without changing the time required to cover a piece of a given length. The machine can be furnished to order to grind a piece 12 in. wide.

The feed is entirely automatic in either direction and can be regulated by moving the feed stud in the slot of the feed disk. The stationary head is rigidly held to the top of the column by four heavy bolts and is inclosed with easily movable guards on both sides. The crank arm is slotted to receive the stud which regulates the throw or travel of the ram and is inclosed in the stationary head.

The crank stud is adjustable in the slot to give the ram a reciprocating motion of any length up to 10 in. Wipers protect the bearings of the ram or slide from dust or grit at both ends. The spindle runs in phosphor bronze bearings which are held rigidly by two extra-heavy iron caps. It is a steel forging 1½ in. diameter through the bearings and takes a grinding wheel with 1¼-in. hole.

The grinding wheel, with a maximum diameter of 8 in. and a face of 1 in., is held rigidly on the spindle between two collars which are tightened by a heavy hexagon steel nut. The wheel hood has a hinged front, affording quick access to the wheel.

The countershaft carries four pulleys—one 13 in. in diameter, 12-in. face; one two-speed cone, 4 and 5 in. in diameter, 1½-in. face, and tight and loose pulleys 6 in. in diameter, 3½-in. face. The shaft runs in ring-oiled boxes held in pressed-steel hangers. The feed-gear mechanism is driven by the cone pulley, and the speed is changed as required for roughing and finishing work. The spindle is driven with a 2½-in. belt.

Coffin Portable Flood Light

The Coffin Valve Co., Boston, Mass., has recently placed on the market the flood light shown in the illustrations. It is made with either a floor stand or with a small base fitted with two T-head bolts, by means of which it may be fastened to a machine table or lathe carriage, as shown. The fixture may be adjusted to throw the light in any required direction. When being moved from place to place the small rod holding the lamp socket may be telescoped into the hollow upright projecting from the tripod. The adjusting feature is composed of a ball and two swivel joints. The outfit includes 6 ft. of cord, socket and shade.

PORTABLE FLOOD LIGHT

Metalwood Straightening Press

The press illustrated is built in 20- and 35-ton sizes, and in three styles—motor drive, belt drive from lineshaft and accumulator drive. All the parts of the press which are under stress or strain are of alloy steel castings or forgings. The sub-base upon which the pump is mounted forms a tank for the liquor.

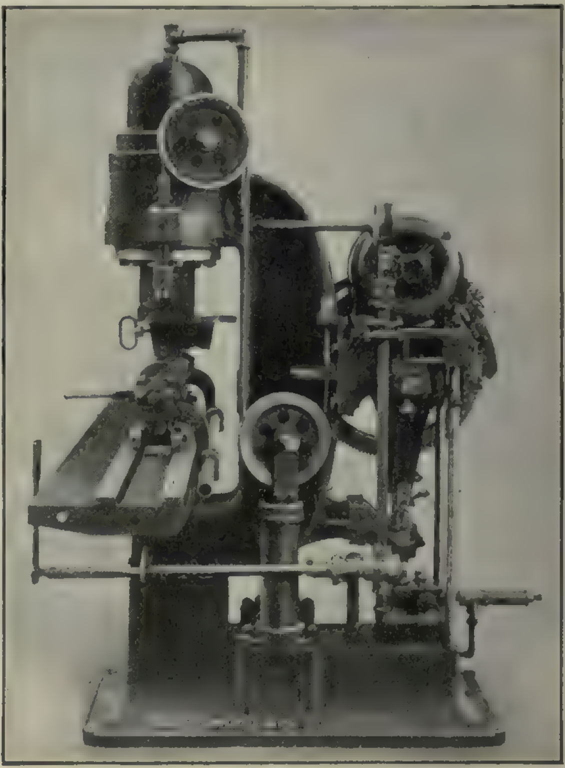
The pump is built directly into the press and is of the two-plunger type; with all the bearings made of renewable phosphor bronze fitted into machined surfaces. The body is of special bronze, with very large valve areas; the plungers are of tool steel, hardened and ground.

The ram of the press is returned by a heavy spring which is arranged for differential pull with adjustable tension. The ram nose is fitted with a sliding chrome-nickel steel resistance block, with two steps for crank work, so as to conserve the stroke of the ram and the use of liquor, and increase the speed of the press.

The table is of semisteel, heavy-ribbed box section, with renewable steel strips on which centers are placed. These also take the thrust of the ram when pressure is applied to the work. The table is finished on top and sides so that indicators may be used. The centers are of the yielding type, adjustable for length. The thrust of the work is taken up by tapered steel wedges placed under the work on steel tracks.

The press is controlled by a Metalwood single-lever, quick-operating valve, which controls the speed of the ram, the pressure applied and the return of the ram.

All fittings are of drop-forged steel, and all piping is of seamless tubing made under hydraulic pressure. A gage is furnished which reads in pounds per square inch and tons on the ram or tons applied to the work.


METALWOOD STRAIGHTENING PRESS

The resistance blocks and all necessary parts for the operation of the press are furnished. The press is made by the Metalwood Manufacturing Co., Detroit, Mich.

Leeds & Northrop Optical Pyrometer

The Leeds & Northrop Co., Philadelphia, Penn., has placed on the market an optical pyrometer which is intended to be used for determining the temperature of bodies heated above a dull red heat. The illustration shows the instrument in use. The rays from the hot body are brought to a focus on a tungsten lamp filament which appears to the observer to lie upon the surface of the image.

In use a current of electricity is passed through the filament, a rheostat and a milliammeter, and the filament is brought to such a temperature that its color blends with or becomes indistinguishable upon the background formed by the hot object. The reading of the milliammeter is then taken, and from this information the temperature can be determined. It is claimed that the instrument is very accurate on account of the fact that the effect of radiation upon the eye varies from about 14 to 20 times faster than does the temperature.

When such high temperatures are to be measured that the light emitted becomes dazzling, a red glass is placed in the eyepiece. At temperatures above 2500 deg. F. the red glass becomes insufficient to prevent the blinding effect, and above this temperature a screen is placed between the lens and the image in such a manner that it reduces the light from the hot body but not that from the hot filament, due corrections being made, of course, on the ammeter readings. This screen may be thrown into or out of field by means of a milled disk projecting through an opening in the instrument tube.

PORTABLE OPTICAL PYROMETER

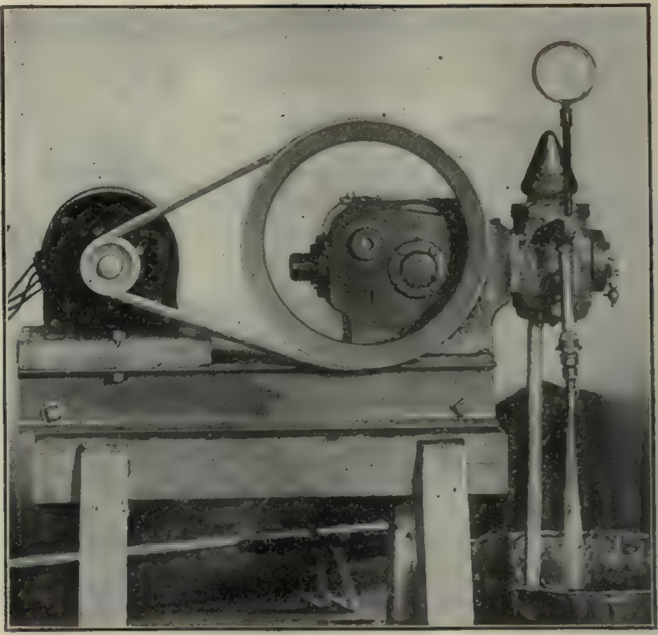
The readings obtained with this instrument are always the same for the same temperature, if the body viewed is surrounded by other objects, such as the walls of a furnace at the same temperature.

The entire outfit is portable, the instrument itself weighing only a few ounces. The case containing the battery, rheostat and milliammeter is designed to be slung about the neck and weighs about 10 pounds.

Invincible Water Pump

This pump was designed and built by the General Machinery Co., West Toronto, Ontario. It is of the double-action type, with an intake, and discharges twice during each revolution of the main shaft. This enables the pump to operate at an extremely low rate of piston travel, which is 33 ft. per min. when operating at maximum capacity. The valves of this pump are of rubber, and reversible, while the valve seats are of hard brass. These valves are so placed as to be always primed. Hyatt roller bearings are used on the main shafts.

The pumps are made in seven sizes, with respective capacities of 150, 285, 500, 700, 950, 1300 and 2000 gal. per hour. Motor, gasoline or shaft drive may be used. Electric motors range from ¼ hp. for the smallest to 2 hp. for the largest. Flat belt, V-belt or gearing may be used to suit conditions.



INVINCIBLE WATER PUMP

The Davis Close-Coupled 12-Inch Lathe

The machine shown in Fig. 1 has been designed to meet the requirements of a modern toolroom. The bed is ribbed transversely with heavy, double-wall cross-girts, regularly spaced, to resist strains. The rear end is made to permit sliding the tailstock off without disengaging the clamping bar or removing the bolts.

The headstock is a heavy one-piece casting having solid boxes with front and rear walls brought up to the centerline of the spindle, thus tying the whole head together in a most substantial manner. The gear guards are made integral with the head and form a cover for the cone. In the top of the gear guard is mounted a brake for stopping the spindle.

The spindle is made from high-grade crucible steel, turned all over and ground to micrometer size. A 1½-in. hole is bored its entire length, with the front end bored to Morse taper No. 3.

The back gears are placed under the headstock at the front end of the spindle, as shown in Fig. 2. This arrangement applies the drive from the cone through the gears without the long eccentric shaft and quill used on most cone-driven lathes, thus eliminating all torsional strains. The back gears are brought into mesh by a handle placed on the front at the right of the gearbox, making it unnecessary for the operator to reach over the cone, as in the old construction.

The carriage has a bearing on the ways of 19¼ in., with a cross-bridge 6 in. wide. The compound-rest swivel base is graduated and provided with four clamping bolts for locking in position. Full length taper gibs are provided in both cross and compound slides with an end screw and adjustment for taking up wear. The apron is of the double plate type, with two bearing supports for all shafts.

Screw cutting provides for a range of threads from 1½ to 80 per inch, including 11½, instantly obtained through the quick-change gearbox. Thirty-six leads are regularly supplied, but others can be cut by changing gears on the quadrant. The lead screw is 1¼ in. in diameter, and is guaranteed for accuracy, the maximum error allowed being 0.001 in. in 12 in. The lead screw is used only for cutting threads and can be locked out when not in use, so is not subjected to unnecessary wear.

The feeds are obtained through an independent feed rod and the quick-change gearbox, without the use of lead screws. They are 36 in number and vary from 4½ to 240. The feed rod can be locked in or out by means of a clutch placed next to the gearbox.

The gears in the gear box are made with Brown & Sharpe 20 deg. involute pointed tooth which provides not only a stronger tooth but permits changes to be made while running without gears riding on the top of the teeth. Special leads can be cut by changing gears on an auxiliary quadrant, which is furnished with each lathe. Provision is also made for cutting metric threads with English lead screw by using transposing gears, furnished at an extra charge.

The automatic stop for the carriage is obtained through the same rod that operates the reverse mechanism. Adjustable collars permit the lathe to be used for duplicate or shoulder work. The tailstock is cut away on one side to permit the compound rest to be set parallel with the bed. It is very heavy and substantial, and is locked to the bed by two ⅝-in. bolts. The upper part is arranged to set over for taper turning.

The alignment of a lathe is a difficult thing to maintain, unless great care is exercised to see that the lathe always stands perfectly level. If the lathe is bolted to an uneven floor, it cannot turn nor bore true. To guard against disalignment a foot is placed in the center of the right leg, which carries the lathe on a three-point support. This assures the lathe being free from strains due to bolting, or even setting, on an uneven floor. To overcome any rocking tendency, the outer ends of the right-hand leg are supplied with adjusting bolts, which can be screwed down until they just touch the floor without taking any of the weight.

The regular equipment consists of a 5-ft. 6-in. bed, large and small faceplates, compound and steadyrests, one set of round centers, double friction counter-shaft and the necessary wrenches.

At an extra cost a taper attachment, draw-in chuck and collets up to 1 in. in capacity, oil pan bed, oil pump, follow rest, transposing gears for cutting metric threads and relieving attachment for backing off taps and milling cutters will be furnished.

A motor mounted over the headstock and geared to the spindle through a train of gears which provide four mechanical changes of speed obtained by sliding clutches will be furnished when specified with order. A further range of speed is obtained through the motor, which should have a variation of from 500 to 1500 revolutions per minute.

This lathe is built by the W. P. Davis Machine Co., Rochester, N. Y.

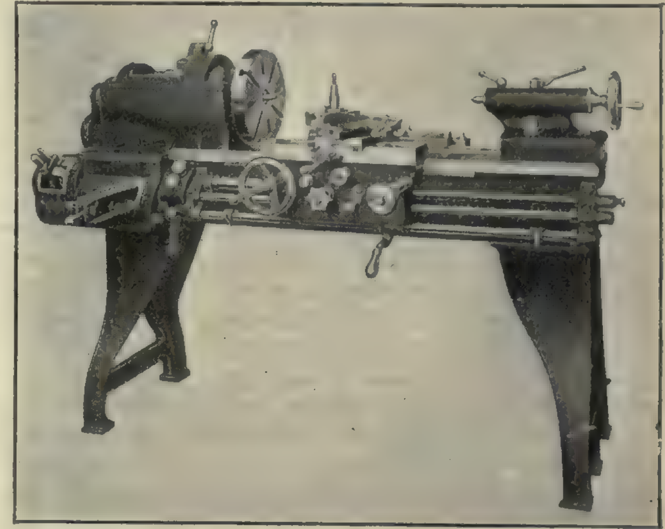


FIG. 1. CLOSE-COUPLED 12-IN. LATHE

Swings over bed, 13⅝ in.; swings over carriage, 8¼ in.; takes between centers, or 5-ft. 6-in. bed, 29 in.; hole in spindle, 1⅛ in.; front bearing, 2⅝ x 4 in.; rear bearing, 2⅛ x 3 in.; centers, No. 3 Morse; cone diameters, 4 to 9 in.; width of face, 2 in.; ratio back gears, 8 to 1; nose spindle, diameter 2⅜ in.; number of threads, 6; size of tool, ½ x 1 in.; diameter of tailstock spindle, 1⅝ in.; travel of tailstock spindle, 5 in.; cut threads, 1½ to 80; capacity of center rest, 5 in.; countershaft pulleys, 10 x 3¾ in.; countershaft speeds, 200 and 300 r.p.m.; floor space, 28 in. x 6 ft.; net weight, 1350 lb.; gross weight, boxed for export, 1800 lb.; size of box for export, 30 x 36 x 82

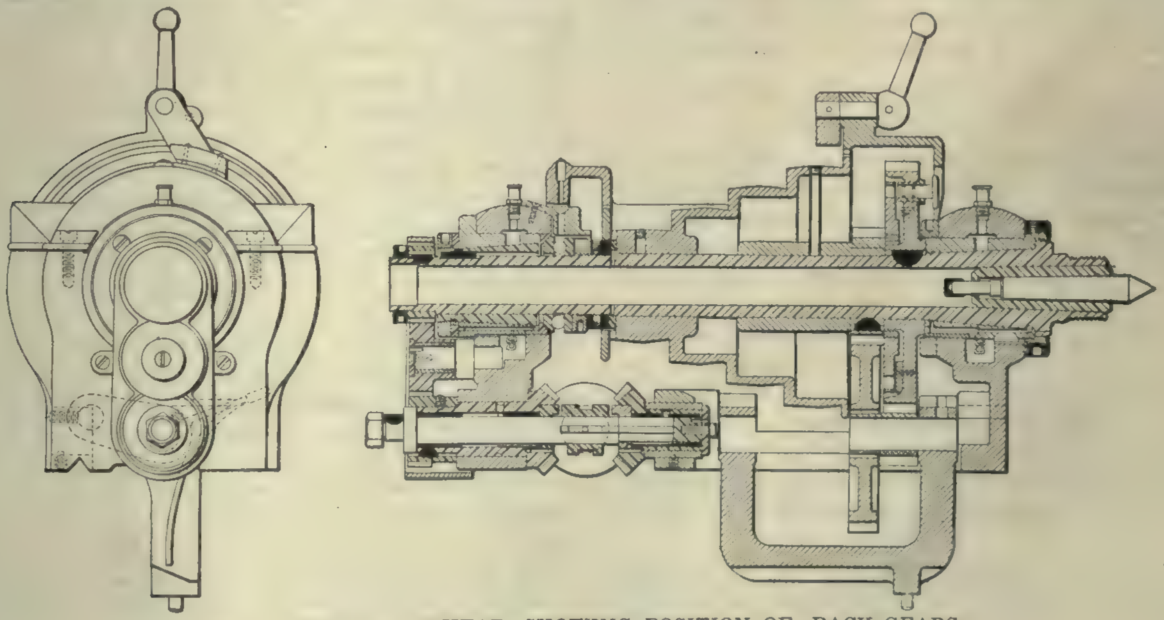
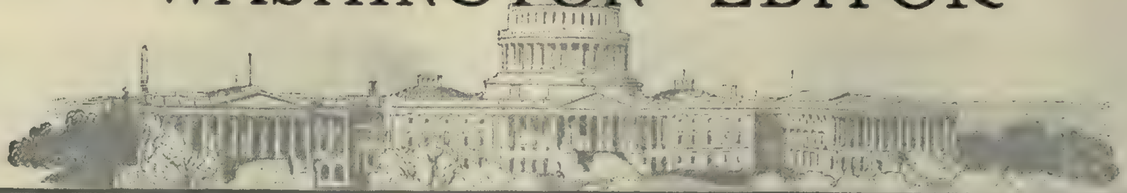


FIG. 2. DETAILS OF HEAD, SHOWING POSITION OF BACK GEARS

LATEST ADVICES FROM OUR WASHINGTON EDITOR



One of the most interesting and gratifying features of this whole matter of war preparation is the widespread desire to be of service, to do one's part, displayed by men from all parts of the country. And one of the difficulties is to make us all realize that we may be doing our part in the best possible manner by keeping on with our regular work instead of turning the shop over to the making of munitions. It is very probable that if every shop in the country could be making some part of a shell or fuse, some bolt or nut or screw which belonged to some sort of munition work, they would feel more as if they were really helping. Yet this would not be a real help in many cases, as it would involve transportation over railroads already crowded and might easily delay more than it would help.

The small shops of the country can, however, be of great assistance, either directly or indirectly, by seeing to it that they are doing their particular job in the best possible manner for the good of the country as a whole; that they are not wasting material or breaking tools unnecessarily; that they are conserving the supply of taps, drills, etc., so as not to call on the general market for more, which may be needed directly on munition work. Furthermore, every man they train to do good work—and this applies equally well to the large shop—is an asset to the country, not only for the present crisis, but for the stern commercial struggles that are sure to come after the war. We must not forget that every large nation involved in this war is a commercial and a manufacturing nation, and they have all learned great lessons in efficiency and particularly in coöperation.

Buttons for Ineligibles

Suggestions have been made, and it might almost be said that plans are under way, for the use of buttons or badges for those who are doing Government work or who, though eligible for military service, are exempted because of the fact that they can serve best in some other capacity. This plan has been in use in England since the early days of the war and seems to have much to commend it, for it is hardly fair to the men who are serving with all that is in them, to be passed by as slackers just because they are not wearing a uniform. A simple but distinctive button, preferably of metal, something on the order of the little Grand Army button, but of a special shape and design, ought to be helpful in many ways.

It is also gratifying to be able to state that reports show the work on the 110-ft. submarine chasers to be well ahead of the contracted schedule.

There seems to be some misunderstanding as to the status of the eight-hour law, owing to the Executive Order under date of May 17, which suspended this law with respect to defense work. This does not mean the beginning of a breaking down of the labor legislation regulating the maximum hours of labor, the order simply making it possible for the law to be suspended whenever in the judgment of the Secretary of War it becomes necessary to do so for the building of defense fortifications or similar work. Both the President and Mr. Baker are strong advocates of the eight-hour day, and as the Government departments, with the exception of those engaged in issuing the Liberty Loan bonds, began their Saturday half holidays as usual, there need be no fear of any backward step in this direction. As has been repeatedly pointed out, this question of hours has been carefully considered, both from experience in this country and abroad, and the new order is simply a war measure for the purpose of maintaining efficiency, and is in no sense a lack of appreciation of our needs at this time. It is needless to say that all the department heads understand and appreciate the seriousness of the present crisis much more than those who are not in possession of all the facts.

Reclaiming Steel and Other Metals in France

There is considerable speculation as to the amount of steel and other metals that has been shot into the ground in the northwestern portion of France, where the struggle has been going on for two years. The amount is pure guesswork without more accurate data than seem to be available at present, although it is easily conceivable that the French and English could give a fair estimate. At any rate, it must run into the thousands of tons, and there will undoubtedly be some means found for reclaiming at least a portion of it.

One of the dangers to be guarded against after the war is the explosion of shells that have not gone off, but which lie buried in the soil, as ready to maim and kill the innocent farmer who strikes them with his plow as they were to crush the enemy when they were fired. One suggestion is to locate the shells by means of a sensitive magnetic needle, which can readily be done, and then secure them by hydraulic mining methods. A powerful stream of water will wash away the earth and allow the shells to be recovered without danger of accidental explosion. This might be considered a trifle expensive, but men are going to be one of the greatest assets in all the warring countries and no expense should be spared to make the occupation of raising foodstuffs as safe as possible.

Exploded shells are in such small pieces as to make it difficult to locate them, and it may be necessary to resort to the placer mining methods or to run the dirt over a magnetic separator as in the old brass foundry. This would not pick out the brass and aluminum, both more valuable than steel and iron, but as the percentages of these metals are small in comparison with the steel lying around loose, these may have to be overlooked.

Another method that has been suggested is to plough and harrow the fields after the unexploded shells have been removed and then go over them with a huge electromagnet. This would undoubtedly extract a large amount of metal and might be made to pay for the work done. The removal of unexploded shells is an absolutely necessary piece of work, however, and will doubtless receive considerable thought. It is quite certain that the French will devise some method of recovering the steel and other metals, and that this will, in a way, compensate her for the vast amounts of ores that have been removed by the Germans from the mines in northern France.

Airplane Motors

The problem of radiation, for cooling the jacket water, is much more important in the airplane than in the automobile, because there is more heat to be disposed of and it is necessary to keep down the weight of water carried to the lowest possible limit. The high compression used to get more power out of the same sized cylinder adds to the difficulty of cooling. The radiator and its design is one of the many problems that are being worked out by the Bureau of Standards, which is conducting some extensive tests on radiators so as to secure the greatest efficiency and thereby insure perfect cooling with a minimum weight. This means a more reliable and more efficient motor, which in turn means a power plant of lighter weight.

There was some criticism of these tests brought out at the Cincinnati meeting of the American Society of Mechanical Engineers, the charge being made that all previous tests were abandoned and new tests made instead of utilizing the experience of the past few years. Traced to its source, this charge seems to have little foundation, as all known data have been carefully considered. In some cases the formulas that have been used by some radiator builders do not seem to have a solid foundation in either theory or practice, and these have been discarded and new laws, or perhaps it would be better to say new interpretation of existing laws or practices, are being worked out, with very good results. Using these as a basis, it is expected to have new types of radiators very shortly which will be more efficient in every way and add to the work obtained from the new motors that have already been mentioned. It must not be forgotten that the question of radiation applies almost as much to the lubricating oil as it does to the cooling water, the oil heating to an alarming degree in some cases and seriously affecting the lubrication of the motor.

Airplane preparedness does not end with the motor, as more accessories are needed for an airplane than for an automobile. The aviator must depend greatly on his ability to navigate the air. There are compasses; drift indicators to allow him to compensate for drifting due to side winds; cameras for observation purposes; bomb droppers; inclinometers to show the climbing angle; stallomometers to prevent the machine being pointed up too sharply, so as to stall, lose headway and control at the same time; servomotors for performing the actual work of operating the ailerons, rudders or planes in large machines and tabilizers, which use the gyroscope or other devices as the automatic pilot or brain for controlling the operation of these servomotors. Then there are searchlights, landing gears of various types that may or may not be made by the builder of the planes, pneumatic tires, wireless sets, etc.

The Great Problem of Propellers

I have purposely omitted propellers, as for the most part this is a wood-working job, but one that can be done in any good pattern shop when a man understands the requirements. Unfortunately, there has been little standardization in propeller shapes, each designer having his own peculiar curve and contour, just as in the case of the propeller for a ship or a speed boat. Hubs have been standardized to some extent, but even this is not final. With the aid of French and English experience along this line we will probably adopt the standard which they recommend, and whether we like it or not, it is pretty sure to be in metric measurements, because both the French and English employ this method exclusively on airplane work.

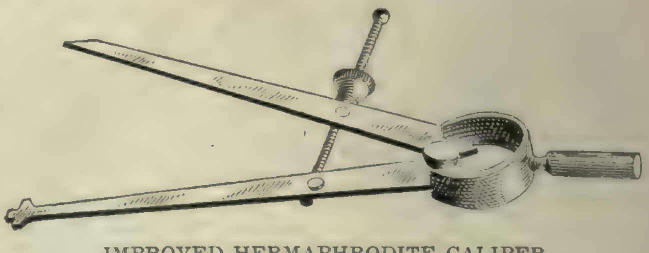
Standard propeller shapes are sure to be developed for each type of machine, and when that comes we shall see propellers worked out by machine instead of by hand, unless the pulp, veneer or stamped-metal propeller makes its appearance and proves successful. In the meantime, however, thousands of propellers will have to be made by hand, in shops of all sizes, the main requirements being that the proper wood be obtained, that the right templets be secured and followed and, above all, that the work be done in the best possible manner so far as the gluing of the various pieces and fastenings is concerned. This is about as near a "pon honor" job as we know of, for a poor joint which loosens in the air nearly always means death to the aviator and destruction to a valuable machine.

Fred H. Colvin.

Improved Hermaphrodite Caliper

By George Wood

The illustration shows an improved hermaphrodite the design of which is somewhat out of the ordinary. The tool itself is made from a common pair of dividers, one leg of which is flattened and fashioned after the shape shown, so that it can be used for locating from inside or outside edges.



IMPROVED HERMAPHRODITE CALIPER

New Publications

Oxyacetylene Welding Practice—By Robert J. Kehl, M. E. One hundred and two 5 x 8-in. pages; 111 illustrations; buckram binding. Published by the American Technical Society, Chicago.

This book is an attempt to place before the mechanical public an authoritative volume on the subject of oxyacetylene welding and cutting. The work is divided into four principal sections, the first dealing with welding processes, the second with the technique of oxyacetylene welding, the third with miscellaneous oxyacetylene processes, such as cutting, lead burning and carbon removal, and the fourth with examples of automobile repair. These examples have been taken from the automobile industry, because in that field almost every phase or class of welding is covered, and while the instructions and data deal with automobile welding in particular, the repairman and manufacturer will find no difficulty in applying this information to their own particular needs.

Wire and Sheet Gage Tables and Metal Calculator—Compiled by Thomas Stobbs. Ninety-five 5 x 7-in. pages; cloth bound. Published by Spon & Chamberlain, 123 Liberty St., New York.

This little book is a compilation of 57 tables. The title is perhaps unfortunately chosen, since it would tend to the belief that the book was written around the particular subject of wire and sheet metal. As a matter of fact it is a metal calculator and ready reckoner, containing English, metric, and foreign wire and sheet gage tables with net and gross devices for finding net and working weights, allowances for mill scrap, and weights of all sections of precious and common metals. It also contains a number of tables devoted to English and metric weight and measure equivalents. One of these tables included in this book is a conversion between Russian units and pounds avoirdupois and kilos. Another is the equivalent of the French, Austrian, Russian and Reinish "lines" with millimeters. An item of considerable interest and rather new is the inclusion of weight figures for high-speed steel.

Organization in Accident Prevention—By Sidney Whitmore Ashe, B. S., E. E. One hundred and twenty-seven 6 x 9-in. pages; numerous illustrations; cloth binding. Published by the McGraw-Hill Book Co., 239 West 39th St., New York City. Price $1.50.

This book is one of the most creditable pieces of safety-engineering literature that has been produced during the last few years. It attacks the problem from a very practical point of view and avoids the dogmatic theorism which has made the field of safety engineering somewhat open to attack as the camping place of numerous emotional generalities.

Mr. Ashe in this book tells not only how to prevent accidents, but also how to take care of them after they have happened, which is perhaps equally important and certainly a more neglected field from the viewpoint of available literature. The sections on Specific Accidents and the Examination of Employees are particularly valuable. Those on Emergencies and First Aid Hospitals also deserve commendation for the treatment that Mr. Ashe has given them. Altogether, this book may be said to be an indispensable tool for every factory manager and employer of labor.

Storage Batteries Simplified—By Victor W. Pagé. Two hundred and eight 5 x 7½-in. pages; 89 illustrations; cloth bound. Published by the Norman W. Henley Publishing Co., New York City. Price $1.50.

In the past few years developments in the storage battery field have been very rapid. The uses for storage batteries have multiplied to an extent that makes it essential to spread a practical working knowledge of the operating principles and care of the various types that are now available.

This book is divided into six chapters, the first taking up the principles of storage-battery action, the second treating of the construction of various storage batteries in commercial use, the third dealing with storage-battery defects, the fourth with charging methods and the fifth with the uses of storage batteries. The sixth chapter is a glossary of storage-battery terms.

A review of the heading of Chapter 5, the Uses of Storage Batteries, indicates the extremely wide field of service for this kind of equipment. Perhaps one of the most spectacular uses is that applied to submarine boats for underwater propulsion. Two insert charts included with this book show the arrangement of batteries on a submarine.

Wiring for Light and Power—By Terrell Croft. Four hundred and twenty-six 4⅞ x 7½-in. pages; 392 illustrations; bound in flexible leather. Published by McGraw-Hill Book Co., 239 West 39th St., New York City. Price $2.

This book is a compendium of approved methods of installing electric wiring and apparatus. These methods have been gained accumulatively by hundreds of workers during many years of practice.

The idea back of this book has been to elaborate the "National Electrical Code," which is a concise and unelaborated statement of wiring requirements, into a handbook sufficiently illustrated and containing enough detail to make the application of this code an easy matter.

This book is divided into six broad divisions, the first covering generators, motors and switchboards; the second, outside work of all systems and voltages; the third, inside work; the fourth, fittings, materials and details of construction; the fifth, miscellaneous, and the sixth, marine work.

This book is well arranged and cleverly illustrated and indexed. It should prove of value not only to electricians and others who have to do with electrical wiring, but also to consulting engineers and factory managers who find it necessary to keep posted on these important matters.

The Founder's Manual—By David W. Payne. Six hundred and seventy-six 5 x 8-in. pages; 245 illustrations; flexible leather binding. Published by the Van Nostrand Co., 25 Park Place, New York. Price $4.

This book is the result of an effort to make information available for the foundryman in the same way that it has been made available for the mechanical, civil and electrical engineer, in handbook form.

While there has been a great deal of information published on every phase of foundry management and operation, this book, perhaps, is the first attempt to centralize this information in convenient usable form. The chapters specifically relating to foundry practice are given the following headings: Alloys, Iron, Chemical Constituents of Cast Iron; Mixing Iron, Steel Scraps in Mixtures of Cast Iron, Test Bars; Chemical Analyses; Standard Specifications for Cast-Iron Car Wheels; Standard Specifications for Locomotive Cylinders; Standard Specifications for Cast-Iron Pipe; Mechanical Analyses; Malleable Cast Iron; Steel Castings in the Foundry; Foundry Tools; The Cupola; Molding Sand; The Coreroom and Appurtenances; The Molding Room; Molding Machines; Continuous Melting, Determination of Weights of Castings; Foundry Accounts. In addition to these topics, which are very creditably handled, a large amount of irrelevant material has been introduced in the way of standard mathematical tables. It is to be regretted that in an otherwise very excellent handbook and one of considerable promise the temptation should not have been resisted to introduce these standard mathematical tables, which are found in almost every technical handbook published.

Practical Marine Engineering—By Capt. D. W. Dyson, U. S. N. Nine hundred and ninety-two 6 x 9-in. pages; 5[illegible] illustrations; cloth binding. Published by Aldrich Publishing Co., 8th Ave. and 34th St., New York City. Price $6.

This is the fourth edition, revised and enlarged, of the book originally brought out in 1901 by Prof. W. F. Durand. This latest edition has been thoroughly revised and entirely rewritten by Capt. D. W. Dyson, of the Bureau of Steam Engineering, United States Navy Department. In the new edition those parts of the original book dealing with the fundamental principles of marine machinery have been retained, but the order of treatment has been changed so that the various parts of the book have been brought together to form one connected volume of fifteen chapters. Considerable new material has been added to bring the book up to date. The new matter deals principally with such subjects as steam turbines, improved water-tube boilers, fuel-oil burning superheated steam, oil engines and a great number of auxiliaries that have recently been perfected and are generally adopted in modern marine practice. The treatment of the subject throughout has been with a view to simplicity, and only such parts of the general field of engineering have been included as are of special interest to the practical marine engineer. No attempt has been made to treat of the designing of machinery except in an incidental way, but the topics of construction, operation, management and care, which are of paramount importance to the practical engineer, have been covered thoroughly.

In the chapter on operation, management and repair, which is of special interest to the practical marine engineer, much new valuable information is given regarding the operation of turbine-propelled vessels.

This book contains a collection of miscellaneous problems and discussions, many of which will be of value to the professional engineer in connection with the various questions likely to arise in his experience. At the end of each chapter are questions, with the page reference to the part of the book where the answer to each question may be found. A book of this sort should be extremely useful to an applicant for a marine engineer's license, as the subject matter on which such examinations are based is thoroughly covered in language that can be easily understood.

Forthcoming Meetings

The twelfth annual exhibit of foundry and machine-shop equipment and supplies will be held under the auspices of the American Foundrymen's Association in the Mechanics Building, Boston, Mass., from Sept. 25 to 28, 1917. The officers of the exhibit committee are: President, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; vice president, Benjamin D. Fuller, Westinghouse Electric and Manufacturing Co., Cleveland, Ohio; secretary and treasurer, A. O. Backert, 12th and Chestnut Sts., Cleveland, Ohio; manager of the department of exhibits, C. E. Hoyt, 123 West Madison St., Chicago, Illinois.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

The American and Canadian engineers and architects of Norwegian birth and descent will hold an informal congress and reunion at the Chicago Norske Klub, Logan Square, Chicago, Ill., Sept. 27 to 29, 1917.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary. Pier 45 North Philadelphia, Penn.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

LATHE, THREADING

Automatic Machine Co., Bridgeport, Conn.

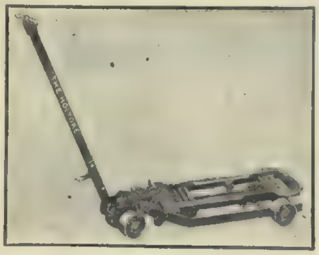
"American Machinist," July 19, 1917

Swing over shears, 15 in.; swing over carriage, $6\frac{1}{4}$ in.; diameter of spindle cones, 9 and 12 in.; hole through spindle, $1\frac{3}{8}$ in.; front spindle bearing, tapered, $2\frac{7}{8}$ to 3 in. by $4\frac{7}{16}$ in.; rear spindle bearing, $2\frac{1}{8}$ x $3\frac{1}{2}$ in.; diameter of tailstock spindle, 2 in.; spindle centers, No. 4 Morse taper; spindle nose threaded $2\frac{3}{4}$ x 6

TRUCKS, TRANSFER

The Holyoke Truck Co., Holyoke, Mass.

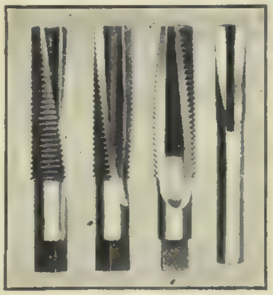
"American Machinist," July 26, 1917



This shows one of a line of trucks made of metal throughout and without springs or other complicated parts to get out of order. They are made in either the three- or four-wheel styles. The operation of raising or lowering the platform is performed entirely by the handle, a downward pressure, after a small hook is engaged, serving to either raise or lower it. The front wheels may be turned at right angles, allowing the truck to be swung around in its own length. Four sizes are made, the larger of these being designed for loads up to 4000 pounds.

TAPS AND REAMERS

Carl Schoenert & Sons, Inc., 631-633 South 20th St., Newark, N. J.



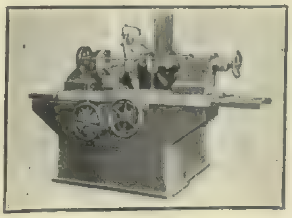
"American Machinist," July 26, 1917

It is claimed that the reamers will cut a smoother and truer hole than a fluted reamer, owing to the fact that they are guided by the entire length of the body, and that chatter is impossible. They may also be sharpened on an ordinary grinding wheel. The taps are made on the same principle and have a large chip clearance. The construction also lends itself readily to good lubrication.

GRINDER, CYLINDRICAL

18 x 50-IN.

McDonough Manufacturing Co., Eau Claire, Wis.

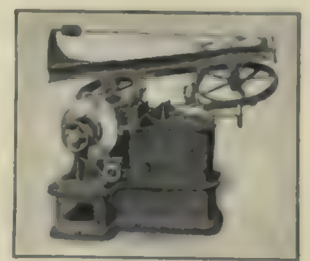


"American Machinist," July 26, 1917

Diameter of tail spindle, $2\frac{1}{2}$ in.; diameter of centers, $1\frac{1}{8}$ in.; diameter of wheel, 20 in.; face of wheel, $1\frac{1}{2}$ to 2 in.; bore of wheel, 5 in.: spindle bearings, $3\frac{1}{2}$ x 6 in.; spindle speed, 1000 r.p.m.; distance floor to spindle, 42 in.; horsepower required, 10; weight, 8000 lb.; floor space, 6 x 10 feet.

SAW, BAND

The Napier Saw Works, Inc., Springfield, Mass.



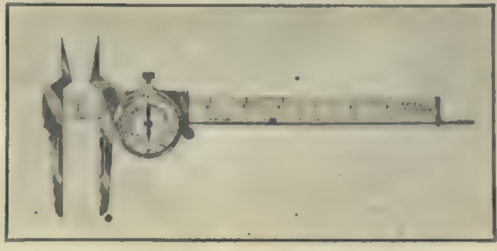
"American Machinist," July 26, 1916

Three sizes, with capacities of 6 x 6, 8 x 8 and 10 x 10 in. Illustration shows largest size.

Capacity, 10 x 10 in.; length of saw, 12 ft. 3 in.; width of saw, 1 in.; thickness of saw, 0.035 in.; speeds, 2; diameter of saw wheels, 24 in.; weight, 1750 lb.; floor space, $43\frac{1}{2}$ x 43 inches.

CALIPER, DIRECT-READING

Fred Todt, 17 Jenks St., Springfield, Mass



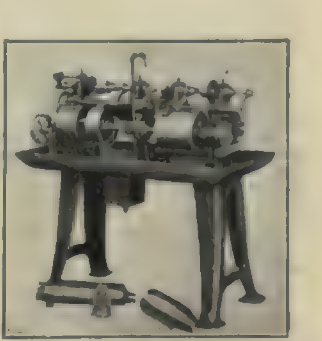
"American Machinist," July 26, 1917

Mounted on the slide is a double graduated dial on which are two pointers, spaced 180 deg. apart. The outer scale has 500 divisions; the inner 32. A $\frac{1}{2}$-in. movement of the slide along the bar causes a complete revolution of the pointers, making the instrument read by thousandths or by sixty-fourths of an inch.

PIN MACHINE, AUTOMATIC

Detroit Tool Co., 1487 St. Antoine St., Detroit, Mich.

"American Machinist," July 26, 1917



Used for cutting-off and turning operations on pins up to $\frac{3}{4}$ in. in diameter. The pieces machined are finished on both ends, making an auxiliary burring operation unnecessary. The machines are also adapted for making any small turned pieces of brass or steel which do not have to be threaded or drilled.

TRUCK, ELECTRIC, WITH DUMPING BODY

Orenstein-Arthur Koppel Co., Koppel, Penn.

"American Machinist," July 26, 1917

The body is of the self-clearing cradle-dump type, with a dumping angle of 40 deg., operation being accomplished from the platform. The truck proper has a steel channel frame and a metal-edged oak platform made in two parts and hinged. Wheels are of cast steel, 20 in. in diameter, with 3-in. solid rubber tires. The wheelbase is 52 in. and the tread gage 34 in. The capacity is 3000 lb., which can be transported at a maximum speed of 7 miles per hour.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Qutations were current as follows at the points and dates indicated:

	July 27, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$47.00	$40.00	$14.50
No. 2X Northern Foundry, Buffalo.....	53.00	47.00	19.75
No. 2 Northern Foundry, Chicago......	55.00	50.00	19.00
Bessemer, Pittsburgh	55.95	55.95	21.95
Basic, Pittsburgh	53.95	50.00	18.95
No. 2X, Philadelphia................	53.00	46.75	19.75
No. 2, Valley.......................	53.00	50.00	19.25
No. 2, Southern Cincinnati...........	49.90	42.90	16.90
Basic, Eastern Pennsylvania..........	50.00	42.50	19.00

STEEL SHAPES—The following base prices in cents per pound are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	July 27, 1917	One Month Ago	One Year Ago	July 27, 1917	One Year Ago	July 27, 1917	One Year Ago
Structural shapes ...	5.25	5.00	3.25	4.50	3.25	5.00	3.10
Soft steel bars......	5.00	4.75	3.30	5.00	3.25	4.50	3.10
Soft steel bar shapes.	5.00	4.75	3.25	4.50	3.25	4.50	3.10
Plates, ¼ to 1 in. thick	9.00	8.00	4.00	8.00	3.65	8.00	3.50

BAR IRON—Prices in cents per pound at the places named are as follows:

	July 27, 1917	One Year Ago
Pittsburgh, mill	4.50	2.50
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		July 27, 1917	One Month Ago	One Year Ago	July 27, 1917	One Year Ago	July 27, 1917	One Year Ago
*No. 28 black.......	8.75	10.50	9.50	3.65	9.00	3.20	9.50	3.20
*No. 26 black.......	8.65	10.40	9.40	3.55	8.90	3.10	9.40	3.10
*Nos. 22 and 24 black	8.60	10.35	9.35	3.50	8.85	3.05	9.35	3.05
Nos. 18 and 20 black	8.55	10.30	9.40	3.45	8.80	3.00	9.30	3.00
No. 16 blue annealed.	9.10	10.20	9.20	4.45	9.20	3.70	9.70	3.60
No. 14 blue annealed.	8.85	10.10	9.10	4.35	9.10	3.60	9.60	3.50
No. 12 blue annealed.	8.65	10.05	9.05	4.30	9.05	3.55	9.55	3.45
No. 10 blue annealed.	8.25	10.00	9.05	4.25	9.00	3.50	9.50	3.40
*No. 28 galvanized..	10.75	13.00	12.00	5.40	10.75	5.20	11.00	5.10
*No. 26 galvanized..	10.45	12.70	11.70	5.10	10.45	4.90	10.70	4.80
*No. 24 galvanized..	10.30	12.55	11.55	4.95	10.30	4.75	10.55	4.65

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring fair-sized lots, the following quotations hold:

	July 27, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	40%	45%
Cleveland	40%	45%
Chicago	45%	50%

SWEDISH (NORWAY) IRON—This material per 100 lb. sells as follows:

	July 27, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	13.30	6.30
Chicago	12.00	5.25

In coils an advance of 50c. usually is charged.
Note—Stock scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire*	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16 ..	
No. 18	
No. 20	

*Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York July 27, 1917	Cleveland July 27, 1917	Chicago July 27, 1917
Tire	5.00	5.00	4.50
Toe calk	5.00	5.50	4.75
Openhearth spring steel...	7.00	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Ordinary carbon tool steel, base price	14.00	13.00	15.00
Special base cast steel....	18.00	20.00	....

*In bars.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of July 2, 1917, for steel pipe, of Apr. 1 for iron pipe:

BUTT WELD					
	Steel			Iron	
Inches	Black	Galvanized	Inches	Black	Galvanized
⅛, ¼ and ⅜..	30%	3½%	¾ to 1½.....	33%	17%
½	36%	21½%			
LAP WELD					
2	35%	22½%	2	26%	12%
2½ to 6......	35%	22½%	2½ to 6......	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	26%	20½%	¾ to 1½.....	33%	18%
½	33%	30⅛%			
¾ to 1½.....	40%	34½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4......	43%	31½%	2¼ to 4.......	29%	17%
4½ to 6......	42%	30½%	4½ to 6.......	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	29%	15%	38.8%	24.8%
3½ to 6 in. steel lap welded	28%	10%	36%	21%	42.8%	27.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 27 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound:

	July 27, 1917	One Month Ago	One Year Ago
Copper, electrolytic (carload lots).....	24.00	31.00	27.00
Tin	62.50	61.00	38.75
Lead	10.50	12.00	6.50
Spelter	8.50	9.25	9.00

*Third-quarter copper; for spot copper the market price is 29c.

ST. LOUIS			
Lead	10.75	12.00	6.37½
Spelter	8.25	9.25	8.50

At the places named, the following prices in cents per pound prevail:

	New York			Cleveland		Chicago	
	July 27, 1917	One Month Ago	One Year Ago	July 27, 1917	One Year Ago	July 27, 1917	One Year Ago
Copper sheets, base	38.00–40.00	42.00	37.50	40.00	37.50	42.00	37.50
Copper wire (carload lots)	38.50	39.50	37.50	39.00	33.00	39.00	38.00
Brass pipe, base...	43.00–45.00	47.50	46.50	46.00	45.00	47.00	45.00
Brass sheets	40.00	45.00	44.50	38.00	42.00	43.00	38.00
Solder ½ and ½ (case lots)	39.25	45.00	24.12½	39.50	27.00	39.00	25.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	July 27, 1917	One Month Ago
Mill	$42.00	$42.00
New York	45.50	45.50
Cleveland	38.00	38.00
Chicago	42.50	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.................................. 19.00

	In Casks		Broken Lots	
	July 27, 1917	One Year Ago	July 27, 1917	One Year Ago
New York	21.00	21.50	21.50	22.00
Cleveland	23.00	22.75	23.25	23.25
Chicago	22.50	20.00	23.50	21.00

ANTIMONY—Chinese and Japanese brands in cents per pound for spot delivery, duty paid:

	July 27, 1917	One Year Ago
New York	15.00	14.00
Cleveland	19.00	19.00
Chicago	17.50	20.25

The Great Canadian Aviation Camp

By Fred H. Colvin

SYNOPSIS — *This is the first of a series of articles dealing with the training of military aviators. The necessary qualifications are given and the mechanical equipment and the manner in which the work is handled are described and illustrated. There is much more to the problem than has been understood generally, the main object being to turn out a large number of efficient fliers as rapidly as is consistent with thorough training.*

THE airdrome, or flying field, at Camp Hoare, which adjoins the infantry camp at Camp Borden, Ontario, Canada, is an excellent example of what can be done to develop a flying field quickly when necessity requires. This particular tract of about 840 acres is located in a country in which a sandy soil predominates and was covered with hundreds of trees and stumps when the first steps were taken to convert it into a flying field. The first engineers arrived early in February of this year, when there was 3 ft. of snow on the ground and the temperature was hovering around 20 deg. below zero.

The stumps were pulled out, the ground was leveled into comparative smoothness, and flying commenced in two months' time. This involved more than the clearing of the field, for hangars, machine shops, offices, commodious quarters for the students and officers, mess halls and cheerful reading and lounging rooms had to be erected. Relaxation is as necessary as strenuous application in the study and practice of the airman's art. Furthermore, grass has been coaxed into existence over nearly the entire field.

There are fifteen hangars, each accommodating six machines and containing one room for stores and another for clothing and fittings for the students assigned to that hangar. There are also offices for each squadron where all records are kept, as well as the general field office and various instruction rooms where the intricacies of the airplane engine, the machine gun, air photography, mapping, directing battery fire, wireless and the various activities with which the modern military aviator must be familiar are taught. Repair shops for engines and planes—for salvaging whatever may be usable from wrecks—a blacksmith shop, testing stands, and gasoline storage and garages go to make up the interesting whole.

Each of the fifteen hangars (one of which is shown in the heading illustration) is 120 x 66 ft. and is made with latticed wooden roof trusses that span the whole structure so as to leave the interior free for the accommodation of machines. The hangars cover a space of about three-quarters of a mile on one side of the flying field. Back of these, separated by a concrete road, are the shops, offices, garages, technical stores, instruction rooms, etc. The quarters for the officers, students and mechanics are perhaps one-half or three-quarters of a mile away, so as to make the relaxation as complete as possible. Furthermore, as far as possible, shop talk is tabooed from the table and lounging rooms.

EACH SQUADRON HAS 18 MACHINES

Each squadron consists of 18 machines, and consequently occupies three hangars. Each six machines is known as a "flight." There are five squadrons to this field, making 90 machines all told, of which about 60 per cent. are kept in commission at all times. Each squadron is composed of about 150 students, or cadets, who are graduated as they become proficient and are then ready to go overseas for additional training on the types of machines used on the battle front. These men leave in classes or groups of 25 or 30, at the discretion of the commanding officer, so that there are always new and old students at the field, affording new students the benefit of observing those who have had more experience.

The five squadrons at Camp Hoare require a total of about 720 men, 150 of whom are the mechanics employed in the repairs divisions. Each squadron has its trained group under a leader, who may be called a foreman with the title of corporal. The men in each group dismantle wrecked machines, take off and replace wings or other parts, get the machines to the repair shops or hangars and otherwise assist in keeping the machines of their squadron in flying condition.

The way in which these men handle damaged parts shows the training they have had as well as their adaptability in new lines of endeavor, for only a few of them were skilled in this work previous to their enlistment. A few are from English fields, while a still smaller number have seen service behind the fighting lines in France and so know exactly what the conditions are at the front. These men assist greatly in the training of new men and are doubtless largely responsible for the systematic manner in which the work is handled at the camp.

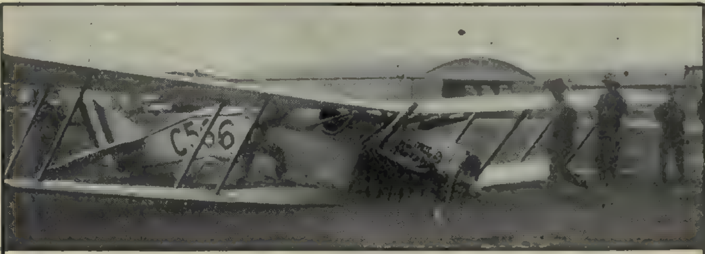


Fig. 1 Nose dug in, propeller and body broken

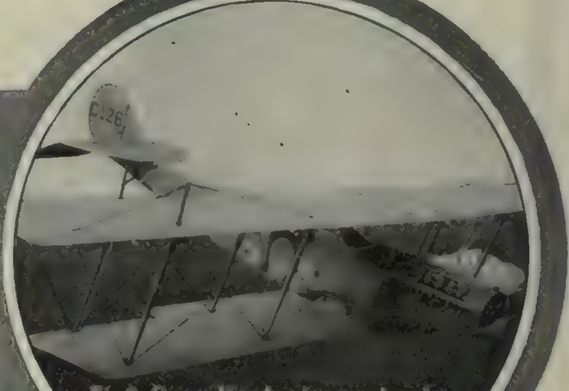


Fig. 2 Propeller broken, wheels pushed up through planes

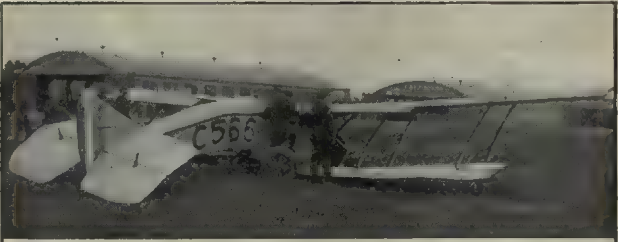


Fig. 3 Planes pushed forward & wheels forced back

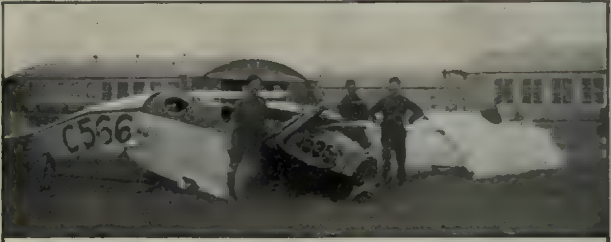


Fig. 4 The wings off, waiting for the truck

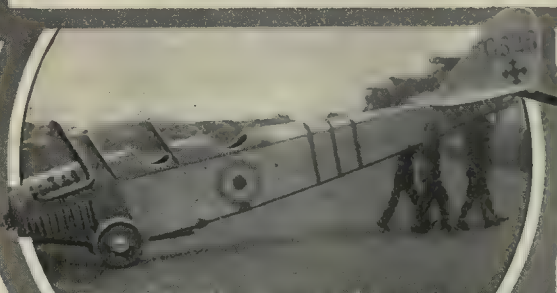


Fig. 5 Rolling a machine to hangar without wings

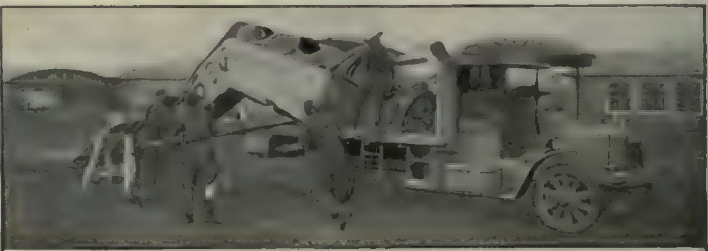


Fig. 6 Loading the broken fuselage on the truck

Some of the "Crashes"

Two typical training-camp "crashes" are shown in Figs. 1 and 2, and the way in which the wrecking crew gets to work reminds one of the men at the repair pits in a long distance automobile race. Every man knows his particular job and starts to work as soon as he reaches the machine. These crashes are nearly always the result of poor landings rather than of falls due to engine failure or losing control of the machine in the air. On this account the breakages are comparatively light, although considerable damage is done in any case, as can be seen from the illustrations. In making a bad landing the front end of the machine usually drops; the wheels strike the ground with enough force to crumple the struts that go from the axle to the fuselage or body, the wheels are forced back under the lower planes and damage them in some way or other, the propeller, or "prop," as it is called for short, digs into the ground and breaks off, and the whole thing looks much more badly damaged than is actually the case. Fig. 3 shows the wheels driven back under the planes.

As soon as a machine strikes the ground the crew starts after it with a repair kit, and in a few minutes the wings are off, as in Fig. 4, and the machine is on its way to the hangar, unless the damage is unusually serious. Generally the wheels do not crumple, so they can be used as a truck for rolling the machine across the field, as in Fig. 5. If the landing has had enough sidewise motion to crumple the wheels, but not enough to seriously damage the axle, new wheels can be put on for rolling the machine; but if this cannot be done, a truck that is attached to each squadron goes after the machine and carts it to the hangar.

The Motor Transport Needed

Each squadron has a transport unit of its own, housed in a garage behind its section of the hangars, consisting of one Packard motor truck of 3-ton capacity, two light tenders (Studebaker six-cylinder chassis with a side-seated body to carry eight or ten men), two Indian motorcycles and one side car. In case a machine has to make a forced landing outside the airdrome and suffers some damage doing so, the squadron commander is notified, and he dispatches the truck with such parts as may be needed to make repairs in the field together with a tender and enough men to do the work. In case the machine cannot be repaired, the men dismantle it, load it on the truck and carry it back to the hangar, repair shop or salvage shop, depending on its condition.

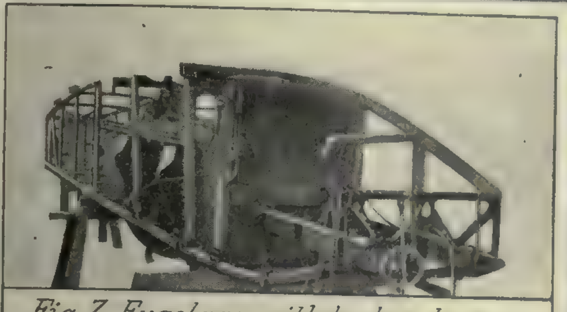


Fig. 7 Fuselage with broken longeron

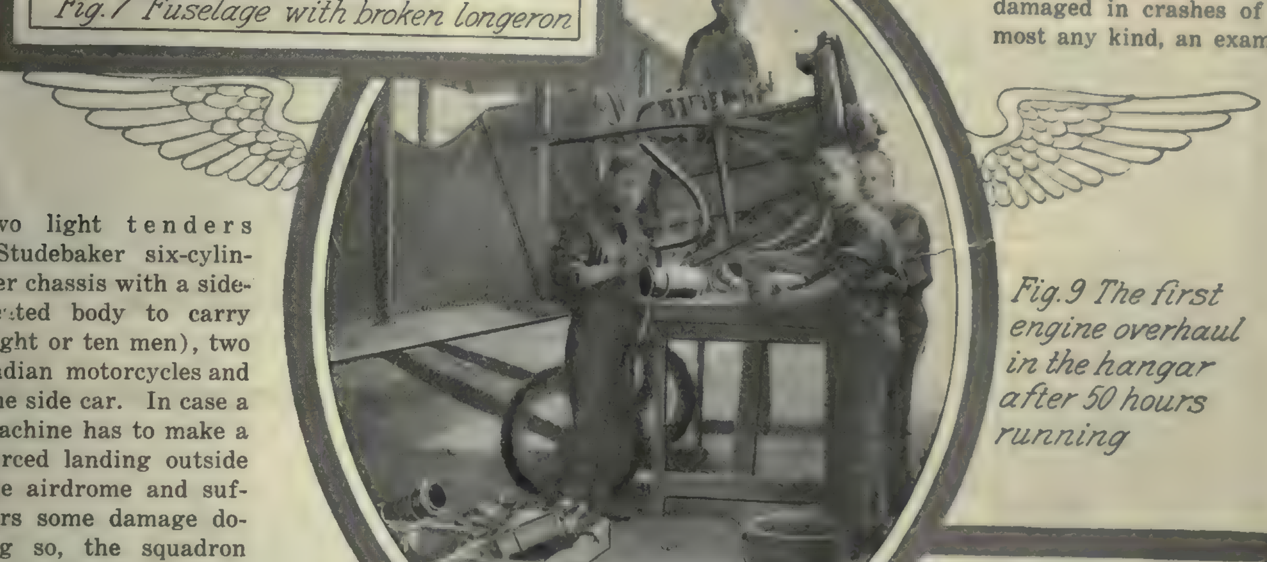


Fig. 9 The first engine overhaul in the hangar after 50 hours running

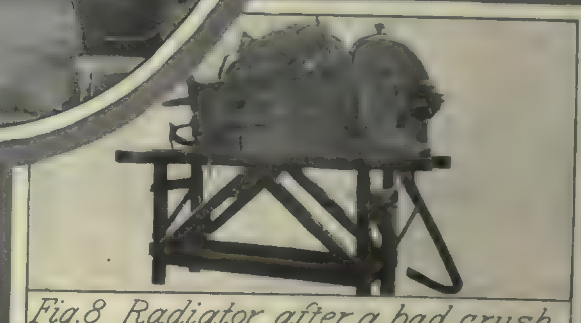


Fig. 8 Radiator after a bad crush

The training machines weigh about 2000 lb., much of this weight being at the front, so that when it becomes necessary to put the fuselage, or frame, on a truck considerable lifting has to be done. An instance of this is shown in Fig. 6, where the fuselage was broken in landing, as were also the lower planes and the propeller. After removing the wings, the truck was brought on the field and backed into position in front of the engine. Then, while the front was being lifted by the aid of scantlings laid under the engine, the truck was backed under carefully and the front of the fuselage loaded on the truck. The rear end, with its undamaged rudder, stabilizers and elevating planes, was kept off the ground, the remains being taken to the hangar for further dismantling. In this instance the fuselage was a total wreck, though the engine was not seriously damaged.

After the engine and such of the rear end as is seen to be undamaged are removed, the rest goes to the salvage shop for complete dismantling. The turnbuckles, the cables with their eyes and loops and all small parts which are usable or which have scrap value are saved and put into special bins. Planes that can be repaired go to the wing shop, and if only one longeron or main frame piece of the fuselage is broken, the frame can be repaired by putting in a new piece or part of a piece, as shown in Fig. 7.

If a main spar is broken in a wing, it is not considered advisable to attempt a repair, as when a wing has had sufficient shock to break a spar it is more than likely that all the other members have been stressed beyond the safety point. Radiators are liable to be damaged in crashes of almost any kind, an example of this being shown in Fig. 8, where the plane fell quite a distance. Fortunately there were no fatalities. For such repairs as can be made, a part of the blacksmith shop is fitted with sheet-metal shears, rolls and soldering apparatus, as well as an oxyacetylene welding and brazing outfit for such cutting and welding as may be necessary. There is also a tire vulcanizer, as the problem of keeping pneumatic tires and tubes in good condition is very serious at times. As with the automobile, nothing has yet been found, that equals an air cushion between the earth and the machine such as furnished by tires.

After 50 hours in the air (an accurate record is kept of every plane and every engine), the engine is examined without taking it out of the machine. Every cylinder is taken off, the pistons are scrutinized, the play in the piston and crankpin is noted, the carbon is scraped from the pistons and cylinders, the valves are ground, and the engine is put in good shape for further running. Fig. 9 shows this being done and also the manner in which the parts are kept separate in the box on the floor. After 100 to 150 hours, if nothing else has happened to make repairs necessary, the engine is removed from the machine, taken to the engine repair shop and thoroughly overhauled. This includes taking off connecting-rods to examine bearings, replacing with new metal if necessary (which is nearly always the case), examining for connecting-rod cracks, installing new piston rings should these be required and, in fact, putting the engine in practically as good condition as when new.

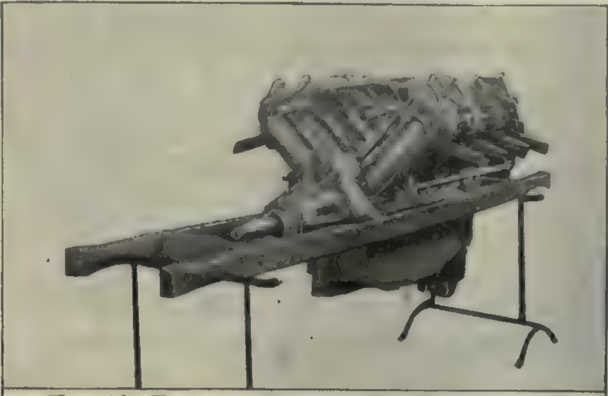


Fig. 10 Engine Stand for Overhaul

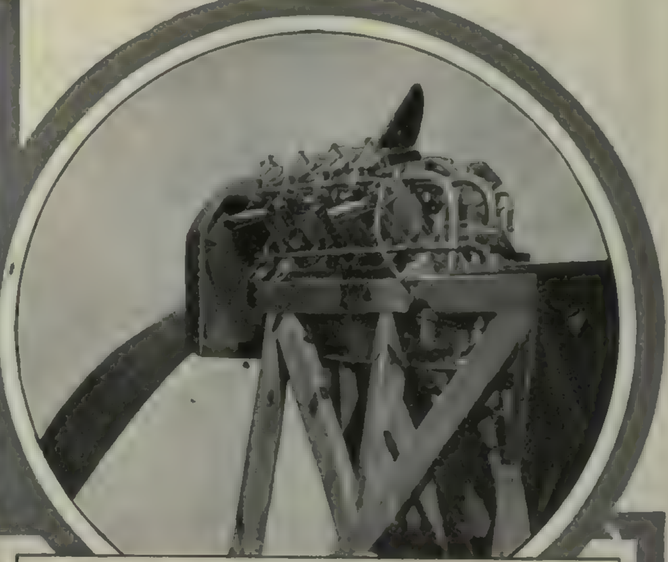


Fig. 12 Engine Testing Stand

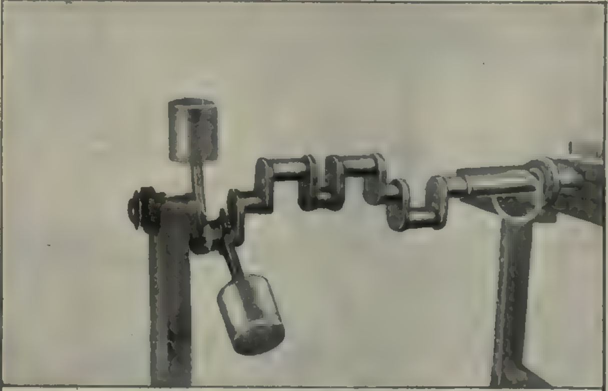


Fig. 11 Supporting Crank Shaft for fitting

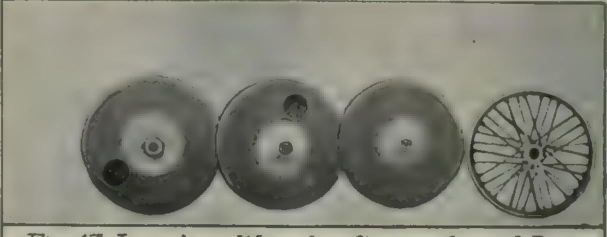


Fig. 13 Landing Wheels, Covered and Bare

For holding the engines, instead of the revolving stands such as are used in the factories where they are built, the engine base is bolted to two substantial wood strips, about 2 x 3, with the ends projecting sufficiently to hold them on frames at each end. These sticks have handles on the ends, thus making it easy to shift the engines from one position to another (see Fig. 10) for the convenience of the workman.

One of the dangers of a forced landing, with the attendant crash, is the bending of the engine crankshaft when the propeller strikes the ground or the engine itself noses into the earth too deeply. When this occurs the engine is sent to the main repair shops in Toronto, where there are facilities for straightening the shafts and putting them in shape again. Where the shaft is not bent and the repairs can be made at Camp Hoare, the rods are fitted with the crankshaft held as shown in Fig. 11. This is a simple clamping device placed on the bench, for holding the shaft from turning while the outer end is supported as shown. In this way it is much easier to fit the rods than if the shaft was on the bench, as the rods may be swung all the way around the shaft so as to feel the fit in all positions. It is one of the little shop devices that make for quicker and easier work.

Few Engine Failures

The motor shop has ten benches and a small machine equipment, this being ample to keep 90 machines in operation as far as the engine end is concerned. From the motor shop the reassembled engine goes to the testing stand, Fig. 12, behind the blacksmith shop, being rolled out on a pair of landing wheels connected by an axle and constituting a very simple truck for the purpose. The engine is run on the stand for a half hour and is then put back into service. It is gratifying to note that engine failures are few and far between, although constant care is necessary to maintain magnetos, spark plugs and similar parts at maximum efficiency so there will be no failure while in the air.

The landing wheels are of wire and weigh much less than might be supposed. They are covered with cloth to reduce wind resistance while in the air, this covering being put on in the shape of cloth disks that come over the edge of the rim. These disks, in addition to being cemented to the rim, are held by the bead of the clincher tires used. The wheels, before and after covering, are shown in Fig. 13.

To maintain the supply of wheels for a training camp is something of a problem, as the number of breakages, or such damage as puts a wheel or tire temporarily out of commission, varies within wide limits. In one month, for example, only 20 wheels were required to keep all the available machines of one squadron in commission for 800 flying hours. In the first seven days of the next month 24 wheels were used during 250 flying hours, an epidemic of bad landings being responsible for the difference. As about 60 per cent. of the machines are in commission on the average, this means only two wheels each a month in the first case and about ten wheels per machine for the next month.

KEEPING ACCURATE RECORDS

It is important in a training camp to maintain accurate and adequate records, and the way in which this is done at Camp Hoare is impressive in its thoroughness and completeness. Each squadron commander keeps an accurate record of the performance of each man and each machine in his charge. Every flight is recorded, from the time a man leaves the ground till he returns, and the data are credited both to the man and to the machine. Every hour the engine runs is recorded, both to insure its being oiled at the proper time and to prevent it from being run for more than 50 hours before undergoing the first examination. After 12 hours of running, the oil is emptied from the crankcase and new oil put in its place. This record is kept in each hangar for the machines that belong there, a board with small clock dials and suitable hands being used for this purpose.

The engine repair shop keeps it record of repairs and of the progress of these repairs on a board fitted with hooks and metal disks. There is a column for each step in the repair work and sufficient room to show all the engines that can be sent through the shop at one time. The disks are colored differently on the two sides, the light side indicating that nothing has been done or that the work is not completed, while the dark side appearing in any column shows that this portion of work has been completed. In this way the status of any engine in the shop can be readily known at a glance. From a survey of the board it can be seen what engines are behind for one reason or another, and men can be taken from one engine to hurry another along should this be deemed desirable for any reason.

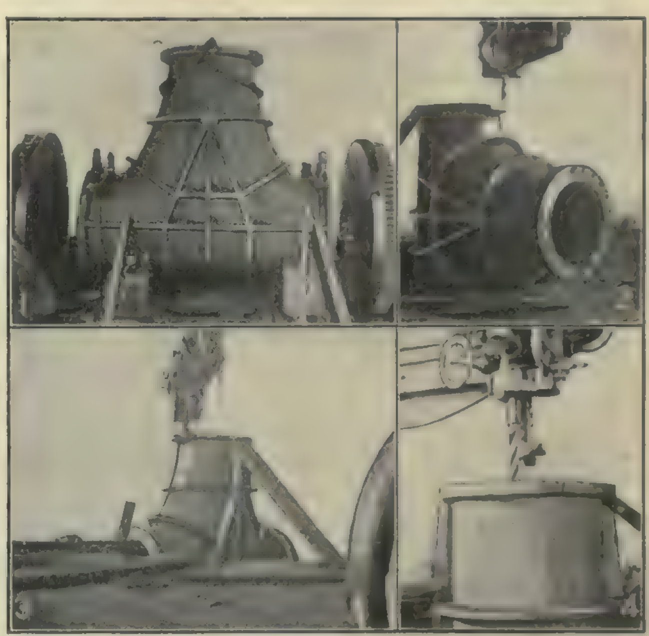
The various records are summarized in the office of the commanding officer, Major O. D. Filley, in such a way that he can tell almost at a glance the condition of the entire equipment. Covering one side of his office is a rack that reminds one of the system employed in many railroad shops to show the condition of the locomotives or rolling stock as well as its disposition along the many divisions of the road. Among other information the board shows the condition of every airplane in the camp, whether it is in flying condition or whether its idleness is caused by the engine or the plane not being ready. It shows the progress of each student and just what part of his course of instruction he is engaged in, and gives the commanding officer a general idea of the work of the entire camp.

Charts on the side walls give summaries of the total hours flown at the school each day, week and month, the work done by each squadron and each student, and such other information as helps in the planning of instruction and mechanical details. Records are also kept of each cadet's performance in wireless, in directing gun fire, in photographing prominent positions on the earth, in handling the machine gun in the air and all the other articles with which they must be familiar.

Large Facing and Drilling Job

BY H. G. McLEAN

Recently, in our shop, we had an order for some 24-in. cast-iron water pipe, including a tee weighing 4500 lb. As our shop is a small one, we were handicapped in handling the job by having no traveling crane or planer large enough. Also, the lathes were too small, with the exception of one for turning steel-tired wheels.



FIGS. 1 TO 4. WORK ON LARGE FLANGES

Fig. 1—Facing the ends in a wheel lathe. Fig. 2—Drilling the flange on the short end of the work. Fig. 3—Drilling the flange on the long end. Fig. 4—How the work was supported for drilling

I found I could use this by bolting the pipe down and putting a facing attachment on the faceplate, as shown in Fig. 1.

Here the advantage gained was that we could use the same setting for the two ends, by simply transferring the facing attachment to the other faceplate. Of course, to face the long end we had to reset the tee.

Figs. 2, 3 and 4 show the same pipe being drilled. To do the long end we found it necessary to enlarge the pit. Then we had to set the tee twice to drill all the twenty holes on the bolt circle.

High-Pressure Babbitting Fixture

By L. B. Hunter

I had experienced a great deal of trouble in babbitting automobile-engine and case bearings, details of which are shown in Fig. 1, on account of the metal being only 2 mm. thick and the bearings 102 mm. long by 40 mm. in diameter. The old method of mandrel ladle and burnt fingers was so unsatisfactory that I decided to develop a suitable fixture for doing this work. The result is that I am now able to do 60 per hour as against 20 by the old method.

We were pouring these bearings by hand on the bench and were getting one perfect bearing in about three trials. The bearings and mandrel were of course preheated and took an indefinite time to cool.

I made an experimental fixture by boring out a piece of cold-rolled stock about a foot long and mounted a small babbitt pot on top, drilling a hole through the bottom into the cylinder. A ram was fitted to the cylinder and the whole clamped to a cast-iron table and inclosed in firebrick. A blow-torch was put underneath and the metal melted. A bearing was clamped against the end of the cylinder and a cast made. The result was a perfect bearing with no waste of metal. I then designed and built the present fixture.

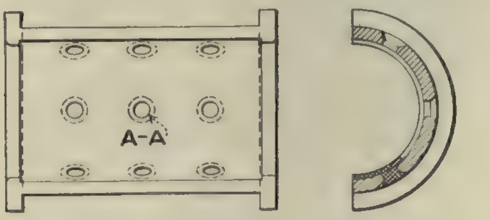


FIG. 1

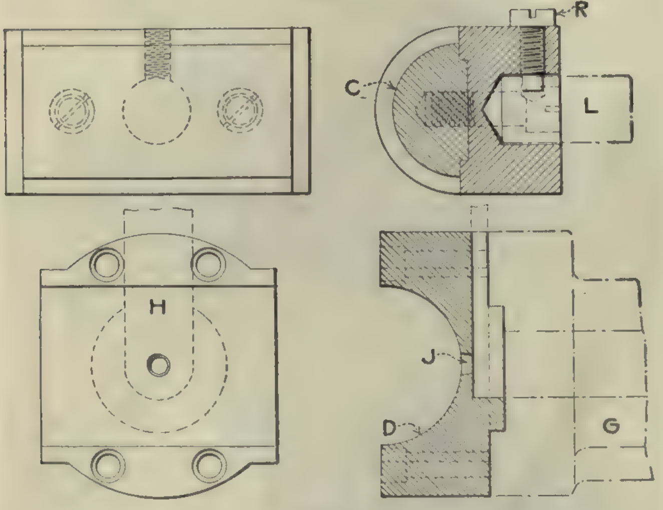


FIG. 2

FIGS. 1 AND 2. BABBITTED BEARING AND MANDREL

The half mandrel block *C*, Fig. 2, is made of machine steel, on which is mounted a tool-steel half mandrel flanged on the ends. This mandrel is held in place by two fillister-head screws, let in from the back of the mandrel block, which is carried on the stud *L* and held in place by a pilot screw *R*. The block *C* has a floating fit on the stud *L*, to insure perfect alignment with the bearing holder *D*. This block is made of tool steel and is recessed into the cast-iron cylinder *G* and held in place by four fillister-head screws. The gate cutoff knife *H* is made of high-speed steel and slides in a recess planed in the back of the bearing holder *D*.

The setscrews *O*, Fig. 3, lock the slide *Y* to the ram *N*, allowing the ram lever *E* to be set at its greatest point of fulcrum for the amount of metal used.

A bearing that is to be babbitted is first rough-turned, faced and bored; also the tie-holes are drilled and countersunk before being put into the fixture. When the bearing is in place in the fixture, Fig. 3, the babbitt is forced through the tuyere *J* into the hole marked *AA*, Fig. 1, in the bearing, this being the most central point of delivery. After babbitting, the bearing is put on a mandrel and the metal is peened in the countersunk holes to tighten the shell inside the bearing, after which the bearing is bored, reamed, turned, faced and milled on the center line.

The fixture is operated in the following manner: The toggle lever *A*, Fig. 3, is pushed back, causing the slide *B*, and the half mandrel block *C* to move away from the furnace. A half case bearing is placed on the half mandrel; the block *C* and the toggle lever *A* are pulled back to the closed position, locking the half case bearing against the holder *D*. The ram lever *E* is now pushed back far enough to allow the babbitt to flow down the hole *F* into the cylinder *G*. The cutoff knife *H* is raised by means of the lever *I*. The ram lever *E* is pulled toward the operator, forcing the babbitt into the half case bearing. The lever *I* is pushed down, cutting off the gate and preventing any more metal from flowing through the tuyere *J*. The lever *A* is pushed back to the open position, allowing the half case bearing to be removed before enough heat has been transmitted to prevent handling.

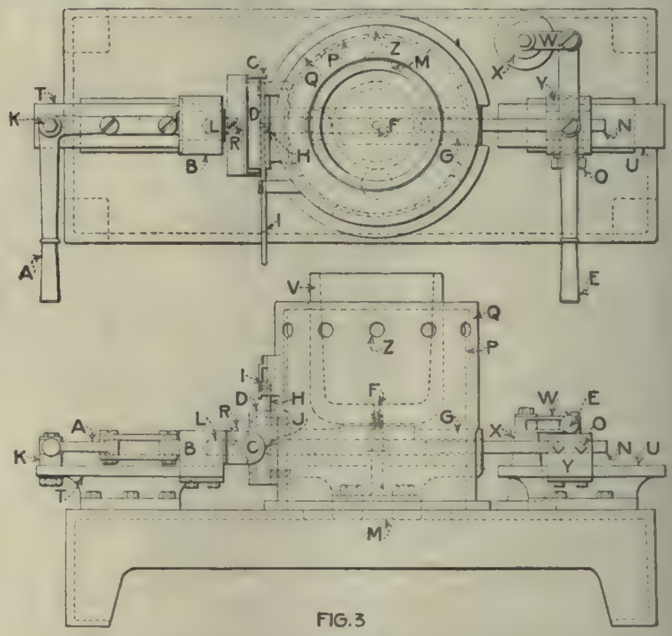
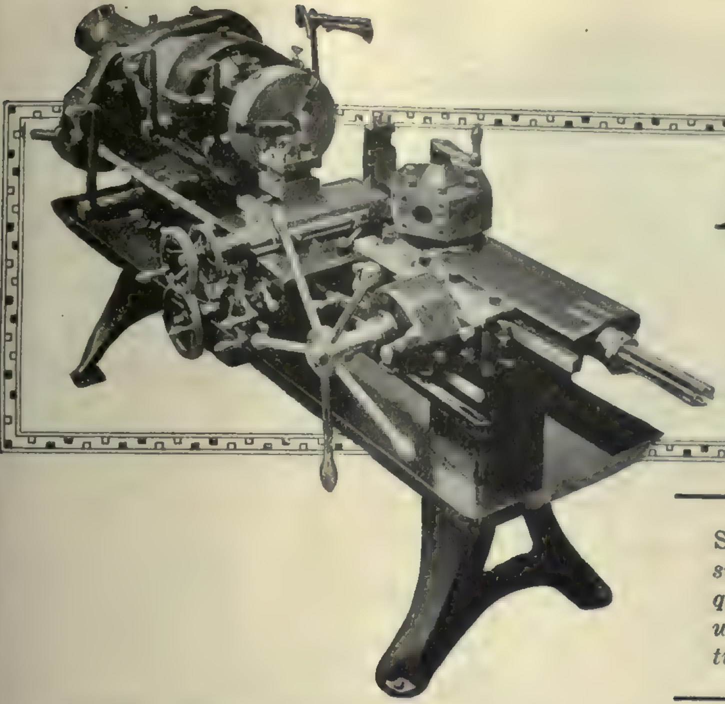


FIG. 3

FIG. 3. DETAILS OF THE BABBITTING FIXTURE

An eccentric stud *K* provides means of keeping the toggles in locking adjustment in case of wear or expansion. Heat is applied by means of two gas torches through the holes *M* in the bed, making it possible to keep the babbitt in the pot *V* and the cylinder *G* at a proper temperature, say about 650 deg. F. The half mandrel block *C* and the bearing holder *D* can be changed to accommodate different sizes and shapes of bearings.



MILLHOLLAND UNIVERSAL TURRET LATHE

SYNOPSIS — *The machine described was designed with the object in view of obtaining a quick set-up, rapid production on bar and chuck work, together with ease and precision of operation.*

ONE of the principal features of the machine shown in the headpiece, which is made by the W. K. Millholland Machine Co., Indianapolis, Ind., is the design and arrangement of the power feed to the cut-off and apron shown in Figs. 2 and 3. Seven gears and a reversing worm and wormwheel transmit the power to the cut-off and longitudinal feed. The feed to the cut-off and longitudinal feed are independent and selective. Either one, or both, feeds can be engaged or disengaged at will, with automatic stops for both. The stop roll and stop on the apron are adjustable to the full turning range of the machine. The adjustable stop bar mounted on the bed affords a rapid and convenient method for adjusting the stop over a wide range. The bar has a series of slots milled in it which engage a key in the stop bracket. The adjustment of the stop bar is accomplished by a quarter turn and then drawing the bar out or in to the nearest notch desired, then turning the bar around until the key engages the slot. No binder screw is necessary on the bar stop. This obviates the necessity of using long stop screws in the stop roll on the apron. The automatic stop for the cut-off is of the miller type, and is adjusted in much the same way as on a milling machine.

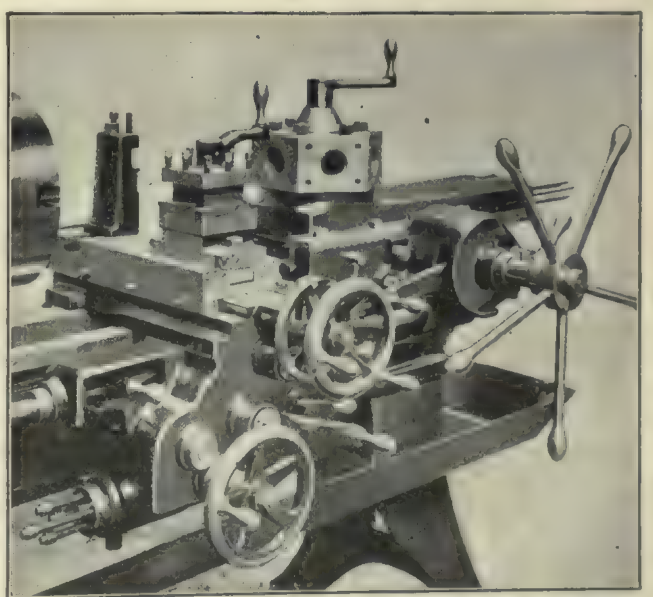


FIG. 2. VIEW OF APRON AND CROSS-SLIDE ARRANGEMENT

Automatic chuck capacity, $1\frac{5}{8}$ in.; hole in automatic chuck plunger, $1\frac{11}{16}$ in.; hole in spindle, $2\frac{1}{32}$ in.; thread on spindle, $5\frac{1}{4}$ in. 6 U.S.S.; holes in turret, $1\frac{3}{4}$ in.; center of holes in turret to top of slide, $3\frac{3}{8}$ in.; diameter of turret across faces, 9 in.; length that can be turned, 10 in.; greatest distance end of spindle to turret, $23\frac{3}{4}$ in.; swing over bed, $18\frac{3}{4}$ in.; diameter of spindle bearings, front, $3\frac{1}{2}$ in.; diameter of spindle bearings, rear, $2\frac{7}{8}$ x 4 in.; width of belt for cone, 3 in. double; pulleys on countershaft, 12 x 4; width of belt for countershaft, $3\frac{1}{2}$ in.; a countershaft speed, 230; spindle speeds, 19-345; floor space of machine, 2 ft. 8 in. x 8 in.; extension of wire feed rod, 3 ft. 6 in.; weight, net, 2665 lb.; weight, crated, 2900 lb.; weight, boxed for export, 3390 lb.; cubic measurement, boxed, 135 cu.ft.

Adjustable stops are mounted in tee slots on the right-hand side of the cut-off slide, and by adjusting these stops at the desired depths the cross-feed automatically trips. The cut-off slide has the automatic stop for either direction of the feed—that is, in or out.

The feed mechanism is very simple. Two friction clutches engage the feed gears of the apron and are operated by raising the handles on the front of the turret until the trip fingers engage. The cam faces on the levers force the friction clutches firmly into the taper of the gears, and a very powerful feed is the result. So powerful in fact, that on the tests made the drive belt would slip before the frictions. Trip handles independent of the automatic stops permit the tripping of the feed at any desired point. All handles, trips and levers are conveniently located within comfortable reach of the operator. All clutches on the machine are of the same general design, making it a very easy machine to learn to operate and adjust. The worm on the extreme left of the apron is the means of reversing the direction of the feed. This can be done while the machine is in operation by raising the reversing handle and sliding it from right to left, which engages either the left- or right-hand worm, as desired. A neutral position of the reversing worm permits the worm to run idle without being in mesh with the wormwheel.

Toolpost and Turret

The turret toolpost mounted on the cut-off slide is arranged for holding four tools. Each tool has two indexing positions, allowing the same tool to be used for both turning and facing cuts. The locking handle on top of the turret toolpost has a double function. One complete turn to the left unlocks the tool block and raises it clear of the locking pin in the base. Eight hardened and ground taper bushings in the bottom of the tool block index with the lock bolt in the base, giving eight tool positions for the toolpost. The locking motion of the toolpost handle brings the tool block down again and locks it rigidly in place.

The turret is of the solid hexagon type, automatic in its indexing, with independent stops for each position of the turret. One feedshaft driven by the eight-feed gearbox furnishes eight feeds for the turret and the apron.

The headstock is a three-step cone double back-gear type with a full web to the center line of the spindle. The pan is pressed steel, electric welded at the corners, making it proof against breakage or serious damage. Double friction countershaft, oil pump, oil tank, piping, automatic chuck and bar feed and necessary wrenches are furnished with the machine.

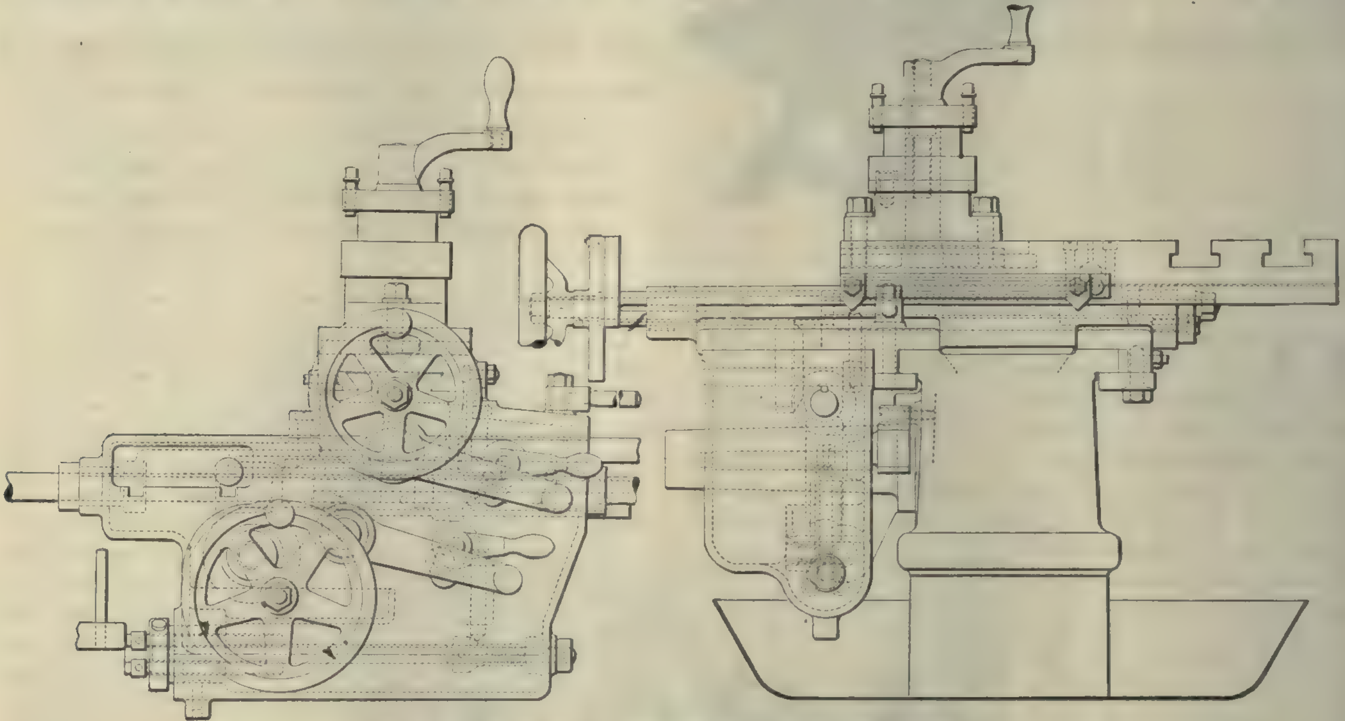


FIG. 3. DETAILS OF POWER FEED ARRANGEMENT

Wisconsin Gun Company

The Wisconsin Gun Co., Milwaukee, has been incorporated with a capital stock of $100,000 to erect and equip a plant for the manufacture of 3-in. field pieces of the 1916 model for the United States Government. The company is organized at the request of the Government by five important metal-working industries of Milwaukee: Kearney & Trecker Co., milling machines; Cutler-Hammer Manufacturing Co., electric controlling devices; Northwestern Malleable Iron Co., founder; Bucyrus Co., South Milwaukee, steam shovels, and Power and Mining Machinery Co., Cudahy unit of the Worthington Pump and Machinery Corporation. The officers will be: President, W. W. Coleman, Bucyrus Co.; vice presidents, E. J. Kearney, Kearney & Trecker Co., and John D. Bird, Power and Mining Machinery Co.; secretary, Frederick L. Sivyer, Northwestern Malleable Iron Co.; treasurer, Frank R. Bacon, Cutler-Hammer Manufacturing Co. The directors include the officers and E. D. Swigart, Bucyrus Co.; Theodore Trecker, Kearney & Trecker Co.; A. W. Berresford, Cutler-Hammer Manufacturing Co.; W. C. McMahon, Northwestern Malleable Iron Co.; C. P. Coleman, Power and Mining Machinery Co.

The company will immediately erect and equip a shop with 40,000 sq.ft. of floor space and employ 400 skilled workmen. The Cutler-Hammer Manufacturing Co. has given the service of its superintendent, Henry J. Wiegand, to supervise the erection, equipment and management of the plant. It is calculated to produce guns at the rate of three each working day. The main forgings will be supplied in rough finish by the Government, and the carriages and other parts will be made elsewhere, so that the Milwaukee shop will do the machining and assembling of the ordnance and make it ready for mounting on the carriages. The completed gun will be about 7½ ft. long and weigh 1100 pounds.

This gun is absolutely standardized in every particular for interchangeability of every part in assembling, reassembling or in case of replacements.

The Four Wheel Drive Auto Co., Clintonville, Wis., is rushing work on the construction and equipment of a large machine-shop addition, undertaken a short time ago, to enable it to make the earliest possible delivery of 3250 Class B army trucks to the Government.

Dies for Making Fancy Jewelry

By O. E. McLaughlin

SYNOPSIS—*Diemaking for fancy or ornamental jewelry is different from that with which the average toolmaker is familiar. This article was written by a man of long experience in the business and his methods of handling the work are practical.*

The conditions in a manufacturing jewelry shop are such as are not met with in any other branch of the tool trade. In our branch of the trade we make a large amount of solid gold jewelry, and any job that is not punched out must be sawed out. Today we pay $9 per gross for saws that were formerly bought for 85c. or less. Also, the chips resulting from the sawing are lost to a certain extent, and when one realizes that these chips are worth $12 per ounce as scrap, it naturally follows that great care must be taken to save them for melting over. If one examines the center cut in the headpiece, he will see that to saw around and into corners is a very delicate job. Perhaps there are only twelve of this emblem to make. Let us analyze conditions: It will take 30 min. to saw out and file up each one, or a total of 6 hours for the twelve. The gold loss will perhaps amount to $1, being sometimes more and sometimes less, depending on the workman's carefulness. The labor cost is about one and one-half times as much per hour for a toolmaker as for a jeweler. The gold loss from the sawing will pay for enough steel to make a die or a cutter plate. This cutter plate can be made in 3¼ hours, and the use of it means the saving of ½ hour of high-rate time. In addition, the cutter plate can be used at no cost for any repeat orders for the same article, which occurs about seven times out of ten.

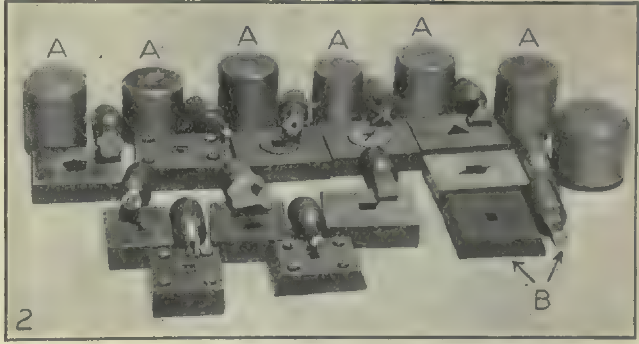


FIG. 2. EMBOSSING DIES AND CUTTER PLATES

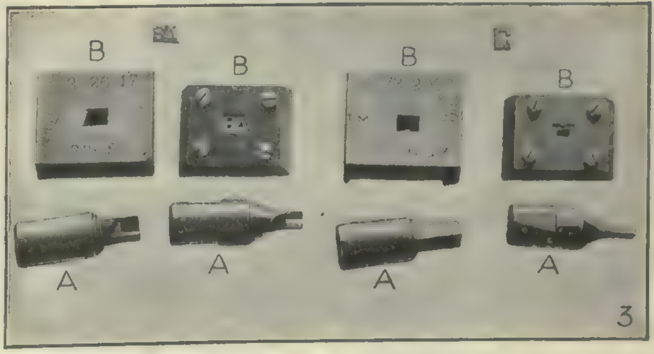


FIG. 3. PLUNGERS AND PLATES

In order to avoid confusion I shall explain some terms used by us which are new to those outside the trade. When I mention die, an embossing die is meant. Several of these are shown at *A*, Fig. 2. A cutter plate is a complete punch and die, as shown at *B*, Fig. 2. A plunger is a punch, as at *A*, Fig. 3, and a plate is a blanking die, as at *B*, Fig. 3. The reason for thus naming these parts is obvious, as if both were called dies, there would be no end of confusion. Our dies are made by the following method: First a hub, which is an exact reproduction of the finished article, is cut on the end of a steel block, as shown at *H*, Fig. 4. This block is hardened and tempered and then driven into a soft die block *A*, Fig. 2, either hot or cold, according to the conditions. This die is then hardened and sent to the hammerman, who strikes up a few proofs in brass, and from these and the hub the cutter plates are made. All plates are made from 2 x ½-in. steel planed up in strips and cut off in a power hacksaw as long as wanted. If a piece is flat, as in *H*, Fig. 4, the same hub is driven into the plate as into the die. If a piece is high (deep die), as at *T*, a piece of steel is heated red hot and struck in the die so that an impression of the die, face or outline of the article is upon it, as at *P*. This is then hardened and tempered and struck in the plate the same as a hub. In some exceptional cases a proof is made, sawed out, filed up and used the same as an ordinary templet, but this method is unsatisfactory, very expensive, and is only used once in a while.

ANNEALING THE PLATE

After laying out a plate by striking, it is put in an electric muffle furnace to anneal thoroughly. One of these furnaces is always going at 1200 deg. F. This annealing is not a life or death operation and requires absolutely no attention from the toolmaker if the furnace is set to go no higher than 1200 deg. F. A plate may be left in the furnace 15 min. or 5 hours, according to when one gets time to take it out, but I would recommend 1 hour as being sufficient to remove the strain from the most difficult piece. Next the most stock that can be removed by using *one* ordinary twist drill is taken out and a hole drilled clear through the plate. On a Thurston die miller as much stock is removed as possible, using very small cutters to get in every corner, which in no case requires over 15 min. A stub cutter is put in and the hole backed out, leaving a $\frac{3}{16}$-in. shell on the face of the plate. Finish is done with a filing machine to an exact fit; not to any hypothetical tolerance in figures, but until a lead from the die is sheared *absolutely clean* in the plate. The plate is now ready to harden, after dating and numbering it to correspond with the die. To harden the plate it is placed in the 1200-deg. furnace and left until it is as hot as the furnace. It is then placed in the hot furnace and heated until 100 deg. hotter than the operator thinks it ought to be. Then it is quenched *without* motion in a 30-gal. tank of hardening medium, which contains 18 lb. pure table salt, 1 oz. bichloride of mercury and 1 pint c.p. hydrochloric acid. I have used the same bath for four years, adding only the water evaporated and small quantities of acid from time to time, and it works better now than it did when new. I have only checked one plate in 11 years, and that was usable, only a corner being cracked off. The plate is removed from the bath when the vibrations cease and laid on a piece of waste or rag to cool off, *not* on an iron block. The face is ground on a disk grinder and then the temper is drawn to a dark brown or purple. The steel used is Bohler styrian red label.

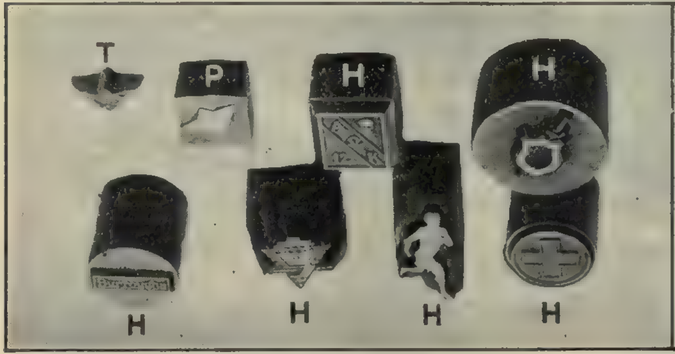


FIG. 4. EXAMPLES OF HUBS

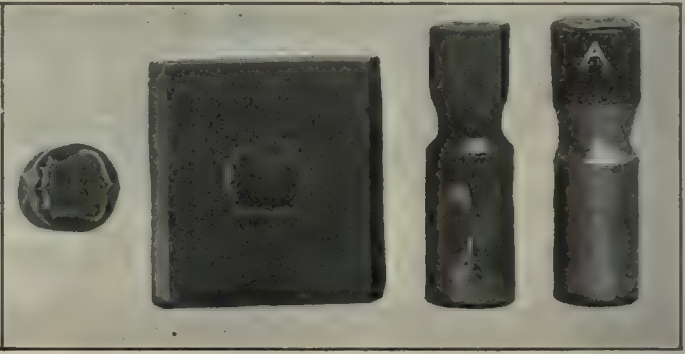


FIG. 5. NICKED PLUNGERS AND OTHER WORK

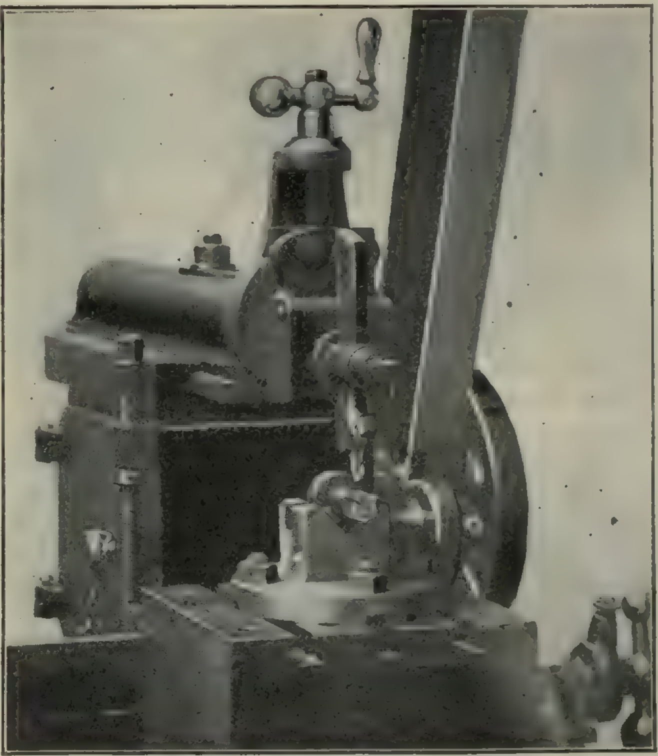


FIG. 6. METHOD OF PLANING PLUNGER

Work is next started on the punch, or plunger as it is called. As cost reduction has been a most important factor, we have standardized our plunger shanks on a basis of 0.735 in. diameter, in order that we may use $\frac{3}{4}$-in. steel and only take one cut over one half of the piece. It is also faced off on the same chucking. The piece is then turned end for end and nicked out and faced as in *A*, Fig. 5. The diameter cut on this half is taken only to remove surplus stock. None was taken in this case. Next a plunger templet is made. This generally takes the toolmaker some time to fix exactly, but I will explain how a perfect one can be made in less than 2 min., and when finished will be better than can be produced in any other way. Take one of the brass proofs above referred to and cut off as much surplus flash as possible with a pair of hand shears. Put the proof in the plate the same as in punching, and squeeze in a vise. Then file across the face of the plate to remove the stock above the opening, till all is flush. Next put a piece of $\frac{1}{8}$-in. sheet lead on top of the proof and squeeze again, and the job is done. Remove the burr from the back and fasten the whole to the plunger blank with ordinary solder. The plunger is now ready to plane up.

In planing up the plunger we use the fixture shown in Figs. 6, 7 and 8. In Fig. 6 the plunger is shown in place on an ordinary 7-in. Rhodes shaper such as is used in all jewelry toolrooms. A general description of the fixture is given without dimensions, as they are not important since the fixture must be built to suit one's individual requirements, also to fit the machine on which it is to be used.

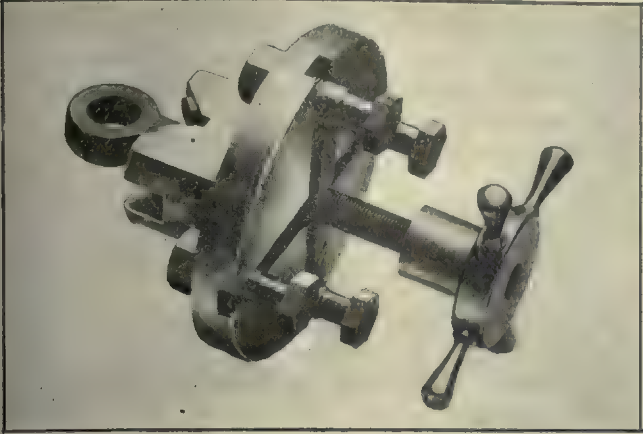


FIG. 7. DETAILS OF WORKHOLDER

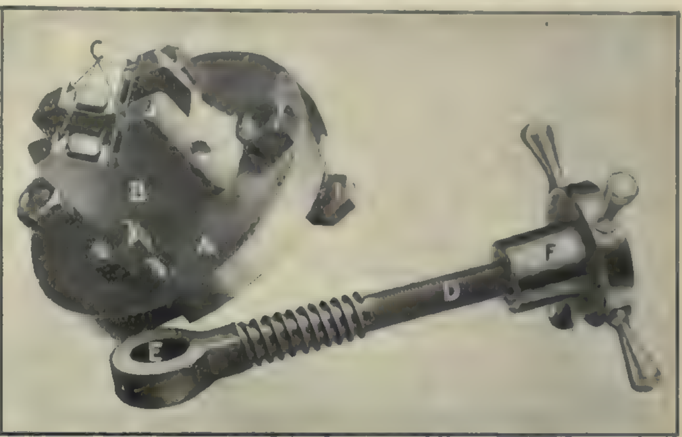


FIG. 8. ANOTHER VIEW OF HOLDER

The base, *A*, Fig. 8, is made from a piece of ordinary round machine steel, of a diameter that will cover nicely three slots in the shaper table (as in Fig. 6).

The base blank is chucked and turned, and a $\frac{1}{2}$-in. hole is bored clear through. This hole is then bored out $\frac{11}{16}$ in. in diameter to within $\frac{1}{8}$ in., plus slot depth, of the bottom. The two slots in the bottom are shaped out at right angles to each other and line blocks fitted. Next the holding-down bolt holes are bored. These bolts are ordinary S. A. E. $\frac{1}{2}$-in. twenty-thread bolts, nicked out and with the heads thinned down to fit the T-bolt slots. The base is then bolted to the shaper table and the sides cut down as shown at *B*, Fig. 8. The piece is next turned at right angles and a V, 45 deg. on a side, cut as at *C*. Lines for the location of buttons are made with a scriber in the toolpost. The center slot across the V's is made with a $\frac{1}{2}$ x 3-in. side mill run down vertically to the right depth. Holes for the buttons are drilled in the regular way. The buttons are made, hardened and driven into place. They are then tested for accuracy with an indicator in the toolpost. These buttons must be absolutely accurate. On final O K of the buttons the base is done.

FIG. 9. THE ELECTRIC HEATING FURNACES

Work on the Clamping Bolt

The bolt *D*, Fig. 8, is of hardened tool steel. The hole *E* is 0.750 in. ±, bored out true in a lathe. The top of the hole has a series of teeth cut in by running the lathe carriage and tool back and forth on the bed and setting over for spacing with the teeth in the back gear. The shoulder under the hole is $\frac{11}{16}$ in. OD on round and $\frac{1}{2}$ in. thick on flat. The threaded part is $\frac{1}{2}$ x 20 S. A. E. standard. The spring is only strong enough to hold up the complete member when the pilot wheel is loosened. The pilot wheel hub *F* is hardened tool steel, with machine-steel spokes. A coarser thread than twenty on the eye bolt should not be used, as I have tried it, and with $\frac{1}{2}$-in. x 13-thread fixtures are an absolute failure. If I were to build another, I would use a 32 thread.

I think this description will enable almost any toolmaker to build one. If a good job is done the bolt will last for years. Sometimes ours is left on the shaper for a month or two at a time, as we use it almost every day.

In using the fixture, place the plunger as in Fig. 6, with a fairly pointed tool in the toolpost. Don't swing the tool, but revolve the plunger so that you are always taking a top cut, never a side cut of any kind. Plane very close to templet or, to be exact, right down to it, as a chip breaking off at the end of the cut will leave about three or four thousandths to shear. The plunger shown in Fig. 6 was planed so close that it was sheared in the plate in exactly 1 min. and never had a file or tool of any kind used on it. The tool has cut out 5000 blanks from flat stock and trimmed the same number after being struck, and is still good for 100,000 more. It was made from Bohler red label steel hardened the same as the plate and drawn to a blue.

Perhaps the reader will wonder where the stripper or shedders are. I will explain. In all our work we set up tools mostly for small quantities only, so we use a finger stripper made on the same principle as those used in a boiler shop punch press, which any toolmaker will understand.

HINTS ON THE ELECTRIC FURNACE

In closing this article I will endeavor to give the results of my six years' experience with electric furnaces.

By referring to Fig. 9 it will be seen that for two furnaces there is only one rheostat, and that is connected with the hot furnace at the right. The 1200-deg. furnace is set with an outside resistance, which is behind the furnace and is not shown. It is only about 30 ft. of winding from an old heating element that was burned out, and is wound around a common porcelain tube insulator, such as is used to go through floors and walls in house wiring. This, of course, is in series with the furnaces.

The makers guarantee 1000 hours' service for a heating element which costs about $10. They average 2200 hours on the 1200-deg. furnace and 1400 on the hot furnace. We will put renewals at 1c. per hour and current at 3½c. per hour, both of which are high. This makes the running cost for the two furnaces about 72c. per day of eight hours, if run continuously. The saving in labor will more than offset the cost.

Do not under any circumstances put any asbestos or other material under the piece to be hardened, but put it directly on the furnace floor. Keep the muffle clean, and sweep it out with a brush every morning before turning on the current. Have a couple of extra heating elements in stock for repair, and your hardening results will surprise you the same as they did me.

Approach of Milling Cutters

BY C. J. MORRISON

The article by Francis J. G. Reuter, page 928, Vol. 46, "Calculating the Approach of Milling Cutters," is very interesting, but gives a rather long and unnecessary method of solving a simple problem. His Fig. 1 solves the problem, and there is no necessity for a calculating chart, formulas or a slide rule. All that is necessary to determine the approach of a milling cutter is to draw the cutter to scale, lay off the depth of cut on the vertical diameter, measuring from the bottom of the circle, draw a horizontal line through this point and measure the length of the line from the point on the vertical diameter to its intersection with the circumference of the circle representing the cutter. Where considerable accuracy is required the circle representing the cutter can be drawn full size.

Although it takes but a few minutes to solve the problem in this way, it will probably be found more convenient to have some junior draftsman make drawings and measurements for various size cutters and depths of cuts and prepare tables giving the diameters of cutters in vertical columns and depths of cuts in horizontal columns. The approach would then be placed in the intersection of these various columns.

A table prepared in this way shows, for Mr. Reuter's problem of a 6-in. cutter making a cut 1 in. in depth, the approach to be 2.25 in. Mr. Reuter's approach is shown as 2.24. Assuming the latter figure to be correct, the error in solving the problem by measurements is a hundredth of an inch. On a milling cutter feeding 6 in. per minute, this would make the error in time amount to one-tenth of a second, which is absolutely negligible. In fact it has been found that even for the most accurate work that tables laid out to thirty-seconds are thoroughly satisfactory, on account of the possible error being only 1/64 in., which involves a negligible time error.

In fact the solutions by measurements are more apt to be correct than the solutions obtained from a calculating chart. This chart necessitates drawing two parallels which cross the lines on the chart at such angles that errors in readings are liable to occur. Of course, if the lines were not drawn exactly parallel another error would be introduced.

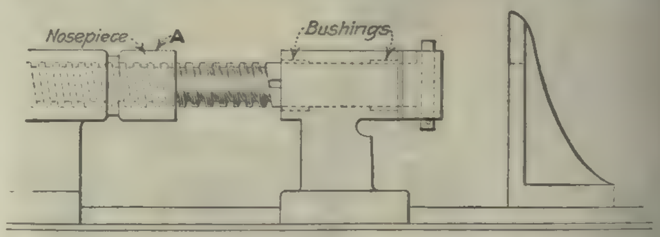
Mr. Reuter's statement that in cases "where a clean smooth finish is required, the length of cut must be added to twice the length of approach, all depending upon the requirement," is not altogether clear. For cutting grooves where a smooth finish is required it would be necessary to use twice the length of approach, as the milling cutter would have to both enter and completely leave the work; but in milling plane surfaces, no matter how smooth a finish is required the approach should be used only once, as nothing would be gained by running the cutter after it cleared the work.

Old Lathe Used as a Broaching Machine

BY D. REPONY

An old hollow-spindle lathe that was no longer in use was made into a broaching machine in the following manner:

A nosepiece *A* was turned and fitted to the spindle. The inside of the nosepiece was threaded to take the lead screw, which carried the broaches. Bushings in the tailstock supported the outer end of the lead screw. The carriage was tightened to the lathe bed, and behind it a heavy angle plate was fitted as a bolster for the work.



IMPROVISED BROACHING MACHINE

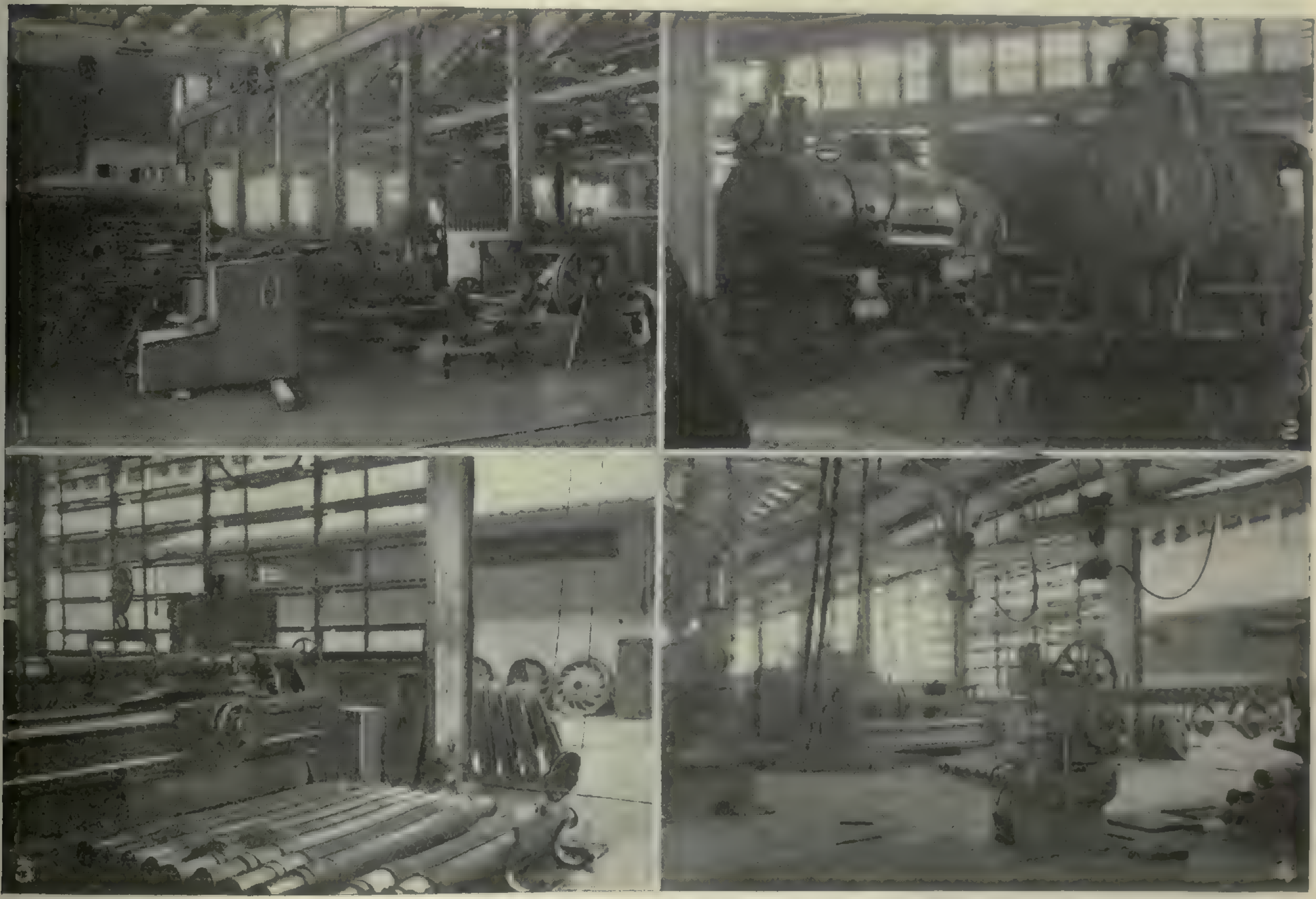
This arrangement made a good machine for broaching out numerous shop jobs.

Railroad Work in the Panama Shops

BY FRANK A. STANLEY

SYNOPSIS—*This article describes the car and locomotive repair work of the Panama R.R., as it is carried on at Balboa. The wheel and axle, airbrake and other departments are shown in considerable detail. There is also a convenient scaffold for painting cars of various kinds.*

IN OTHER articles on the Panama Canal shops at Balboa reference has been made to the section of the main machine shop where heavy locomotive repairs and general overhauling of engines are attended to. As already pointed out, one-half of one of the main bays is devoted to this class of work. This section has four pits, while outside the building there is an electrically operated transfer table on which locomotives are brought from the yard tracks to the shop tracks over the pits.



FIGS. 1 TO 4. VARIOUS TYPES OF RAILROAD WORK HANDLED IN THE PANAMA SHOPS

Fig. 1—The heavy crane for pit work. Fig. 2—Locomotive over the pit. Fig. 3—One of the axle lathes. Fig. 4—Press for wheel and axle work

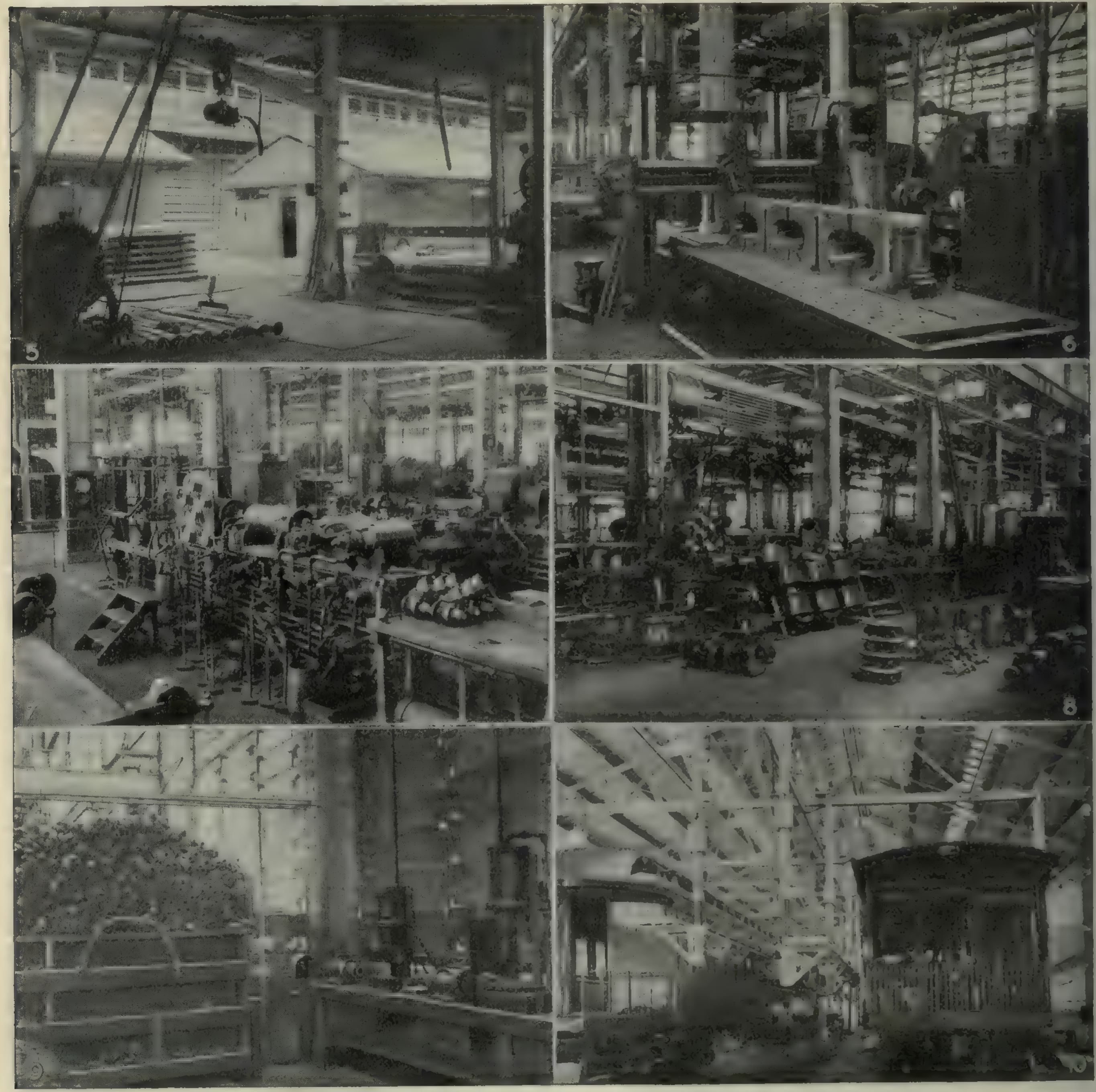
Figs. 1 and 2 show the corner of the shop in which the pits are located. The first of these views illustrates among other features the heavy overhead traveling crane that serves this section of the building; the other shows a locomotive over one of the pits. The locomotive work in these shops is likely to form an important item in the general repair work essential to the upkeep of the Panama Canal equipment. This, however, along with railroad work as a whole, will doubtless be considerably diminished with the continued operation of the canal and the consequent carrying of an increasing proportion of cargo by waterway instead of by rail. As is the case in most railroad shops, there are many features of interest to be noted in the overhauling of engines. Some of these have been selected to bring out a variety of characteristic operations and equipment.

Axle and Wheel Work

Possibly no department in railroad shops is of greater interest than the one devoted to axle and wheel work. Figs. 3 to 5 inclusive are reproduced from photographs taken in this department. The first of these illustrations shows one of the axle lathes with an axle ready to be removed. At *A* may be seen the yoke-shaped sling by which axles are picked up, placed in the lathe or removed. The arms of the sling are separated sufficiently to balance the work properly, so that the axle is always held securely against slipping while being transferred between floor and machine.

Fig. 4 shows the hydraulic press. It is at the opposite side of the doorway from the lathe, so that when wheels and axle are ready for dismounting or mounting, the apparatus for the purpose is conveniently situated relatively to the passageway through which they are rolled into and out of the shops.

Fig. 5 shows the hydraulic press from the front, with a pile of axles just outside the building, and also illustrates the manner in which the axle sling is controlled by a hoist attached to a trolley operating on the arm of a jib crane.



FIGS. 5 TO 10. A NUMBER OF VIEWS IN THE RAILROAD SHOPS AT BALBOA

Fig. 5—How the axle sling is controlled. Fig. 6—Planing locomotive driving-axle boxes. Figs. 7 and 8—Equipment for overhauling airbrake apparatus. Fig. 9—Dismounting old couplings and hose. Fig. 10—Paint-shop scaffolds

Fig. 6 is presented to illustrate the method of planing locomotive driving-axle boxes, which are here seen placed three pairs in a row, so that the entire series passes under the tool at each stroke of the platen. These boxes are lined up in the usual fashion on the planer and are held against shifting sidewise or endwise.

Figs. 7 and 8 show methods and equipment used in connection with the overhauling of air apparatus. The department illustrated is one of the most important in the building and has a variety of ingeniously designed apparatus for overhauling air pumps, brake equipment, hose coupling and other parts. The testing machines for pumps and other members, the air mains, the pressure gages and other essential features are included in the illustrations and will serve to convey an adequate idea of the thoroughness with which the department has been fitted up.

Fig. 9 shows at the left a great quantity of air hose and couplings, while at the right will be seen the bench equipment for dismounting old couplings and hose and reassembling couplings and new hose sections. The vertical machine at the right-hand end of the bench is an air-operated device carrying a chisel-shaped member for stripping old hose from the couplings. Another pneumatic machine, at the left end of the bench, is used for assembling couplings and hose. This consists of a pair of long clamp jaws brought together by air pressure to secure the section of hose while air is admitted to two horizontal cylinders, one at each side, to force the couplings into place.

One view in the paint shop is given in Fig. 10, to show a very handy arrangement of scaffolds for car painters and varnishers. These scaffolds are broad platforms suspended at either side of the tracks by vertical columns that telescope into hollow members hung from the roof chords. The scaffolds, or platforms, are in lengths of some 12 or 14 ft. and form a continuous runway along the side of the car. Each section is independently counterbalanced and may be easily raised or lowered to any desired point by hand. The supporting columns of steel are provided with locking points at close intervals, and a lever for each column controls the detent by which the scaffold section is rigidly held when set at any desired height.

With this arrangement the scaffold sections may be kept at a uniform height for the entire length of the car, or any section may be elevated or lowered independently of the others, thus permitting the workmen readily to adjust their position to suit the work to be done.

The Electric Welder in Stove Making

SPECIAL CORRESPONDENCE

The Detroit Stove Works, of Detroit, Mich., are finding it advantageous to employ electric welding machines (made by the Detroit Electric Welder Co.) in the manufacture of their sheet-metal stoves.

The finished product, as a direct result of this improved welding method, is more durable; and because of the smoothness of the joints the appearance of the stove is enhanced. In addition, the electric welder simplifies the manufacturing problem, as a number of small parts may be readily welded together.

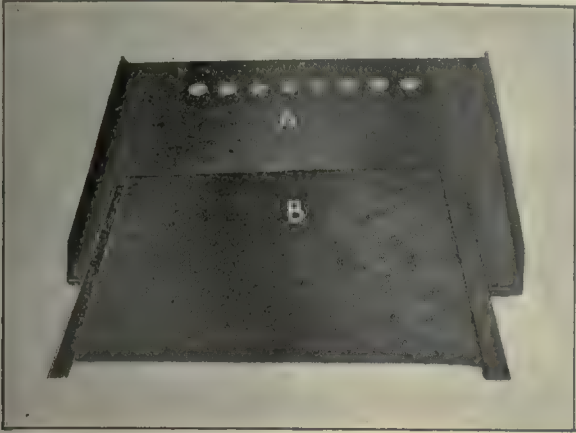


FIG. 1. ELEMENTS FOR A STOVE TOP

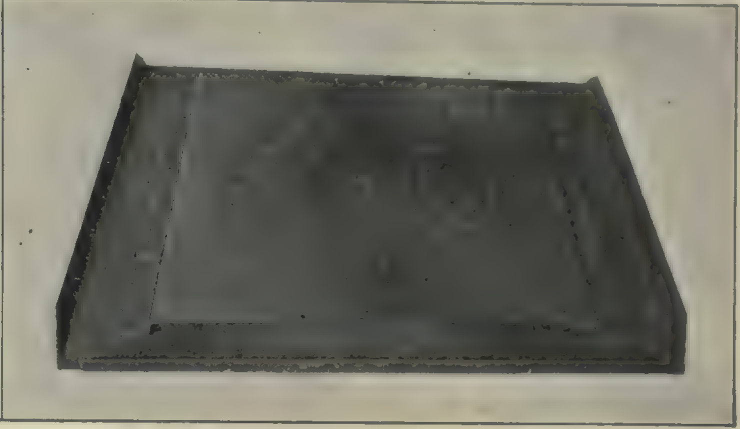


FIG. 2. A WELDED STOVE TOP

In Fig. 1 are shown two parts for the top of the stove. The piece *A* is made from 0.025 in. (No. 24 gage) steel, and the piece *B* from 0.05 in. (No. 18 gage) steel. They are punched and formed to the shape shown. The top pan is then placed on the lower piece and united to it with nine spot welds. The time necessary for this operation is about ½ minute.

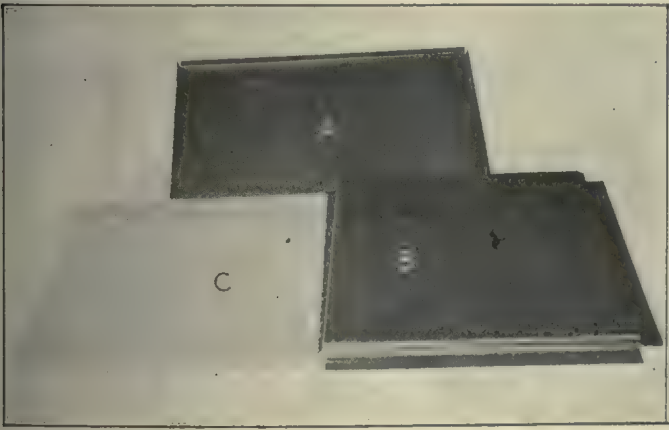


FIG. 3. ELEMENTS FOR A STOVE BOTTOM

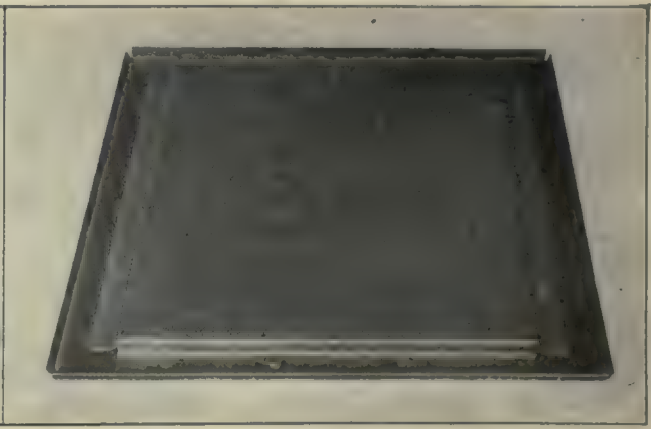


FIG. 4. A WELDED STOVE BOTTOM

One of the welded stove tops is shown in Fig. 2. The spot welder is also used on the stove bottom.

At *A*, in Fig. 3, is shown the bottom plate, which is made of 0.025 in. (No. 24 gage) steel; *B* is the pan, of 0.05 in. (No. 18 gage) steel, and *C* the asbestos sheet, which is ⅛ in. thick.

The asbestos is placed above the bottom plate and the pan put over it. The two plates are then attached with 12 spot welds, the asbestos sheet being held between them. The time required for the operation is ½ minute.

Fig. 4 shows one of the stove bottoms after the welding operation. A view of one of the electric welders, with a number of the parts used to make stove bottoms, is shown in Fig. 5.

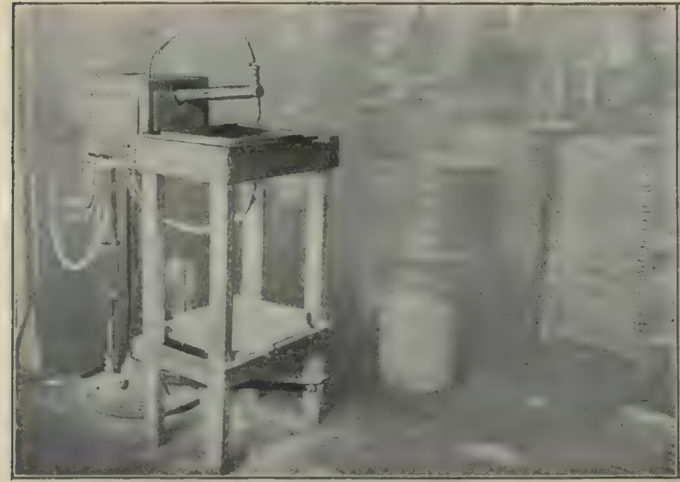


FIG. 5. AN ELECTRIC WELDING MACHINE

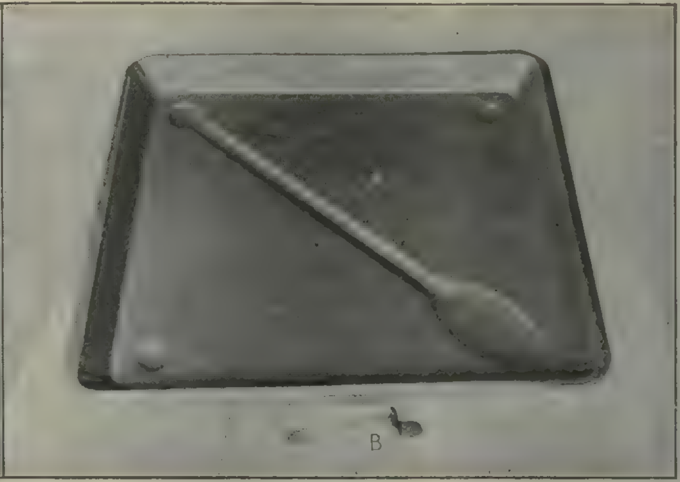


FIG. 6. THE BOILER PAN

The boiler pan is made in two parts; the pan proper is shown at *A* in Fig. 6, and the handle at *B*. The pan is made from 0.025 in. (No. 24 gage) steel, and the handle is united to it with two spot welds.

Vast Amount of Construction Material Required for Army Camps

Figures just issued by the War Department will go far to give an idea of the magnitude of building activity which will be necessary for the construction of the 16 Army cantonments. These figures deal with the estimated amounts of material required, and cover such important items as lumber, electrical equipment, roofing and concreting materials.

In the Southern States there will be about 5,600,000 board feet of boards, 7,800,000 board feet of dimension stuff, 177,000 ft. of 4 x 4-in. timbers, 2,800,000 ft. of flooring, 1,200,000 ft. of siding, and 1,400,000 ft. of matched boards. In the northern cantonments the amount of lumber will be increased about 216,000 board feet.

NAILS AND SHEATHING REQUIRED

To construct one of these cantonments in the South it will be necessary to use over 2500 kegs of nails, and in the northern cantonments about 2650 kegs. The buildings in a southern cantonment will require 4800 rolls of sheathing paper, 6300 squares of one-ply roofing, 21,900 squares of two-ply roofing, and about 2000 rolls of tarred felt. In the northern cantonments the amount of one-ply roofing will be reduced to about 800 squares, while the amount of tarred felt will be increased to 3200 rolls, on account of the more rigorous climatic conditions.

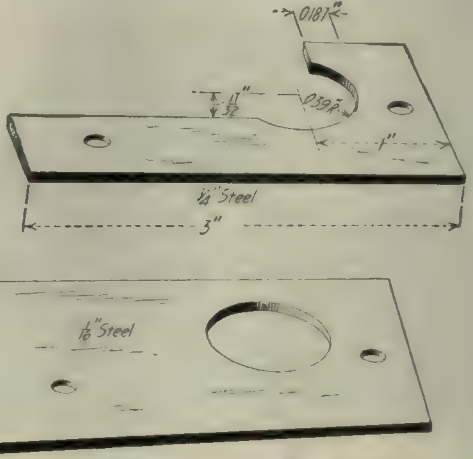
The concrete work in a cantonment is estimated to require 4700 bbl. of portland cement, 1400 cu.yd. of sand, and 2500 cu.yd. of broken stone or screened gravel.

The amount of electrical equipment will vary with the shape of the cantonment. The estimate for the total requirements for the 16 military cities amounts to 20,800,000 ft. of insulated wire, 260,000 ft. of lamp cord, and a large number of miscellaneous items on a similar scale.

Grinding Correct Radius on a Gage

BY FRED HENKE

Given three gages to make (see illustration), I used the following method. Three blank pieces were machined on all flat sides, and another piece of $\frac{1}{16}$-in. steel the same size was added. These were clamped together and drilled for two dowel pins. I laid out the large hole on the thin piece, as I kept this on top, clamped the pieces on the faceplate of the lathe and bored them out, leaving enough for grinding. The thin piece was then taken off and the others machined.



THE GAGE AND TEMPLET

After hardening and grinding on the flat surfaces, I put the whole together with the dowel pins, the thin piece being on top. I then fastened them on the faceplate of a bench lathe and, indicating the hole true, I ground them out with an internal grinding attachment, making the hole 0.780 in. in diameter, thus giving me the correct radius.

United States Munitions*

The Springfield Model 1903 Service Rifle

Bayonet Catch, Grip, Guard, Scabbard-Catch, Etc.

SYNOPSIS—*This installment takes up the operations involved in the manufacture of the various small parts used in connection with the layout, finishing the series on the Springfield rifle.*

OPERATIONS ON THE BAYONET CATCH

Operation	
A.	Forging from bar
B.	Annealing
B-1	Pickling
C	Trimming
D	Cold-dropping
2	Punching screw holes
3-4	Milling top and bottom edges
BB.	Removing burrs left by operation 3
CC.	Removing burrs left by operation 4
5	Hand-milling sides of hook
6	Hollow-milling front end in lathe
8	Polishing sides and end of hook
9	Filing hook and joint
9-A	Bluing
10	Harden in cyanide (hook end, ½ in.), quench in water

OPERATION A. FORGING FROM BAR

Transformation—Fig. 2240. Number of Operators—One. Description of Operation—Shaping from bar. Apparatus and Equipment Used—Billings & Spencer 400-lb. drop hammer. Production—125 pieces per hr.

OPERATION B. ANNEALING

Number of Operators—One. Description of Operation—Packed in iron pots with powdered charcoal, heated to 850 deg. C. (1562 deg. F.) and left over night to cool. Apparatus and Equipment Used—Cast-iron pots, Brown & Sharpe annealing furnaces and oil burners.

OPERATION B-1. PICKLING

Number of Operators—One. Description of Operation—Same as all other picklings, as already described; same apparatus, etc., used as before.

OPERATION C. TRIMMING

Machine Used—Bliss back-geared 1½-in. stroke press. Number of Operators per Machine—One. Punches and Punch Holders—Square shank. Dies and Die Holders—Held in shoe, by setscrews. Stripping Mechanism—Down through die. Average Life of Punches and Dies—15,000 pieces. Production—650 pieces per hr.

OPERATION D. COLD-DROPPING

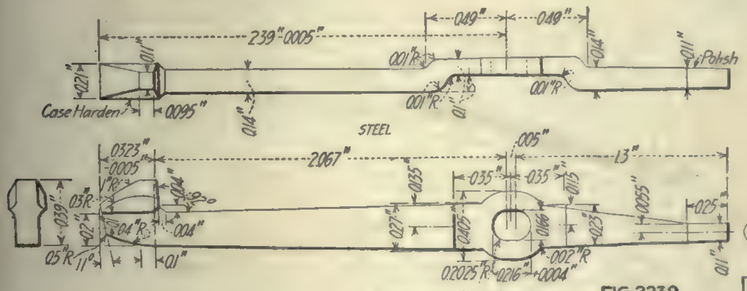
Number of Operators—One. Description of Operation—Straightening after trimming. Apparatus and Equipment Used—Billings & Spencer 400-lb. drop hammer. Production—900 pieces per hr.

OPERATION 2. PUNCHING SCREW HOLES

Transformation—Fig. 2241. Machine Used—Garvin press, 1½-in. stroke. Number of Operators per Machine—One. Punches and Punch Holders—Round shank. Dies and Die Holders—In shoe, by setscrew. Stripping Mechanism—Steel stripper screwed to face of die. Lubricant—Cutting oil on punch. Gages—Fig. 2242; form, hole location and diameter. Production—900 pieces per hr.

OPERATIONS 3 AND 4. MILLING TOP AND BOTTOM EDGES

Transformation—Fig. 2243. Machine Used—Pratt & Whitney No. 2 Lincoln miller. Number of Machines per Operator—Three. Work-Holding Devices—On pin, clamped by vise jaws, Fig. 2244. Tool-Holding Devices—Standard arbor. Cutting Tools—Milling cutters, Fig. 2245. Number of Cuts—One. Cut Data—70 r.p.m.; ⅝-in. feed. Coolant—Cutting oil, put on with brush. Average Life of Tool Between Grindings—5000 pieces. Gages—Form. Production—75 pieces per hr.



Bayonet Catch FIG.2239

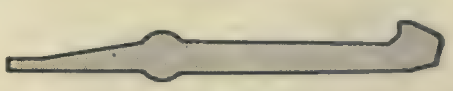


FIG.2240 OP.A

FIG.2241 OP. 2

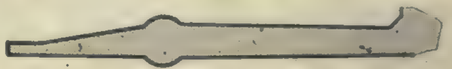


FIG.2243

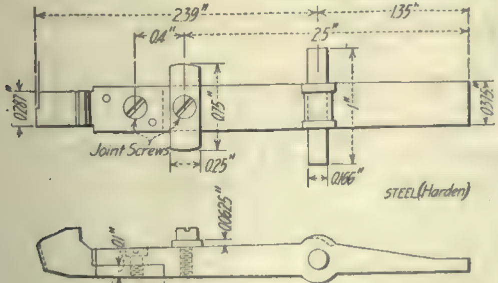


FIG.2242 OP 2

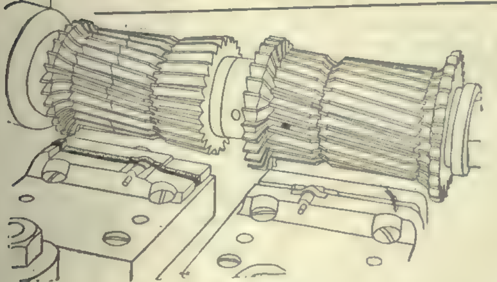
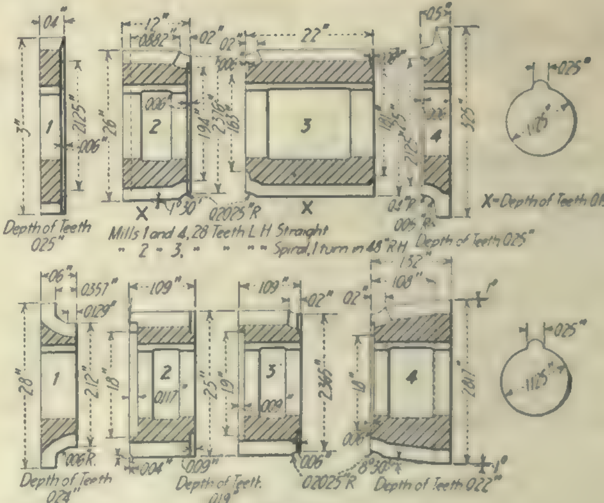


FIG.2244



OPERATION 3&4

FIG.2245

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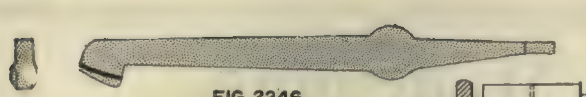


FIG. 2246

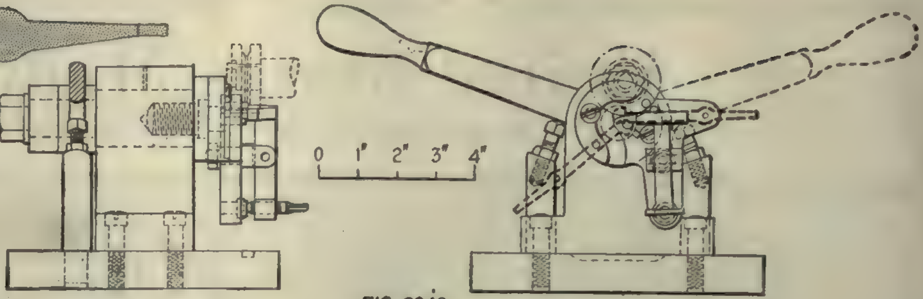


FIG. 2248

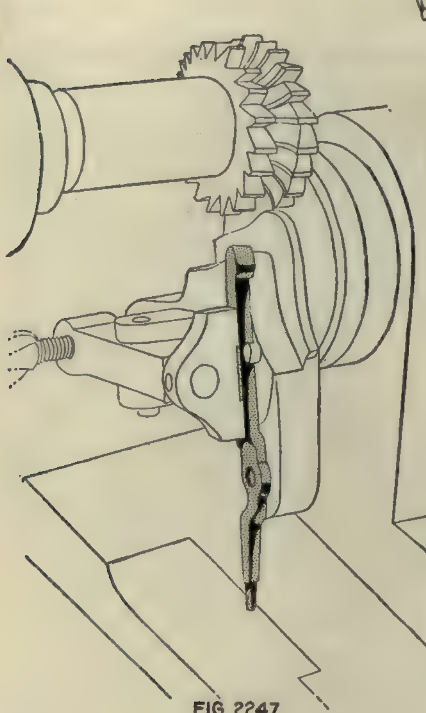


FIG. 2247

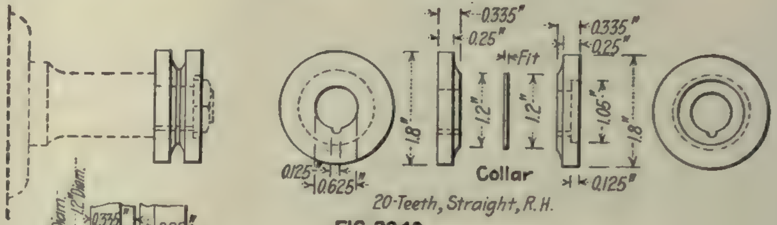
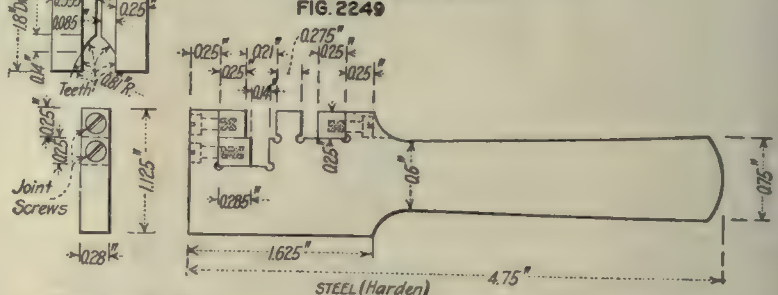


FIG. 2249



OPERATION 5

FIG. 2250

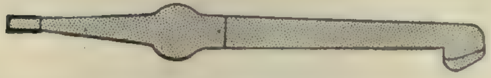


FIG. 2251

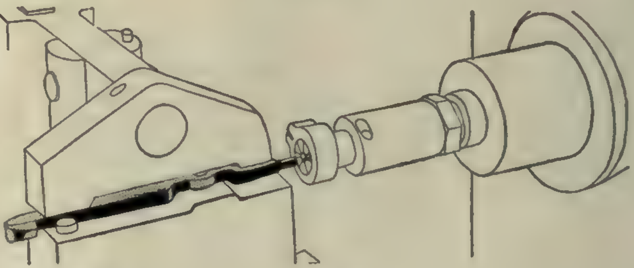


FIG. 2252

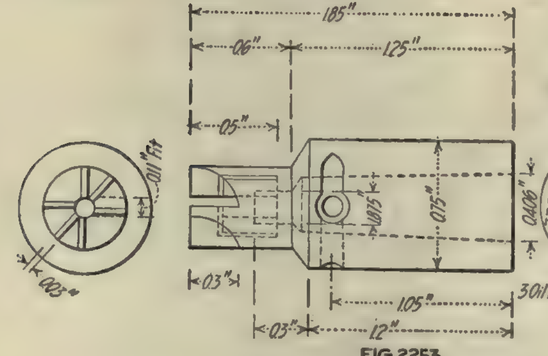


FIG. 2253

OPERATION 6

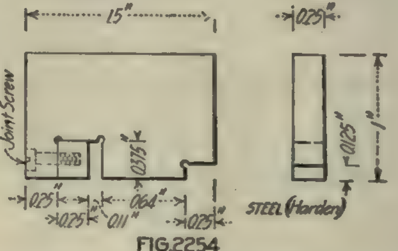


FIG. 2254

OPERATIONS BB AND CC. REMOVING BURRS LEFT BY OPERATIONS 3 AND 4

Number of Operators—One. Description of Operation—Removing burrs from operations 3 and 4. Apparatus and Equipment Used—File. Production—Grouped with operations 3 and 4.

OPERATION 5. HAND-MILLING SIDES OF HOOK

Transformation—Fig. 2246. Machine Used—Garvin No. 3 hand miller. Number of Operators per Machine—One. Work-Holding Devices—Held on pin in rotating fixture, clamped by finger clamps, Fig. 2247; details in Fig. 2248. Tool-Holding Devices—Taper shank. Cutting Tools—Milling cutter, Fig. 2249. Number of Cuts—One. Cut Data—450 r.p.m.; hand feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—5000 pieces. Gages—Fig. 2250. Production—350 pieces per hr.

OPERATION 6. HOLLOW-MILLING FRONT END IN LATHE

Transformation—Fig. 2251. Machine Used—Built at Hill shop. Number of Operators per Machine—One. Work-Holding Devices—Held on pin, clamped by finger clamps, Fig. 2252. Tool-Holding Devices—Taper shank. Cutting Tools—Hollow mill, Fig. 2253. Number of Cuts—One. Cut Data—900 r.p.m.; hand feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—5000 pieces. Gages—Fig. 2254, diameter and length. Production—175 pieces per hr.

OPERATION 8. POLISHING SIDES AND END OF HOOK

Number of Operators—One. Description of Operation—Polishing sides of hook. Apparatus and Equipment Used—Polishing jack and wheel. Production—175 pieces per hr.

OPERATION 9. FILING HOOK AND JOINT

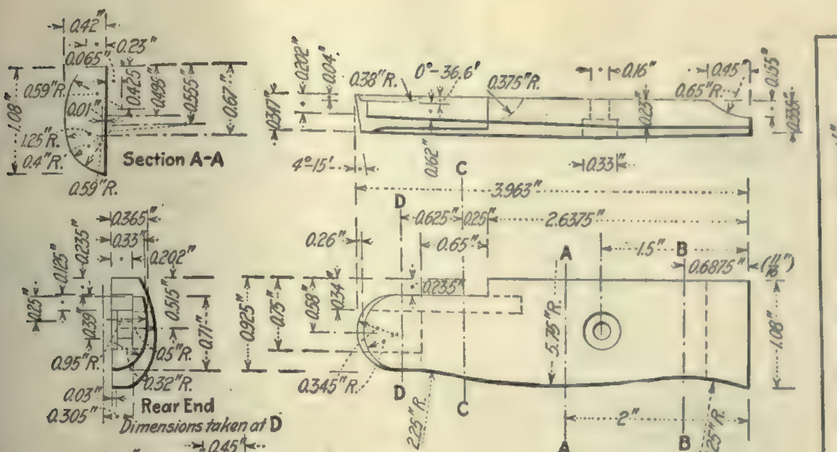
Number of Operators—One. Description of Operation—Filing hook and joint. Apparatus and Equipment Used—File. Production—75 pieces per hr.

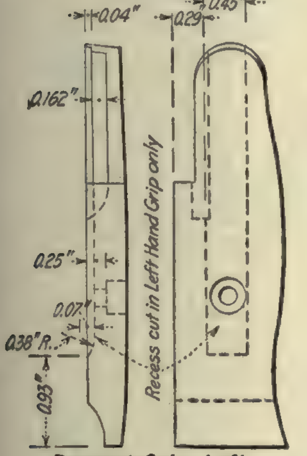
OPERATION 9-A. BLUING

Number of Operators—One. Description of Operation—Same as all other bluing operations. Equipment and Apparatus Used—Same as all other bluing operations.

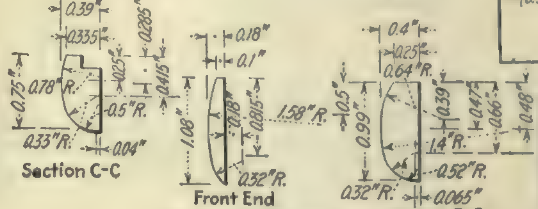
OPERATION 10. HARDEN IN CYANIDE

Description of Operation—Harden in cyanide at 1500 deg. F.; quenched in oil.





Bayonet Grip, Left



Bayonet Grip, Right.
(DENSE WELL SEASONED BLACK WALNUT)
FIG. 2255

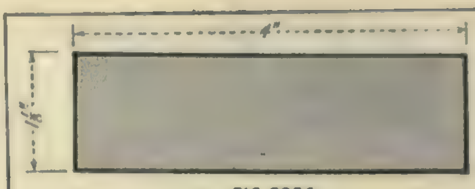


FIG. 2256

OPERATION A

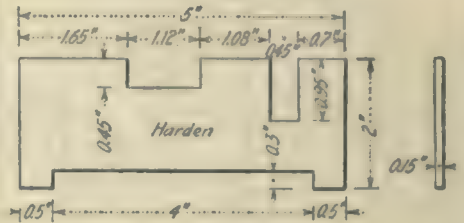


FIG. 2257

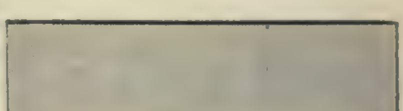


FIG. 2258

OPERATION 1

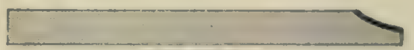


FIG. 2259

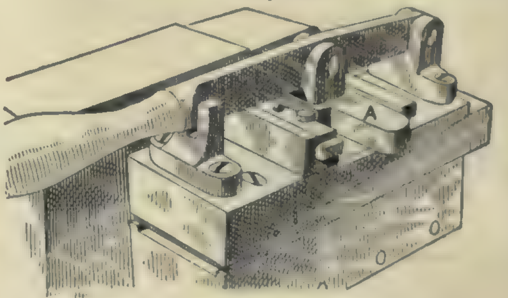


FIG. 2260

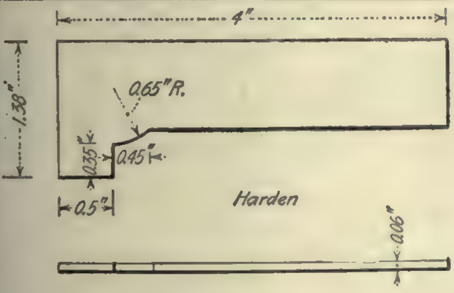


FIG. 2262

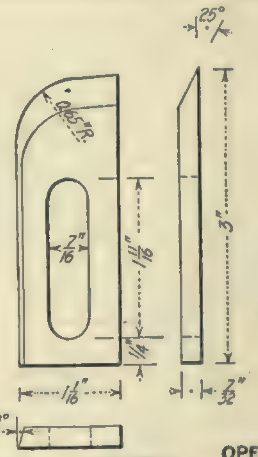


FIG. 2261

OPERATION 2

The Bayonet Grip

OPERATIONS ON THE BAYONET GRIP, RIGHT

Operation
A. Sawing blanks
1. Sawing blocks, day work, from condemned stocks
2. Cutting circle, inside, front end
3. Cutting to fit pommel, top, rear end
8. Boring and counterboring screw holes
7. Cutting circle, rear end
4-5. Cutting grooves, inside
6. Turning two together
6-A. Oiling with linseed oil
9. Assembling washer

OPERATION A. SAWING BLANKS

Transformation—Fig. 2258. Machine Used—Regular saw. Number of Operators per Machine—One. Work-Holding Devices—Held in hand, pushed to stop. Tool-Holding Devices—On spindle. Cutting Tools—Saw. Number of Cuts—One. Cut Data—3500 r.p.m.; hand feed. Gages—Fig. 2257; width, thickness and length. Production—1000 pieces per hr.

OPERATION 1. SAWING BLOCKS

Transformation—Fig. 2258. Machine Used—Regular saw table. Number of Operations per Machine—One. Work-Holding Devices—Hand. Tool-Holding Devices—Circular saw arbor. Cutting Tools—Saw. Number of Cuts—One. Production—350 pieces per hr.

OPERATION 2. CUTTING CIRCLE, INSIDE FRONT END

Transformation—Fig. 2259. Machine Used—Wood miller built at Hill shop. Number of Operators per Machine—One. Work-Holding Devices—Held on block by hand clamp A, Fig. 2260. Tool-Holding Devices—Cutter held in tool head. Cutting Tools—Fly cutters, Fig. 2261. Number of Cuts—One. Cut Data—4500 r.p.m.; hand feed. Coolant—None. Average Life of Tool Between Grindings—2500 pieces. Gages—Fig. 2262, form. Production—700 pieces per hr.

OPERATION 3. CUTTING TO FIT POMMEL TOP, REAR END

Transformation—Fig. 2263. Machine Used—Wood miller, built at Hill shop. Number of Operators per Machine.—One. Work-Holding Devices—Work held by right and left vise jaws, Fig. 2264. Tool-Holding Devices—Cutter in holder. Cutting Tools—Fly cutter, Fig. 2265. Number of Cuts—One. Cut Data—3500 r.p.m.; hand feed. Average Life of Tool Between Grindings—1500 pieces. Gages—Fig. 2266, form. Production—700 pieces per hr.

OPERATION 8. BORING AND COUNTERBORING SCREW HOLES

Transformation—Fig. 2267. Machine Used—Ames profiler. Number of Operators per Machine—One. Work-Holding Devices—Ordinary holding fixture. Tool-Holding Devices—Taper shank. Cutting Tools—Drills and counterbores, Fig. 2268. Number of Cuts—One. Cut Data—3500 r.p.m.; hand feed. Average Life of Tool Between Grindings—500 pieces. Gages—Fig. 2269, diameter and location of hole. Production—450 pieces per hr.

OPERATION 7. CUTTING CIRCLE, REAR END

Transformation—Fig. 2270. Machine Used—Ames Manufacturing Co. wood miller. Number of Operators per Machine—One. Work-Holding Devices—Held in fixture by finger clamp. Tool-Holding Devices—Fly-cutter holder. Cutting Tools—Fly cutters, Fig. 2271. Number of Cuts—One. Cut Data—6500 r.p.m.; hand feed. Coolant—None. Average Life of Tool Between Grindings—500 pieces. Gages—Form, Fig. 2272. Production—450 pieces per hr.

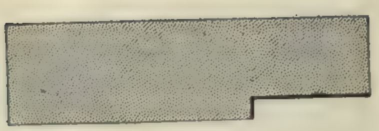


FIG.2263

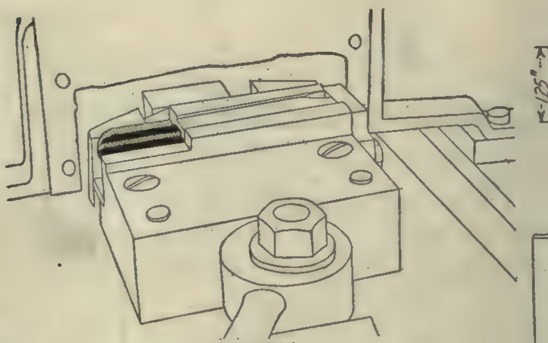


FIG.2264

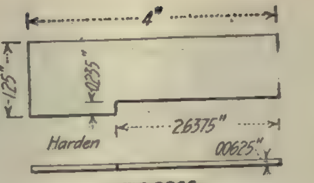


FIG.2266

FIG. 2263, 2264, 2265, 2266 OPERATION 3
FIG. 2267, 2268, 2269 OPERATION 8.
FIG. 2270, 2271, 2272 OPERATION 7.

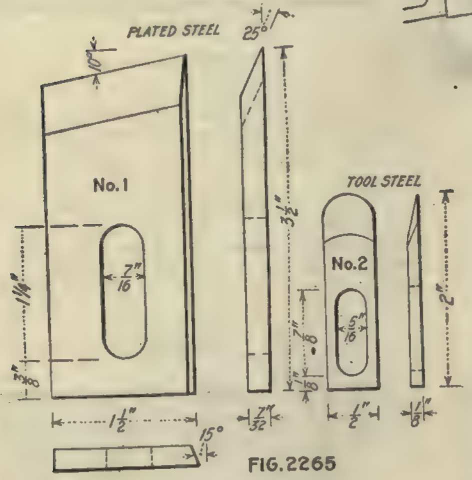


FIG.2265

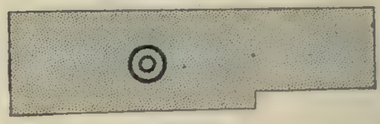


FIG.2267

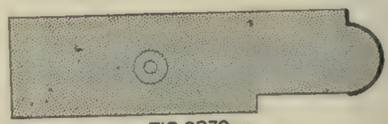


FIG.2270

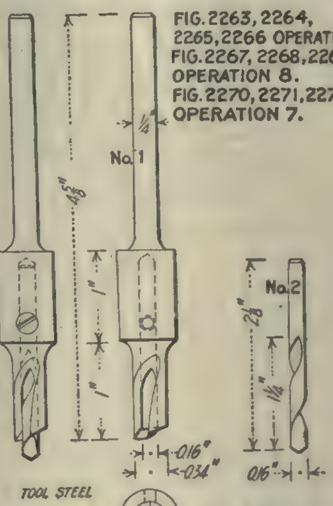


FIG. 2268

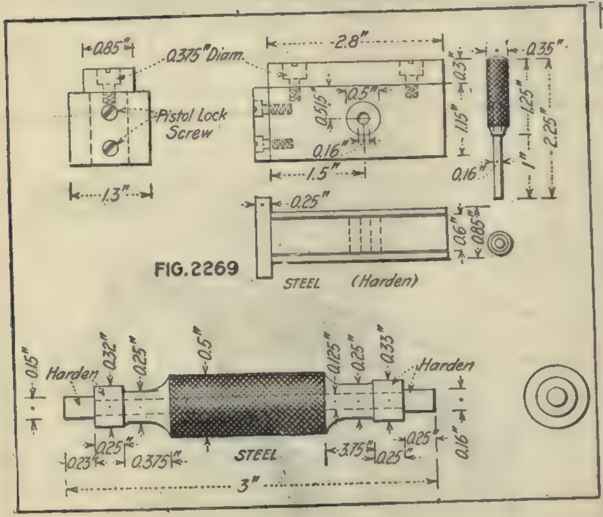


FIG.2269

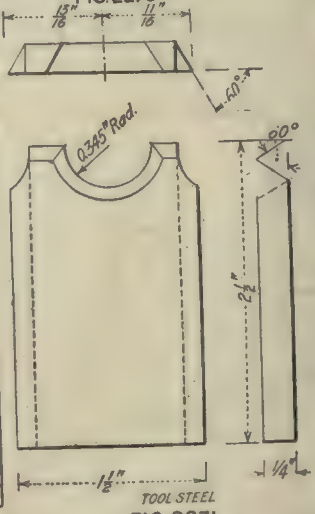


FIG.2271

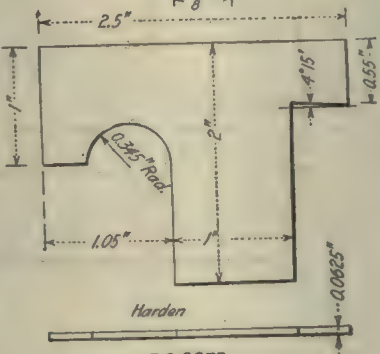


FIG.2272

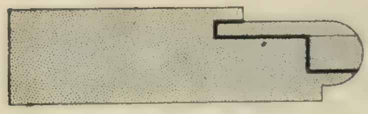
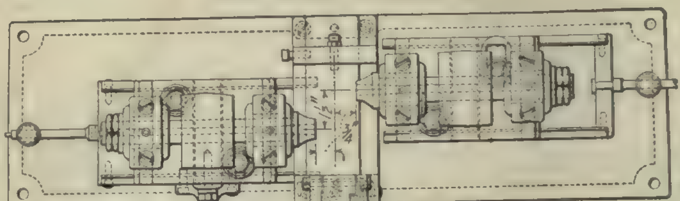


FIG.2273 A



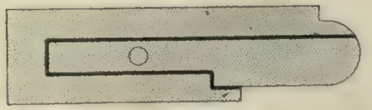


FIG.2273 B

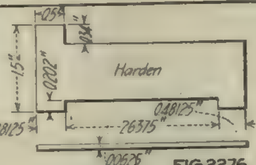


FIG.2276

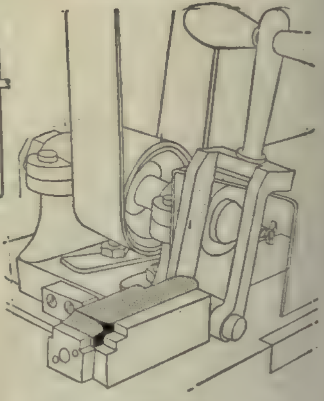
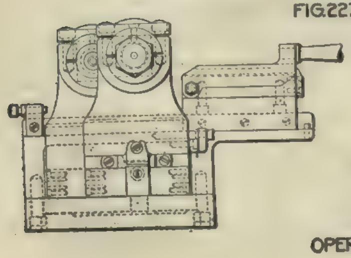


FIG.2275



OPERATION 4 & 5

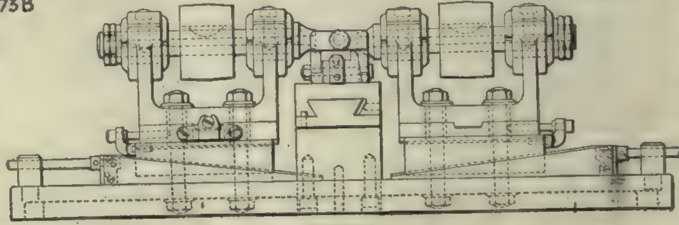


FIG.2274

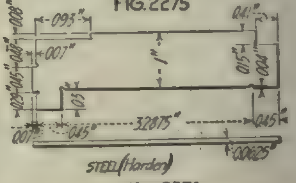


FIG.2276

OPERATIONS 4 AND 5. CUTTING GROOVES, INSIDE

Transformation—Fig. 2273, A and B. Machine Used—Wood miller, built in Hill shop, Fig. 2274. Number of Operators per Machine—One. Work-Holding Devices—Held on block by hand clamp, at rear end, Fig. 2275. Tool-Holding Devices—Taper shank. Cutting Tools—Coarse-tooth cutters. Number of Cuts—One. Cut Data—4500 r.p.m.; hand feed. Average Life of Tool Between Grindings—5000 pieces. Gages—Fig. 2276, location and width of cuts. Production—350 pieces per hr.

OPERATION 6. TURNING TWO TOGETHER

Transformation—Fig. 2277. Machine Used—Ames form trimmer, similar to turning gunstocks. Number of Operators per Machine—One. Work-Holding Devices—Held in arbor clamped at ends, Fig. 2278; turning form shown in Fig. 2279; details of working in Fig. 2280. Tool-Holding Devices—Fly cutters held in holder. Cutting Tools—Hook cutters, Fig. 2281. Number of Cuts—One. Cut Data—Speed of cutter, 6500 r.p.m.; speed of work, 60 r.p.m. Average Life of Tool Between Grindings—5500 grips. Gages—Fig. 2282; A and B, form; C, thickness. Production—125 pieces per hr.

OPERATION 6-A. OILING WITH LINSEED OIL

Number of Operators—One. Description of Operation—Placed in trays and dipped in linseed oil; left over night to dry. Apparatus and Equipment Used—Wire trays, tanks and linseed oil.

OPERATION 9. ASSEMBLING

Number of Operators—One. Description of Operation—Assembling grips to blade. Apparatus and Equipment Used—Screwdriver. Gages—General gage, similar to Fig. 2282. Production—450 pieces per hr.

THE BAYONET GUARD

OPERATIONS ON THE BAYONET GUARD

Operation	
O.	Cutting off
A.	Forging from bar
B.	Annealing
D.	Pickling
C.	Trimming and punching barrel hole
3.	Grinding rear side and front side
6.	Hand-milling slot for blade
7.	Shaving for blade
DD.	Burring operation 71
10.	Reaming barrel hole to finish
12.	Drilling rivet holes
EE.	Burring operation 12
13.	Profiling edges
15.	Hand-milling rear side, lower edge
17.	Hand-milling for scabbard catch
14.	Hand-milling for bolster on blade
16.	Chambering barrel hole
18.	Polishing sides and edges except at rivet holes

OPERATION O. CUTTING OFF

Number of Operators—One. Description of Operation—Bars come about 10 ft. long and are cut in half for drop-forging. Apparatus and Equipment Used—Hilles No. 2 stock shears. Production—900 pieces per hr.

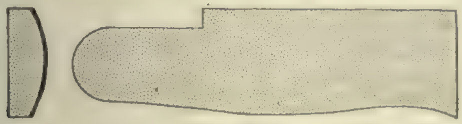


FIG. 2277

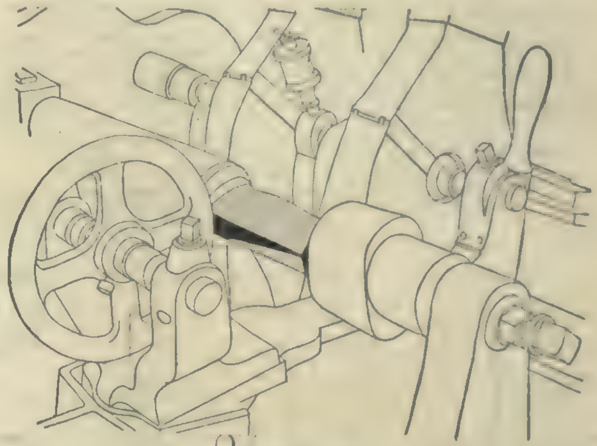


FIG. 2279

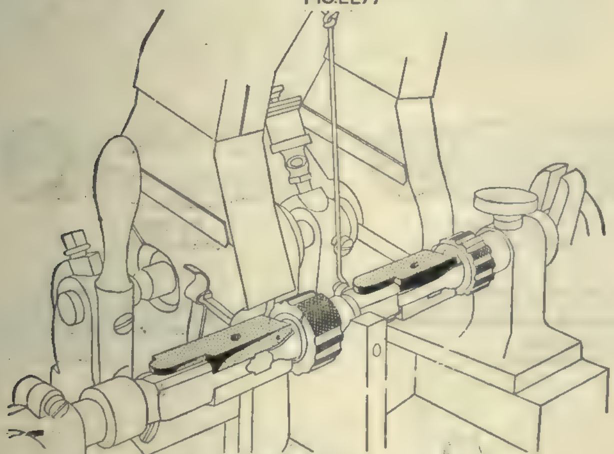


FIG. 2278

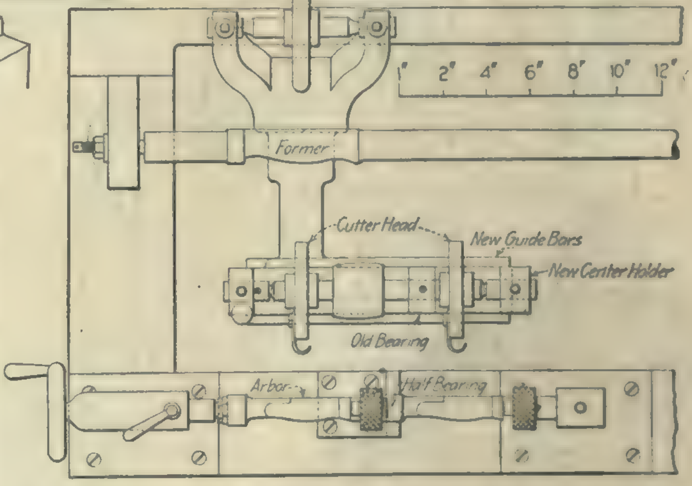
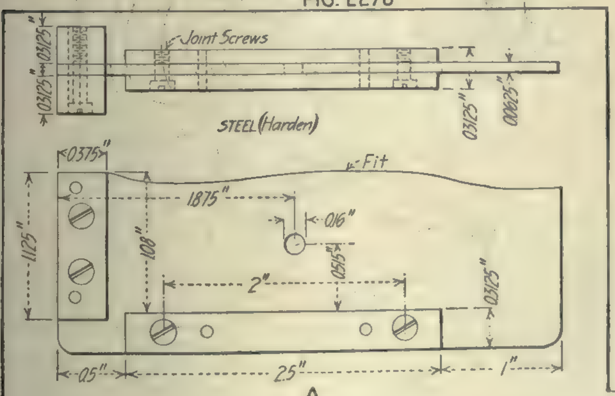


FIG. 2280



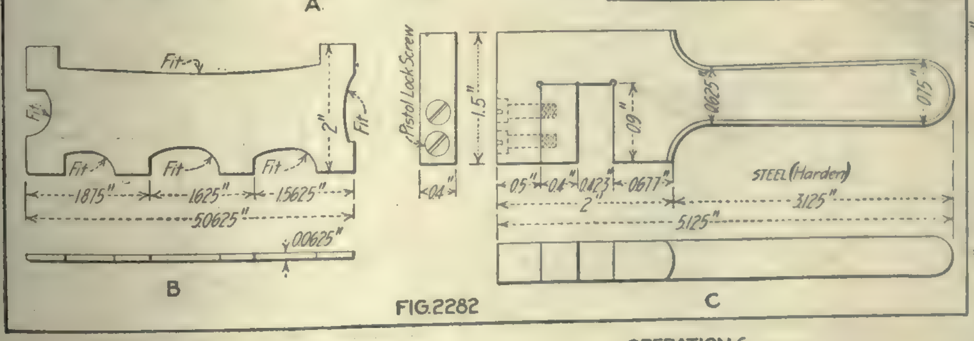


FIG. 2282

OPERATION 6

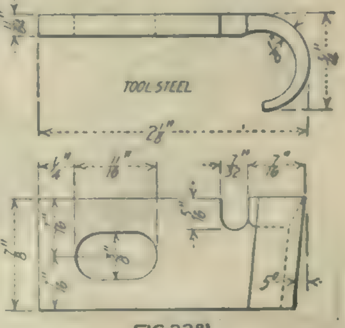


FIG. 2281

OPERATION A. FORGING FROM BAR

Transformation—Fig. 2284. Number of Operators—One. Description of Operation—Shaping from bar. Apparatus and Equipment Used—Billings & Spencer 400-lb. drop hammer. Production—125 pieces per hr.

OPERATION B. ANNEALING

Number of Operators—One. Description of Operation—Placed in iron pots packed with powdered charcoal, heated to 850 deg. C. (1562 deg. F.), left over night to cool. Apparatus and Equipment Used—Brown & Sharpe annealing, oil-burning furnaces; powdered charcoal.

OPERATION D. PICKLING

Number of Operators—One. Description of Operation—Put in wire baskets and placed in the pickling solution, which consists of 1 part sulphuric acid and 9 parts water; left in this from 10 to 12 min. Apparatus and Equipment Used—Wire baskets, wooden pickling tanks, hand hoist.

OPERATION C. TRIMMING AND PUNCHING BARREL HOLES

Transformation—Fig. 2285. Machine Used—Bliss No. 21 tip-over press, 1½-in. stroke. Number of Operators per Machine—One. Punches and Punch Holders—Square shank. Dies and Die Holders—Held in shoe by setscrew. Stripping Mechanism—Same stripping as butt plate. Average Life of Punches and Dies—15,000 pieces. Lubricant—Punches oiled with cutting oil. Production—600 pieces per hr. Note—This is the same style of die as for trimming butt plate.

OPERATION 3. GRINDING REAR AND FRONT SIDES

Transformation—Fig. 2286. Machine Used—Same Pratt & Whitney vertical grinder as all others. Number of Operators per Machine—One. Work-Holding Devices—Held between strips of steel on sides and ends of magnetic chuck. Cut Data—Same as previous grinding on this machine. Production—165 pieces per hr.

OPERATION 6. HAND-MILL SLOT FOR BLADE

Transformation—Fig. 2287. Machine Used—Garvin No. 8 hand miller. Number of Operators per Machine—One. Work-Holding Devices—On pin, clamped by vise jaws, Fig. 2288. Tool-Holding Devices—Standard arbor. Cutting Tools—Milling cutter, Fig. 2289. Number of Cuts—One. Cut Data—450 r.p.m.; hand feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—5000 pieces. Gages—Length and width of slot. Production—350 pieces per hr.

OPERATION 7. SHAVING FOR BLADE

Transformation—Fig. 2290. Machine Used—Snow-Brooks No. 2, 1½-in. stroke. Number of Operators per Machine—One. Punches and Punch Holders—Square shank. Dies and Die Holders—Fixture bolted to bed of press; pins in fixture locate the work, Fig. 2291. Average Life of Punches—500 pieces. Lubricant—Cutting oil, put on with brush. Gages—Width, length and location of slot from barrel hole, Fig. 2292. Production—120 pieces per hr.

OPERATION DD. BURRING OPERATION

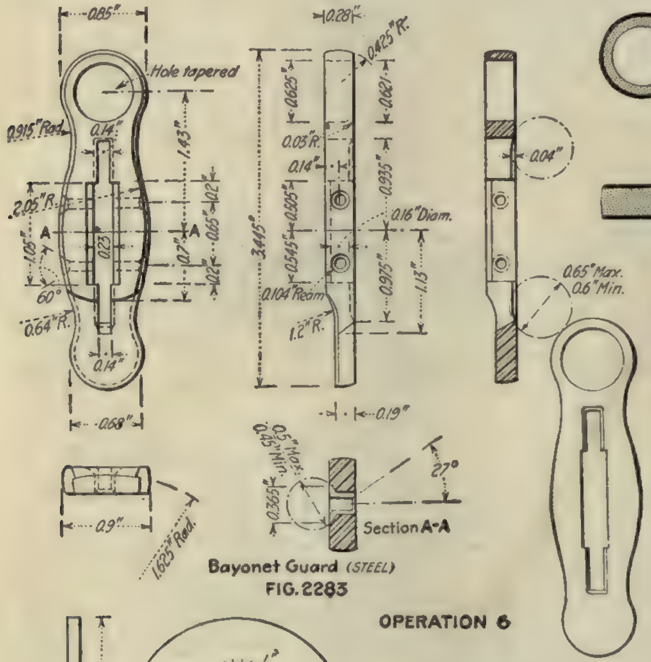
Number of Operators—One. Description of Operation—Removing burrs from operation 7. Apparatus and Equipment Used—File. Production—400 pieces per hr.

OPERATION 10. REAMING BARREL HOLE TO FINISH

Transformation—Fig. 2293. Machine Used—Ames single-spindle 16-in. upright drilling machine. Number of Operators per Machine—One. Work-Holding Devices—Work set in block with pin for stop; lever across top to keep work down, Fig. 2294. Tool-Holding Devices—Taper shank. Cutting Tools—Fig. 2295; A, counterbore; B, reamer. Number of Cuts—Two. Cut Data—450 r.p.m.; hand feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—1500 pieces. Gages—Plug for diameter. Production—100 pieces per hr. Note—Counterbored and reamed at one setting.

OPERATION 12. DRILLING RIVET HOLES

Transformation—Fig. 2296. Machine Used—Pratt & Whitney three-spindle upright 16-in. drilling machine. Number of Operators per Machine—One. Work-Holding Devices—Drill jig, Fig. 2297; cam A locates and holds guard. Tool-Holding Devices—Drill chuck. Cutting Tools—Twist drills. Number of Cuts—Two. Cut Data—750 r.p.m.; hand feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—360 pieces. Gages—Fig. 2298, diameter and location of holes. Production—50 pieces per hr.



Bayonet Guard (STEEL)
FIG. 2283

OPERATION 6

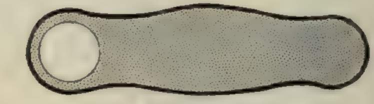


FIG. 2284
OPERATION A

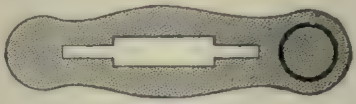


FIG. 2285
OPERATION C

FIG. 2286
OPERATION 3

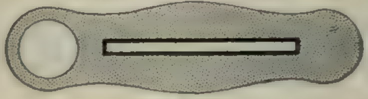


FIG. 2287

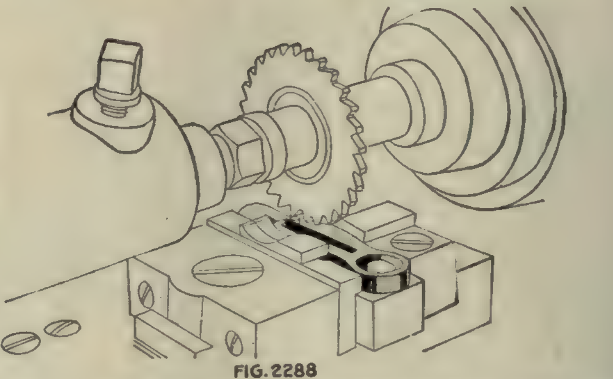


FIG. 2288

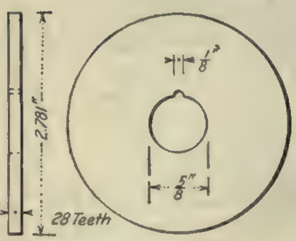


FIG. 2289

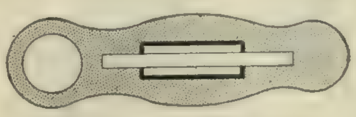


FIG. 2290

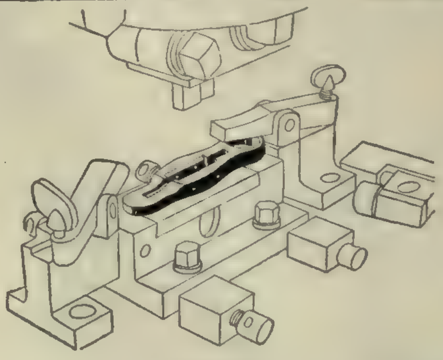


FIG. 2291

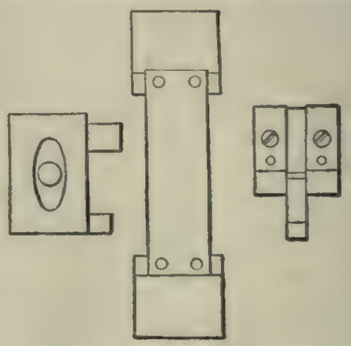


FIG. 2292

OPERATION 7

OPERATION EE. BURRING OPERATION

Number of Operators—One. Description of Operation—Removing burrs from operation 12. Apparatus and Equipment Used—File. Production—300 pieces per hr.

OPERATION 13. PROFILING EDGES

Transformation—Fig. 2299. Machine Used—Pratt & Whitney No. 2 profiler. Number of Operators per Machine—One. Work-Holding Devices—Held on pin, clamped by finger clamp, which comes up through hole in blade, Fig. 2300. Tool-Holding Devices—Taper shank. Cutting Tools—Milling cutters, Fig. 2301. Number of Cuts—One. Cut Data—1200 r.p.m.; hand feed. Coolant—Cutting oil, ½-in. stream. Average Life of Tool Between Grindings—300 pieces. Gages—Form, Fig. 2302. Production—40 pieces per hr.

OPERATION 15. HAND-MILLING REAR SIDE, LOWER EDGE

Transformation—Fig. 2303. Machine Used—Brainard large hand miller. Number of Operators per Machine—One. Work-Holding Devices—Held on stud with pin to center work, Fig. 2303. Tool-Holding Devices—Taper shank. Cutting Tools—Fig. 2305, hand miller. Number of Cuts—One. Cut Data—250 r.p.m.; hand feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—5000 pieces. Gages—Fig. 2306, contour and length. Production—175 pieces per hr.

OPERATION 17. HAND-MILLING FOR SCABBARD CATCH

Transformation—Fig. 2307. Machine Used—Whitney hand miller. Number of Operators per Machine—One. Work-Holding Devices—Work held against pin by key in block hole; fixture is held lengthwise; details in Fig. 2308. Tool-Holding Devices—Taper shank. Cutting Tools—Milling cutter, Fig. 2309. Number of Cuts—One. Cut Data—450 r.p.m.; hand feed. Coolant—Cutting oil, put on with brush. Average Life of Tool Between Grindings—3500 pieces. Gages—Form and depth. Production—350 pieces per hr.

OPERATION 14. HAND-MILLING FOR BOLSTER ON BLADE

Transformation—Fig. 2310. Machine Used—Whitney hand miller. Number of Operators per Machine—One. Work-Holding Devices—Work held by key in block hole, Fig. 2311. Tool-Holding Devices—Taper shank. Cutting Tools—Milling cutter, Fig. 2312. Number of Cuts—One. Cut Data—450 r.p.m.; hand feed. Coolant—Cutting oil, put on with brush. Average Life of Tool Between Grindings—3500 pieces. Gages—Form and size. Production—200 pieces per hr.

OPERATION 16. CHAMBERING BARREL HOLE

Transformation—Fig. 2313. Number of Operators—One. Description of Operation—Chambering barrel hole. Apparatus and Equipment Used—Bench lathe and counterbore; work held by hand; cutter, Fig. 2314. Gages—Fig. 2315, diameter and depth. Production—350 pieces per hr.

OPERATION 18. POLISHING SIDES AND EDGES EXCEPT AT RIVET HOLES

Number of Operators—One. Description of Operation—Polishing sides and edges. Apparatus and Equipment Used—Polishing jack and wheel. Production—35 pieces per hr.

THE BAYONET-SCABBARD CATCH

OPERATIONS ON THE BAYONET-SCABBARD CATCH

Operation	
0.	Cutting off
A.	Forging from bar
B.	Annealing
B-1.	Pickling
C.	Trimming
1.	Milling pivot (screw machine)
7.	Milling thumb-piece for bedding
2-3.	Milling right and left sides
6.	Drilling for bayonet catch
4.	Milling thumb-piece (on angle) and hook
BB.	Removing burrs left by operation 4
5.	Milling top and circle of hook
CC.	Removing burrs left by operation 6
8.	Checking thumb-piece
9.	Polishing hook and circle of thumb-piece
10.	Filing, cornering thumb-piece
11.	Casehardening

OPERATION 0. CUTTING OFF

Number of Operators—One. Description of Operation—Cutting stock in half. Apparatus and Equipment Used—Hilles stock shears No. 2. Production—1200 pieces per hr.

OPERATION A. FORGING FROM BAR

Transformation—Fig. 2317. Number of Operators—One. Description of Operation—Shaping from bar. Apparatus and Equipment Used—Billings & Spencer 400-lb. drop hammer. Production—500 pieces per hr.

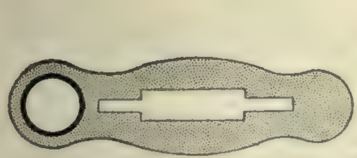


FIG. 2293

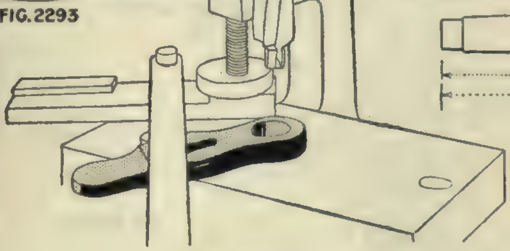


FIG. 2294

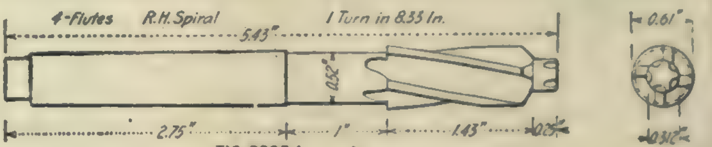


FIG. 2295 A

OPERATION 10

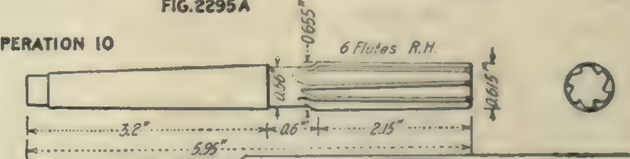


FIG. 2295 B

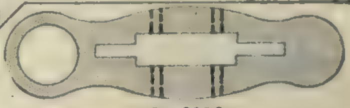


FIG. 2296

OPERATION 12

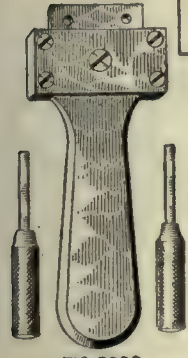


FIG. 2298

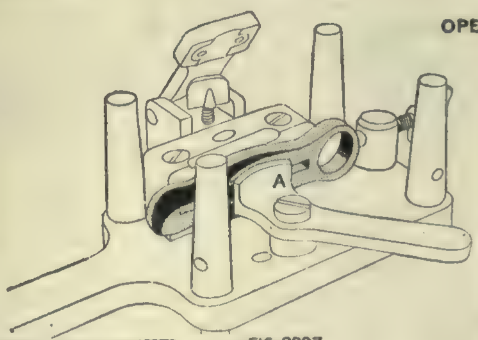


FIG. 2297

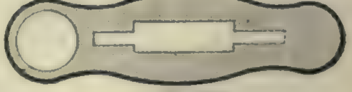


FIG. 2299

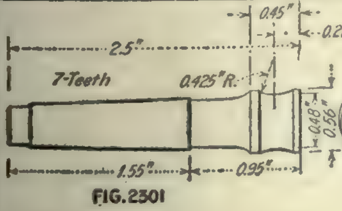


FIG. 2301

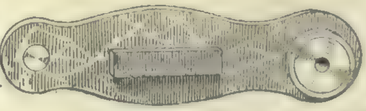


FIG. 2302

OPERATION 13

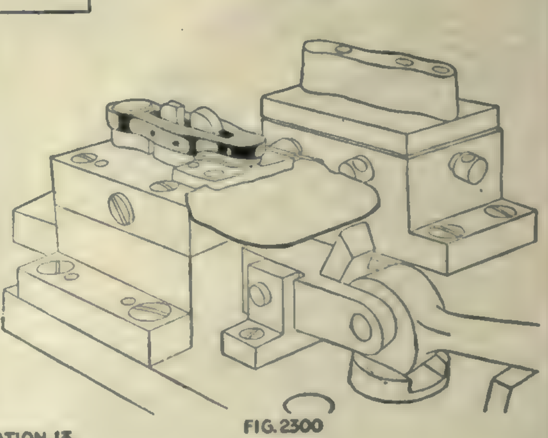


FIG. 2300

OPERATION B. ANNEALING

Number of Operators—One. Description of Operation—Packed in iron pots with powdered charcoal and heated to 850 deg. C. (1562 deg. F.), left over night to cool. Apparatus and Equipment Used—Brown & Sharpe annealing furnaces, oil burner and powdered charcoal.

OPERATION B-1. PICKLING

Number of Operators—One. Description of Operation—Placed in wire baskets and then in the pickling solution, which consists of 1 part sulphuric acid and 9 parts water, and left in this from 10 to 12 min. Apparatus and Equipment Used—Wire baskets, wooden pickling tanks, hand hoist.

OPERATION C. TRIMMING

Machine Used—Snow-Brooks No. 1, 1½-in. stroke. Number of Operators per Machine—One. Punches and Punch Holders—Round shank. Dies and Die Holders—Held in shoe by setscrew. Stripping Mechanism—Pushed down through die. Production—650 pieces per hr.

OPERATION 1. MILLING PIVOT (SCREW MACHINE)

Transformation—Fig. 2318. Machine Used—Pratt & Whitney hand screw machine. Number of Operators per Machine—One. Work-Holding Devices—Held in two-jaw chuck. Tool-Holding Devices—Turret of machine. Cutting Tools—Hollow-mill and cross-slide tools. Number of Cuts—Three. Cut Data—750 r.p.m.; hand feed. Coolant—Cutting oil, ½-in. stream. Average Life of Tool Between Grindings—500 pieces per hr. Gages—Fig. 2319, diameter and length. Production—45 pieces per hr.

OPERATION 7. MILLING THUMB-PIECE FOR BEDDING

Transformation—Fig. 2320. Machine Used—Whitney hand miller. Number of Operators per Machine—One. Work-Holding Devices—Special vise jaws. Tool-Holding Devices—Taper shank. Cutting Tools—Side mill, 1½ x ½ in. Number of Cuts—One. Cut Data—450 r.p.m.; hand feed. Coolant—None. Average Life of Tool Between Grindings—10,000 pieces. Gages—None. Production—350 pieces per hr.

OPERATIONS 2 AND 3. MILLING RIGHT AND LEFT SIDES

Transformation—Fig. 2321. Machine Used—Pratt & Whitney No. 2 Lincoln miller. Number of Machines per Operator—Two. Work-Holding Devices—Held by pivot, on catch clamped by vise jaws, Fig. 2322. Tool-Holding Devices—Standard arbor. Cutting Tools—Formed milling cutter, as shown. Number of Cuts—One. Cut Data—120 r.p.m.; ⅜-in. feed. Coolant—Cutting oil, put on with brush. Gages—Fig. 2323, form and thickness of lug. Production—100 pieces per hr.

OPERATION 6. DRILLING FOR BAYONET CATCH

Transformation—Fig. 2324. Machine Used—Sigourney 16-in. two-spindle. Number of Operators per Machine—One. Work-

FIG. 2303

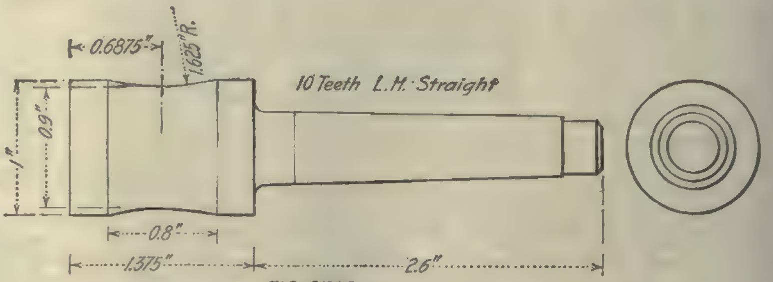


FIG. 2305

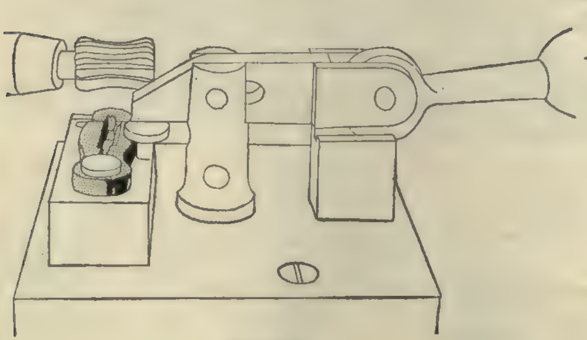


FIG. 2304

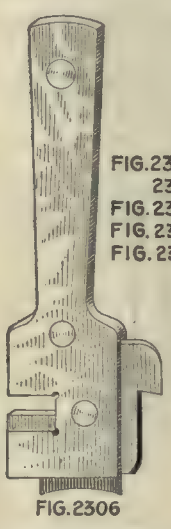


FIG. 2306

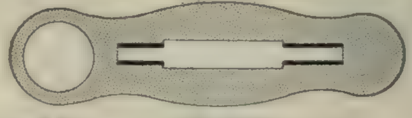


FIG. 2307

FIG. 2303, 2304, 2305 & 2306 OP. 15
FIG. 2307, 2308 & 2309 OP. 17
FIG. 2310, 2311 & 2312 OP. 14
FIG. 2313, 2314 & 2315 OP. 16

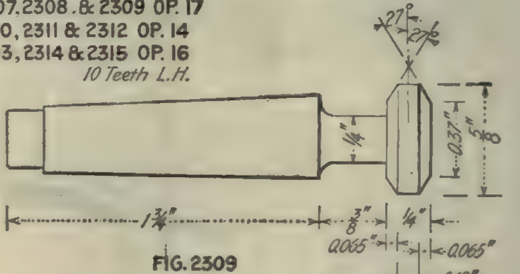


FIG. 2309

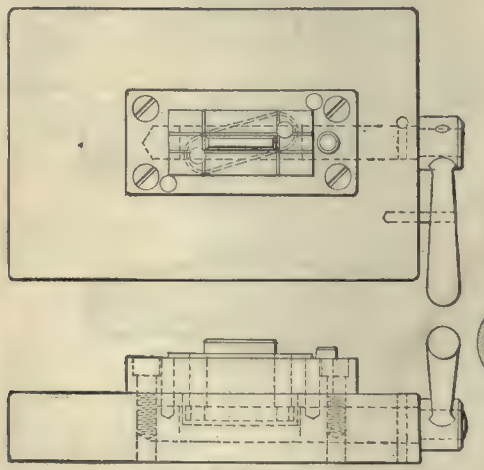


FIG. 2308

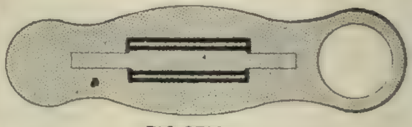


FIG. 2310

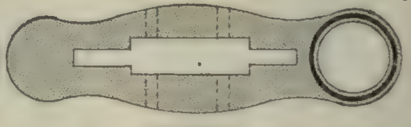


FIG. 2313

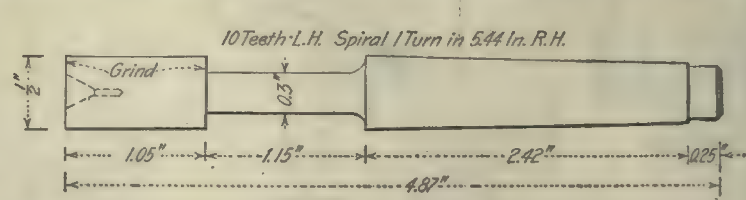


FIG. 2312

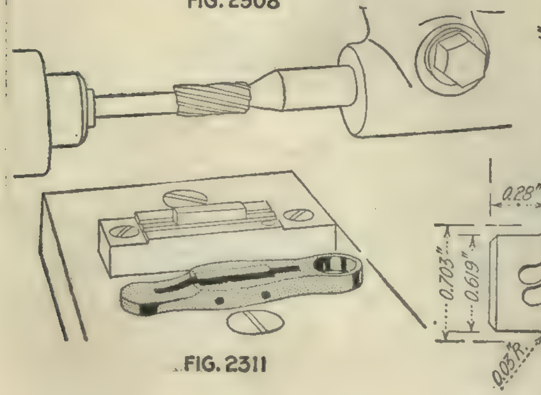


FIG. 2311

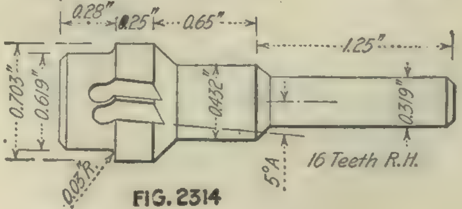


FIG. 2314

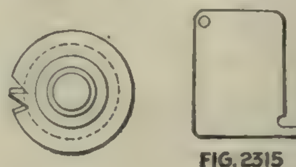


FIG. 2315

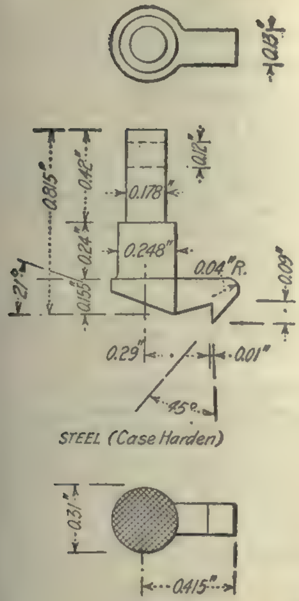
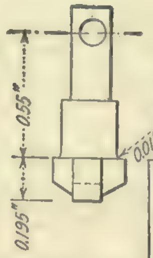


FIG. 2316



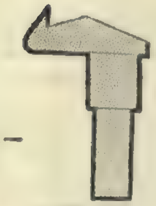


FIG. 2317 OPERATION A

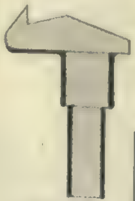


FIG. 2318 OPERATION 1

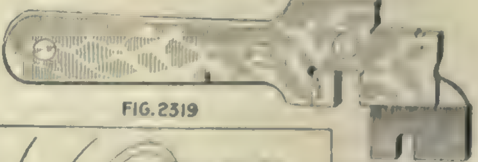


FIG. 2319

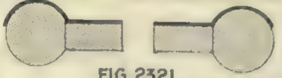


FIG. 2321 OPERATION 2 & 3

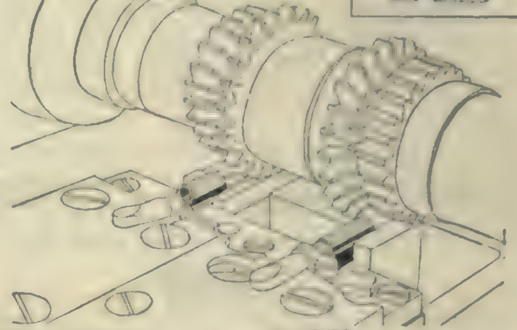


FIG. 2322

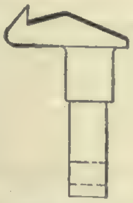


FIG. 2320 OPERATION 7

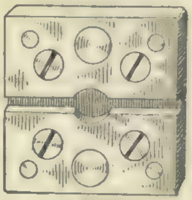


FIG. 2323

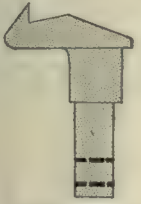


FIG. 2324 OPERATION 6

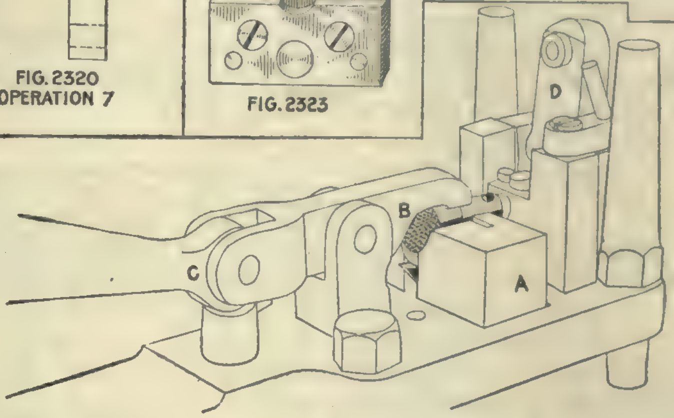


FIG. 2325

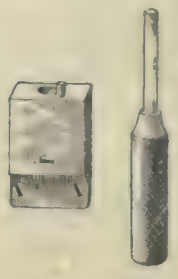


FIG. 2326

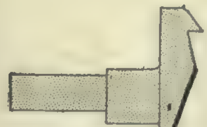
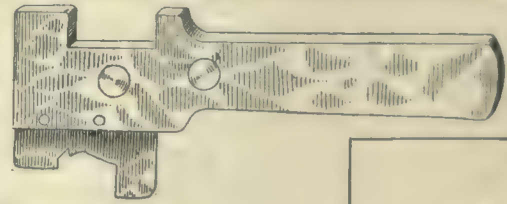


FIG. 2327



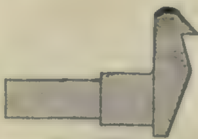


FIG. 2330 OPERATION 5

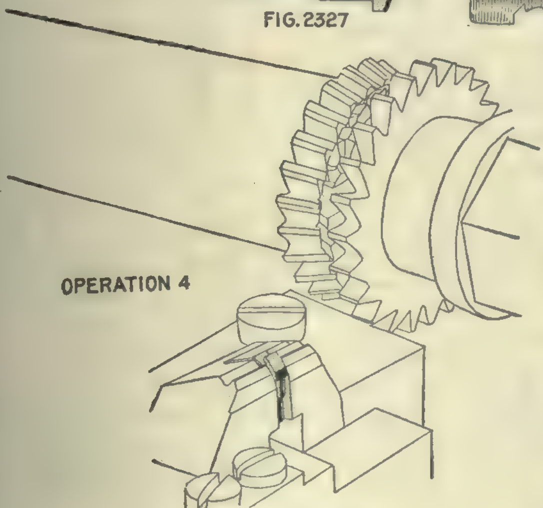

OPERATION 4

FIG. 2328

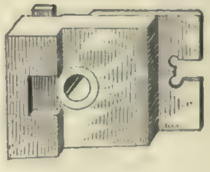


FIG. 2329

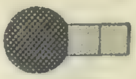


FIG. 2331

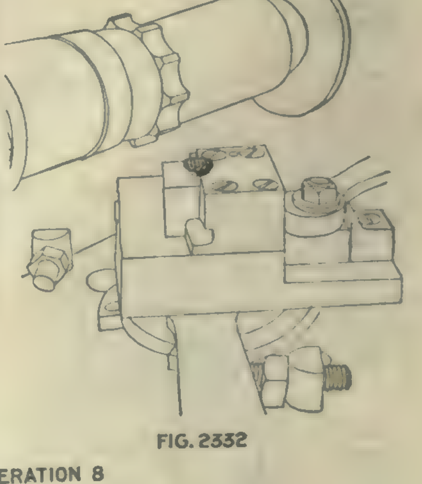


FIG. 2332

OPERATION 8

Holding Devices—Drill jig, Fig. 2325; holds work in V-block, by finger B and cam C; drill bushing in surveying leaf D. Tool-Holding Devices—Drill chuck. Cutting Tools—Twist drill. Number of Cuts—One. Cut Data—750 r.p.m.; hand feed. Coolant—Cutting oil, $\frac{1}{16}$-in. stream. Average Life of Tool Between Grindings—500 pieces per grind. Gages—Fig. 2326, diameter of hole and location by using block. Production—125 pieces per hr.

OPERATION 4. MILLING THUMB-PIECE (ON ANGLE) AND HOOK

Transformation—Fig. 2327. Machine Used—Standard No. 4½ universal miller. Number of Operators per Machine—One. Work-Holding Devices—Upright by vise jaws, Fig. 2328. Tool-Holding Devices—Standard arbor. Cutting Tools—Formed cutters. Number of Cuts—One. Cut Data—120 r.p.m.; $\frac{5}{8}$-in. feed. Coolant—Cutting oil, put on with brush. Average

Life of Tool Between Grindings—5000 pieces. Gages—Fig. 2329, shape and location of cut. Production—350 pieces per hr.

OPERATION BB. REMOVING BURRS LEFT BY OPERATION 4

Number of Operators—One. Description of Operation—Removing burrs from operation 4. Apparatus and Equipment Used—File. Production—Grouped with operation 4.

OPERATION 5. MILLING TOP AND CIRCLE OF HOOK

Transformation—Fig. 2330. Machine Used—Pratt & Whitney rebuilt No. 2. Number of Operators per Machine—One. Work-Holding Devices—Work located against stop, clamped by vise jaws as usual. Tool-Holding Devices—Standard arbor. Cutting Tools—Formed milling cutters. Number of Cuts—One. Cut Data—70 r.p.m.; $\frac{3}{8}$-in. feed. Coolant—Cutting oil, put on with brush. Average Life of Tool Between Grindings—5000 pieces. Gages—Form. Production—350 pieces per hr.

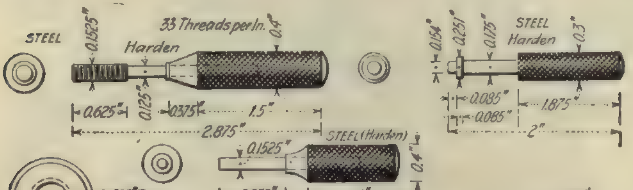


FIG. 2334

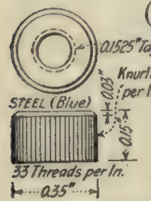


FIG. 2333

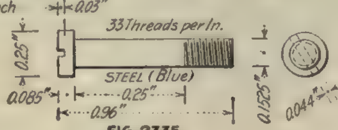


FIG. 2335

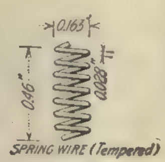
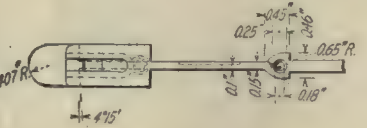


FIG. 2336



OPERATION CC. REMOVING BURRS LEFT BY OPERATION 5

Number of Operators—One. Description of Operation—Removing burrs from operation 5. Apparatus and Equipment Used—File. Production—Grouped with operation 5.

OPERATION 8. CHECKING THUMB-PIECE

Transformation—Fig. 2331. Machine Used—Brainard large hand miller. Number of Operators per Machine—One. Work-Holding Devices—Held in rotating fixture, rotated 90 deg. between the two cuts, Fig. 2332. Tool-Holding Devices—Standard arbor. Cutting Tools—Checking milling cutters. Number of Cuts—Two. Coolant—None. Average Life of Tool Between Grindings—5000 pieces. Gages—None. Production—350 pieces per hr.

OPERATION 9. POLISHING HOOK AND CIRCLE OF THUMB-PIECE

Number of Operators—One. Description of Operation—Polishing hook and circle of thumb-piece. Apparatus and Equipment Used—Wheel and polishing jack. Production—125 pieces per hr.

OPERATION 10. FILING, CORNERING THUMB-PIECE

Number of Operators—One. Description of Operation—Filing and cornering. Apparatus and Equipment Used—File. Production—350 pieces per hr.

OPERATION 11. CASEHARDENING

Number of Operators—One. Description of Operation—Harden in cyanide at 1500 deg. F.; quench in oil.

THE BAYONET NUT

OPERATIONS ON THE BAYONETT NUT

Operation
1. Automatic
2. Polishing
3. Bluing

OPERATION 1. AUTOMATIC

Machine Used—Hartford No. 2 automatic. Number of Machines per Operator—Four. Work-Holding Devices—Held in draw-in chuck. Tool-Holding Devices—Turret of machine. Cutting Tools—Standard. Number of Cuts—Five; fourth cut is a tap. Cut Data—700 r.p.m.; $\frac{3}{16}$-in. feed. Coolant—Cutting oil, $\frac{3}{8}$-in. stream. Average Life of Tool Between Grindings—700 pieces. Gages—Fig. 2334. Production—90 pieces per hr.

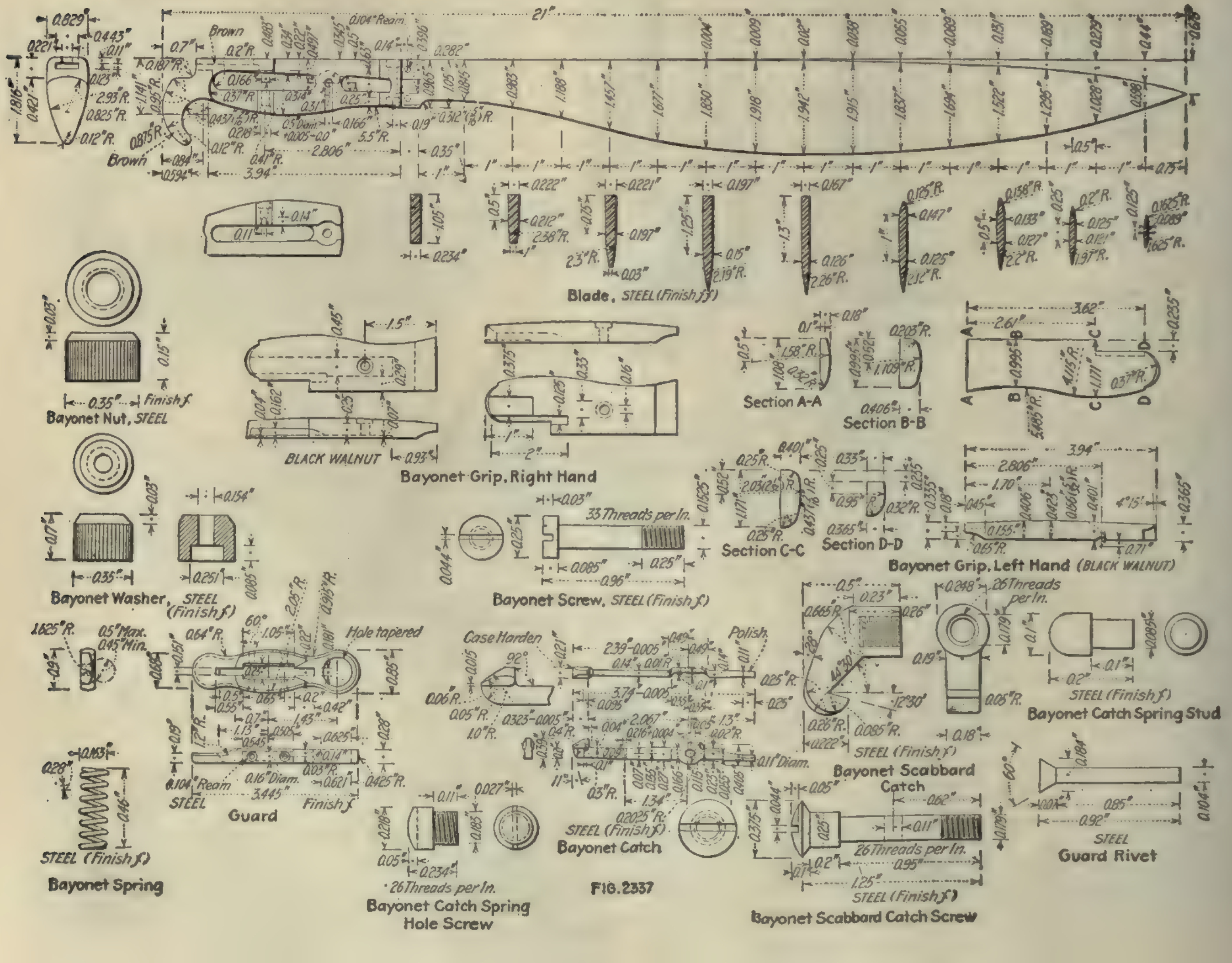


FIG. 2337

OPERATION 2. POLISHING

Number of Operators—One. Description of Operation—Removing burrs. Apparatus and Equipment Used—Wheel and polishing jack. Production—1500 pieces per hr.

OPERATION 3. BLUING

Number of Operators—One Description of Operation—Blued in niter at 800 deg. F., as usual.

The bayonet screw is an automatic screw machine job, details being shown in Fig. 2335. The bayonet rivets are purchased.

THE BAYONET SCREW

OPERATIONS ON BAYONET SCREW

Operation
1. Automatic, Hart No. 2 and Acme
2. Slitting, hand and automatic
3. Crowning hand
4. Bluing

OPERATION 1. AUTOMATIC, ACME

Machine Used—Acme No. 1. Number of Machines per Operator—Four. Work-Holding Devices—Held in draw-in chuck. Tool-Holding Devices—In turret of machine. Number of Cuts—Five. Cut Data—1100 r.p.m.; $\frac{5}{16}$-in. feed. Coolant—Cutting oil, $\frac{3}{8}$-in. stream. Average Life of Tool Between Grindings—800 pieces. Production—100 pieces per hr.

OPERATION 2. SLITTING

Machine Used—Manville automatic screw slotter. Number of Machines per Operator—Four. Work-Holding Devices—Special jaws. Tool-Holding Devices—Standard arbor. Cutting Tools—Slitting saw, 0.044 in. thick. Number of Cuts—One. Cut Data—450 r.p.m. Average Life of Tool Between Grindings—5000 pieces. Production—120 pieces per hr.

THE BAYONET WASHER

OPERATIONS ON THE BAYONET WASHER

Operation
1. Automatic
2. Eluing

The spring is coiled in a speed lathe and cut to length after coiling at the rate of about 350 per hour. One end is then closed in with a special punch, so as to fit the catch, at the rate of about 500 per hour. Details of the spring are shown in Fig. 2336.

THE BAYONET SPRING

OPERATIONS ON THE BAYONET SPRING

Operation
1. Coiling and cutting
2. Crimping

The bolo bayonet is shown in detail in Fig. 2337, the peculiar cross-section of the blade necessitating some very interesting milling fixtures. These are of the bridge-milling type, in which the lengthwise contour is determined by the rise and fall of the bridge that carries the work. In addition to this, the blade is given a side rocking motion by means of properly shaped cams on the sides of the bridge, so that the blade rolls under the cutter from point to pommel. Special formed milling cutters are used for the various operations, as with the regular bayonet, but varied to suit the different shape of the bolo.

Hiring Men Away from Other Shops

By W. B. Greenleaf

I have read with interest Mr. Brophy's article on page 410, Vol. 46. Now, while the attitude he takes is probably right in some instances, there is a decided "other side" to the question. I am inclined to think that he, like most men who have made a notable success in business, is prone to look at any question strictly from his own point of view, and to forget that it may look quite different from various other angles.

Is a man to be forced by "common business courtesy" to give up the position he holds before he tries to get a better one? If so, why is it that practically all firms give preference, in hiring anyone for a responsible position, to those who are "now employed"? As a matter of fact, one of the advantages in a job such as the one mentioned by Mr. Brophy is that a man has a chance to show his ability to others and so better his condition.

Incidentally, why increase his wages beyond what he can earn? Really, Mr. Brophy, you don't mean that, for you know that you won't pay more than he earns. You mean, more than a man of his general appearance ought to get. If the man you send is to be up to his job, he must not only be a first-rate mechanic, and be able to run the machine and repair it if necessary, but much more than that. He must have tact and the ability to get others, over whom he has no control, to follow his instructions. You should be paying enough for the added qualifications to make uninteresting any price that would likely be offered for mechanical ability alone.

There is also another angle, that occupied by your customer, who hires your man. He does not feel that you are sending the man as a "favor"; you are sending him because you want your machine to make good. You are selling a highly specialized high-priced machine. If it is properly handled, it is a standing advertisement; if not, it is very much the reverse. It naturally follows that you send a man to see that it is properly handled and, further, this service is probably part of the terms of sale.

I wonder if you do not give preference to men already employed, as mentioned above? If not, you live up to your opinion; but if you follow the usual custom, I hardly see how it differs from the practice referred to in your article. Except for the accident of business acquaintance, it can just as little be called stealing in one case as in the other.

In conclusion, I will say that I am an innocent bystander. I have never occupied any one of the three sides. I have been both employee and employer, however, about four to one in the latter class. As an employee I should resent the idea that I was "stolen" if someone should offer me more than I was receiving, and I never felt that I was "stealing" when I went after a man who looked as if he were worth more to me than he was getting. Nor did I think that my neighbor was "stealing" when the case was reversed.

Chromic Iron in New Caledonia

A citizen of Sydney, says *Commerce Reports*, who is interested in New Caledonia and has spent many years there, reports that the deposits of chromic iron ore are large. Recently, several American steamers, after discharging cargo at Sydney, went to New Caledonia to load chromic iron ore for the United States, providing a satisfactory cargo for the return trip.

The island is rich in nickel, lead and copper, and there are also gold, silver and coal. The climate, unlike that in some other South Sea Islands, is reported to be quite healthful. The soil is generally broken up by hills, the best agricultural lands being river valleys. The island is about 1000 miles from Australia.

James W. Lyons, former president of the Lyons Boiler Works, DePere, Wis., and later associated with the Lyons-Atlas Co., Indianapolis, has been elected vice president and general manager of the Whitman-Bull Tractor Co., St. Louis.

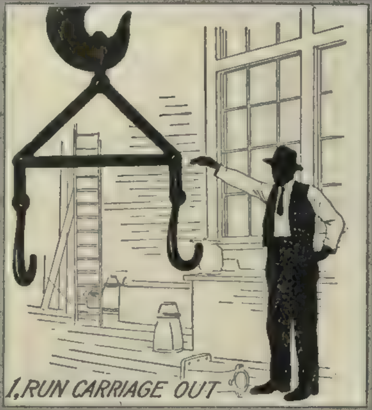
CRANE SIGNAL SYSTEM *of a* RAILROAD SHOP

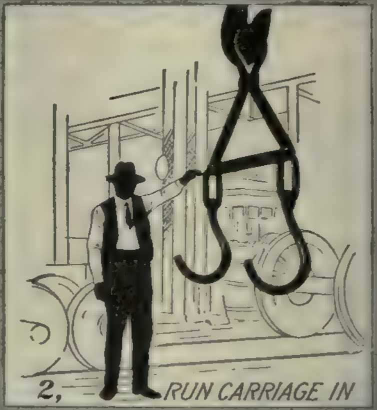
THE engravings show the system of signals used for controlling the operations of the cranes in the railroad shops at Sparks, Nevada.

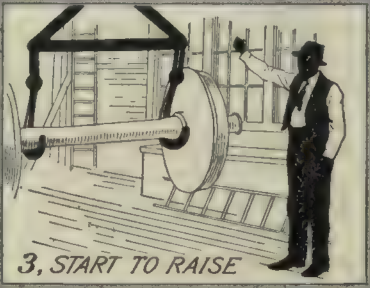
In Fig. 1 the position of the hand and arm indicates that the crane hook and sling are to be moved ahead, or directly away from the man, while in Fig. 2 the hooks are to be run back over the truck wheels. In Fig. 3 the wheels are shown picked up, the signals in both Figs. 3 and 4 being to raise the load.

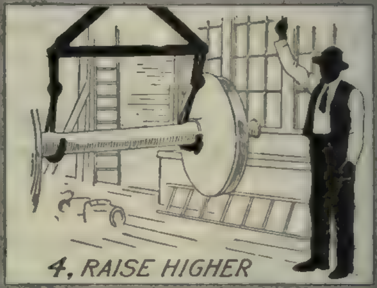
Fig. 5 is the signal to raise still higher, and Fig. 6 to move the wheels laterally, or toward the shop wall to bring them directly over the rails. Figs. 7 and 8 are the lowering signals, with the arm extended horizontally and the thumb of either hand turned downward.

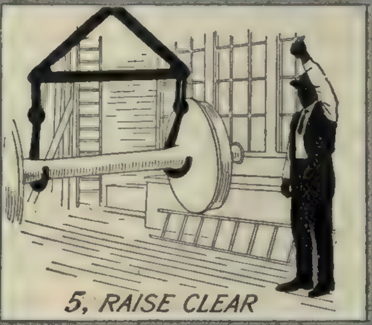
The signals in Figs. 9, 10 and 11 are for controlling simultaneously both hoists of the main crane. The outwardly extended arms with hands outstretched, as in Fig. 9, give the signal to hold the hooks in the position shown. With both hands turned downward, as in Fig. 10, the signal to the crane operator is to lower both hooks simultaneously. In Fig. 11 the arms bent upward and thumbs raised indicate that both hooks are to be elevated in unison.

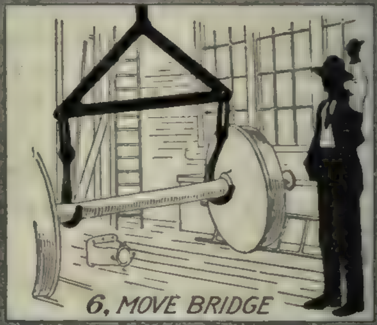

1, RUN CARRIAGE OUT

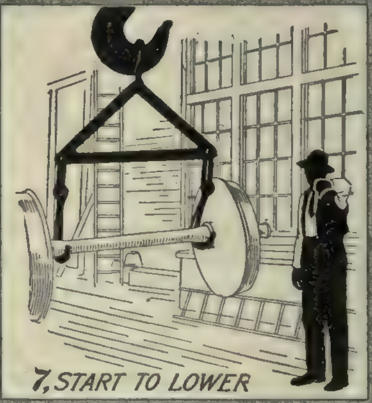

2, RUN CARRIAGE IN

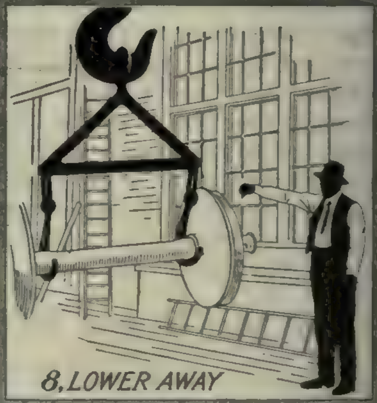

3, START TO RAISE

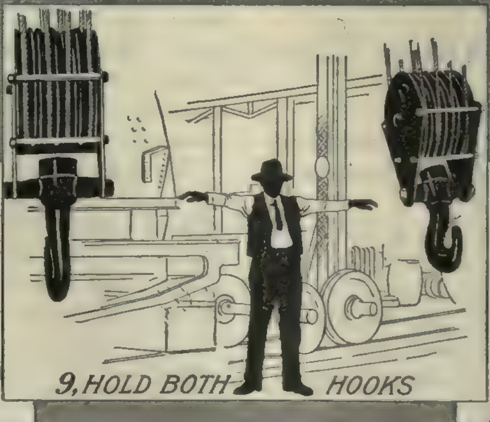

4, RAISE HIGHER

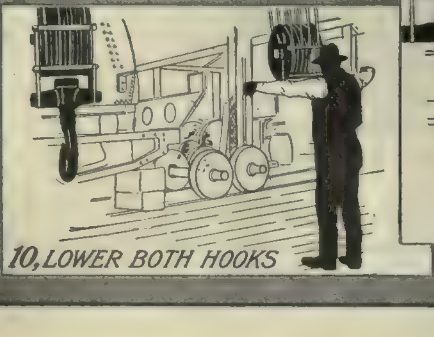

5, RAISE CLEAR

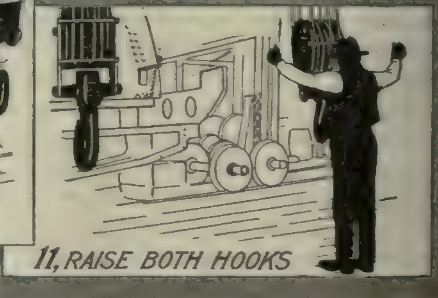

6, MOVE BRIDGE


7, START TO LOWER


8, LOWER AWAY


9, HOLD BOTH HOOKS


10, LOWER BOTH HOOKS

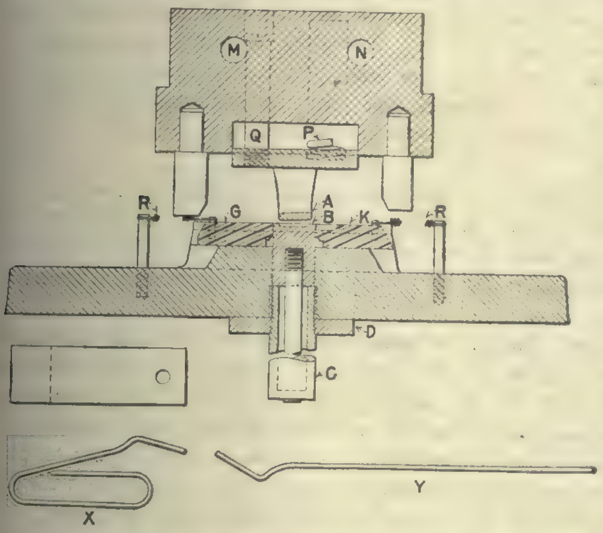

11, RAISE BOTH HOOKS

IDEAS FROM PRACTICAL MEN

Spring-Forming Die

By S. W. Palmer

The illustration represents the cross-section of a die for performing the last operation on the flat spring represented at *X*, while *Y* shows the spring as it comes to the die. The operation of this die is as follows: The work is placed on the lower part of the die between small gage pins, which are not shown. The press is tripped; and as the upper part of the die descends, the ends of the spring are turned up in a vertical position by the L-shaped piece *A* forcing the steel down into the groove cut through the square plunger head *B*. As the upper half of the die continues to descend, the plunger *B* is carried down against the action of a coil spring within the barrel *C*. The square steel plate *D* is threaded to fit the thread on *C* and is fastened to the cast-iron base of the die. The plunger *B* is forced nearly down to the top of the barrel *C* when the wedge engages the slide *G*, which is forced toward the center of the die and thus starts to form that end of the work around *A*. As the downward action continues, the other wedge engages the slide *K* and thus folds over the other end of the work.



CROSS-SECTION OF SPRING-FORMING DIE

While this part of the operation is being done, *B* is stationary and *A* is being forced upward against two heavy coil springs, only one of which is shown at *P*. These springs are located in diagonally opposite corners of the rectangular upper end of the steel part *A*. In the other two corners are hold-up bolts that also act as guide pins. One of these is shown at *Q*. As the head of the press ascends, the slides *G* and *K* are pulled back against stops by the coil springs *R*, as shown. There are two of these springs on each slide, arranged in the form of a V, to pull on each slide. Bolts pass through the holes *M* and *N* to fasten the upper half of the die to the ram of the press.

Making Built-Up Rectangular Tubing

By Donald A. Hampson

This is an account of present-day conditions when orders must be filled on time, when materials are delivered 10 and 12 months after they are ordered. The telescoping tubes of Fig. 1 are part of an apparatus made in quantities and sold at a competitive price. A large stock of the inner tube was on hand and no outer tube to go with it, neither could any be obtained. The story of how the deficiency was made up follows:

Cold-rolled steel in 6-ft. lengths was selected from a stock list, two proper widths being found. A heavy bending brake of 6-ft. length was one of the shop tools, and on this the strips were formed to the shapes shown by Fig. 2. Subsequently, these strips were cut off in the miller to lengths of 4 to 20 in., just as the tubes themselves had been cut. Two of the channel-shaped pieces were put together and riveted, forming the tube sectioned in Fig. 3.

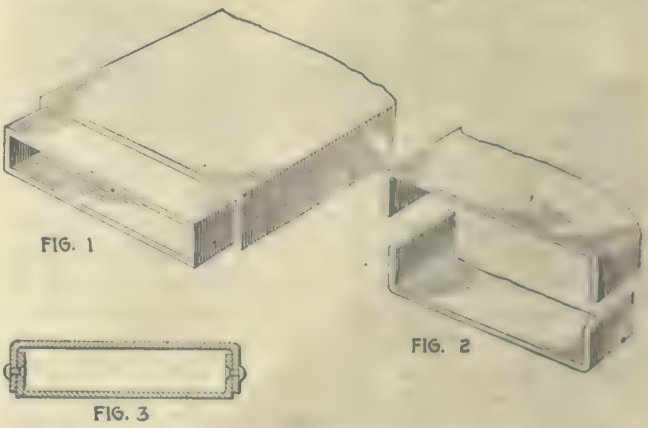


FIG. 1
FIG. 2
FIG. 3

FIGS. 1 TO 3. MAKE-UP OF THE RECTANGULAR TUBES

The brake left rounded corners of fully $\frac{1}{32}$-in. radius. This was not objectionable for the upper half, Fig. 3, but it was for the lower half, because the telescoping inner tube had a smaller radius on its outside covers. To correct this corner, the tubes, after being cut to length, were taken to the planer, where a few simple fixtures had been arranged. A parallel *P*, Fig. 4, was made up with cutouts along the top edges. Over this parallel the V-piece was laid and the vise jaw lightly set up. A hardened roller *R*, turning freely on a hardened pin, was set in a piece of steel held in the toolpost. The rest may be imagined. One stroke of the planer rolled down the V-piece, leaving the nicest of square inside corners. More than that, the roller straightened out a slight bow, noticeable in the longer lengths, which originated on the brake.

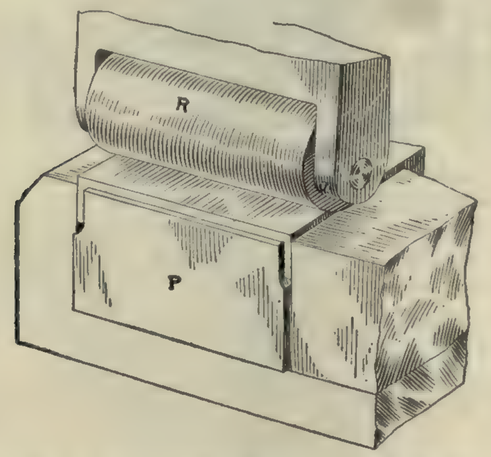


FIG. 4. PARALLEL WITH CUTOUT SIDES

In assembling this tube, certain requirements made it impossible to countersink the inside for the rivet head until the very last. How this was done is plainly illustrated by Fig. 5. The work was performed on a sensitive drill with the aid of a vise, a countersink, an old piece of cast iron and a few links of a discarded speedometer flexible shaft. Two links were straightened out, one to go in the drill chuck and the other to enter the special countersink. Of course, the vise had to be fastened down, or the "universal joints" would have failed to work as desired. The links as taken from the speedometer tube or casing were hardened, and they proved to be quite durable, a set of three lasting for about 200 pieces of half tubing. Three or more holes were to be countersunk in each side of each piece; to locate these under the countersink, a spring plunger was set in the lower part of the cast-iron block. The spring was just heavy enough to allow a boy to feel the hole as he slid the work along. This arrangement would undoubtedly fail on heavier work, but the steel here used was only $\frac{1}{16}$ in. thick and the rivet was set in but halfway.

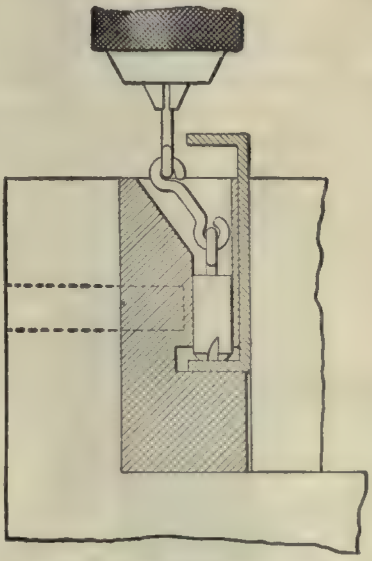


FIG. 5. THE COUNTERSINK

The other interesting feature of the job was the cost, which for the assembled tube, including tool cost, was less than the present price of seamless stock—at 10 months' delivery, remember. The finished job has a neat and workmanlike appearance and answers every requirement. As for the tools, they are simple and good and cost very little.

Mounting, Balancing and Dressing Grinding Wheels

BY LEON M. BUTLER

In many of the factories where production grinding is being done, I have found that each operator is permitted to dismount his old wheel and remount a new one, dress off the sides if accuracy in width is desired with a straight in cut, and then balance. I have found by experiment that a considerable gain in production can be obtained by specializing on this work. The parts ground in this experiment were crankshafts, the concern having an output of between 600 and 700 per day.

A new operator will take two or three hours to set up a new wheel and usually requires the assistance of an older head besides. We were losing this amount of time from thirty to forty roughers weekly, by using the above method, and also several wheels, through the inability of operators to dress their wheels to proper size.

By training a special operator in this work we gained many hours of labor and also obtained better results in the size of our wheels. Using a grinding machine exclusively for this work, with an operator trained to this method, we obtained speed and accuracy.

Care should be taken to keep each wheel mounting clean from dirt and burred-up points. Aside from this no difficulty is experienced, as all grinding-machine spindles are ground to a standard taper and the mountings are interchangeable. To insure even better results two mountings should be numbered to correspond with the number of the machine on which they are used.

Recording Die, Jig and Fixture Numbers on Drawings

BY H. H. ARMSTRONG

When a manufacturing order is received covering a large number of one particular design of apparatus, the main desire on the part of the management is to manufacture these devices satisfactorily and with a minimum labor cost. To do this, dies, fixtures, jigs, etc., are made up by the tool department, from drawings furnished by the manufacturing drafting department.

If the number of devices to be made is enormous, then a complete tool equipment is demanded; but if the number is normal, then only sufficient tools are made, at the discretion of the engineer in charge.

In either case a list of the tools available should be made, so as to acquaint the factory with the equipment on hand to do the work and thus save the time, labor and expense of doing operations manually for which tools have been manufactured.

In some large factories the tool department furnishes the designing engineer with a tool report, a copy of which is also sent to the manufacturing drafting department. This report states the different tools to be made and also gives their estimated cost. If the engineer approves the report, a copy of his approval is also sent to the drafting department. The drafting department then consults the tool report and goes through it, and on each tracing the draftsman records the die, jig or fixture number. When the list is completed the blueprints are sent to the manufacturing departments. The factory foreman can therefore tell from each drawing what equipment will be available, and he can then give his cost and promise of completion with a certain degree of accuracy.

This system will prove efficient if all the information is given on the blueprints, but where operations are omitted or some prints have been overlooked it is useless. The drafting department should be held responsible and must see to it that the system is carried out properly.

The question may arise as to why the factory cannot take the information directly from the tool report. In some cases they may, but often the engineer rules out parts of the tool report which to his mind are not needed, and of course these tools are not made up. But when the manufacturing drawing contains this information it is reliable.

I remember one case that caused considerable trouble in a certain factory. The production department placed orders on the machining department to have some parts made up from a certain drawing, which did not show any tool equipment. The parts were half completed when it was discovered that tools with which to do this work were in stock. It was also found that it would be cheaper to start the work over again with the tools than it would be to finish the parts already started by hand. The question arose as to who was at fault and who should stand the expense of scrapping the half-completed parts. Finally, after a lot of correspondence, the production department and the factory went "fifty-fifty" on the expense.

The production department claimed that the factory was wrong in not looking up to see if there were tools on hand. The factory foreman took the stand that the order was placed on the machine department and that he simply carried out instructions. If the drawing of the particular piece of apparatus had had the die numbers on its face, the order would have been placed on the pressroom and the parts produced in the proper way.

Bear in mind that the tools are estimated on and completed before the manufacturing department can go ahead with the work. Therefore, when the orders are placed on the factory, if there are tools to do the work the drawing will show it. The factory foreman is in a position to know whether tools are needed or not, and if his orders cover a large production, and the drawings do not show any record of tools, he will then question it and the matter will be adjusted.

It is also good practice to record on punching drawings the size of the stock required to produce the part, as this information is invaluable to the order clerk. When once recorded on the drawing it is only a matter of replacing the stock when exhausted, instead of going to the trouble of measuring up the die each time.

The matter of tool information appearing in the detail drawings is valuable to the cost department. In making up its first cost, a price can be obtained from the factory where there are tools to do a certain piece of work much easier than if there were no tools. Also, when the first cost is made, perhaps some parts are made by hand. If, in the meantime, the factory foreman finds out he can save money by making a tool for these parts, this information is put on the blueprint; consequently, when a cost revision is made, and the cost man finds more tools made up, it will result in a lower factory cost than before.

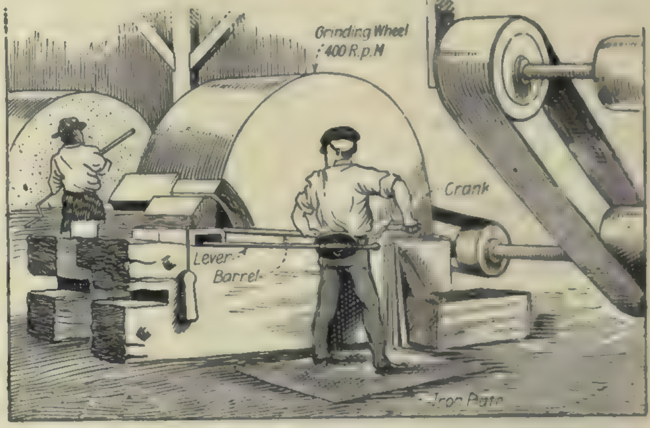
The production department will also be benefited by this system, as when a production man is given certain parts to make he wonders how they will be produced until he sees the die number on the drawing. He then discovers that there are tools with which to do the work, and by interviewing the pressroom an exact promise can be made of the time required to produce the parts.

This system has been in force in large factories and has resulted in a great saving of time and expense.

Grinding Springfield Musket Barrels Sixty Years Ago

BY H. H. PARKER

In comparison with the modern methods of small-arms manufacture as described in recent copies of the *American Machinist*, the old-time practice outlined in a magazine of 1852 might prove of interest. This article dealt with the manufacture, at the Springfield "Armory," by the interchangeable plan, of smooth-bore muskets at that time used by the United States Army. Of special interest was the method of finish-grinding the musket barrels. The barrels were first formed and welded under drop hammers, evidently in semi-cylindrical dies, then bored, turned on the outside, straightened, and then the outsides ground to final form. The process bears a faint resemblance to the modern practice of wide-faced wheel grinding; but instead of relatively small grinding wheels running at high speed, very large grindstones were used, and the work was rotated and advanced by hand. These grindstones were driven by water power. The diameters were not given, but the sketch shows them standing considerably higher than the operators. They revolved with "prodigious" velocity (400 r.p.m.) and were kept wet by streams of water.



OLD-TIME GRINDING SHOP

The operator would hold a barrel against the wheel by hand and rotate it by means of a crank handle held by friction in one end. The required pressure to hold the work was obtained by means of a long lever and pad, against which the man backed. To keep his feet from slipping, he stood upon a corrugated-iron plate during the process. The wheel face was as wide or wider than the work, or barrel, so that there was no axial feed. The barrel was hidden from view while being ground, with only the crank handle and its extension rod projecting. A weight shown on the side of the wheel frame drew the work away from the wheel when the operator eased up on his lever.

The barrels were tapered, and gages were applied from time to time to determine the proper diameters and taper. No mention was made as to the "limits" required. After grinding, the barrels were polished on "emery wheels" revolved with "inconceivable" velocity "by means of machinery." These wheels were leather faced, sized with glue and covered with pulverized emery. The work was applied by hand.

Triangular fluted bayonets were fitted to the muskets, and formerly the grooves had been ground out on the grindstones, the faces of which were fluted for the purpose. At the time of writing, however, this grooving was performed by the cutters of "milling engines," which method was found to be more accurate and economical.

Combination Die for Gear-Shifting Lever Tower Cap

By Fred Rauter

The die shown in Fig. 1 was designed for the manufacture of automobile gear-shifting lever tower caps, Fig. 1. This die blanks, draws and pierces in a single-acting press.

The die, Fig. 2, is constructed as follows: The blanking and forming punch *A*, which is made of tool steel, hardened and ground, is fastened to the cast-iron punch holder *B*. The blanking die *C* is of tool steel, hardened and ground, and seated in the cast-iron base *D*. The piercing and forming die *F* is also seated in the base. The piercing punches *G* are shouldered, to resist the force required for piercing, and are held in place by headless setscrews. The stripper *H*, which strips the scrap from the blanking punch, is suspended from the punch holder by six special screws *I*, which also serve as retainers for the stripper springs.

A safe rule, which I have used quite successfully for the calculation of the stripping pressure required, is approximately 7 per cent. of the blanking pressure. The upper knockout *K* is held in alignment with the punches by three pins *L*, which are pressed in the disk *M*; the spring *N* having the required amount of tension to eject the cup from the punch. The blank holder *O*, which also serves as a stripper for the finished cup, is supported by four push pins *P*, abutting against the disk *Q*, which transmits the spring pressure from the three springs *R* to the blank holder. The spring tension is adjusted by the nuts *S*. The guide pins *T*, which are of different diameters to avoid mis-setting of the die, are a press fit in the base and a sliding fit in the punch holder. The shank *U* is fastened in the ram of the press.

The operation of the die is as follows: The blank is cut from the strip by the punch *A* at the point marked *V*, and is held under tension between the punch *A* and the blank holder *O*. The punch *A* continues down, forming the cup around the die *F*. The punches *G* then pierce the holes, the knockout *K* serves as a bumper, flattening the face of the cap. On the return stroke the scrap is stripped from the punch *A* by the stripper *H*. The cup is pushed up flush with the blanking surface *V* by the stripper *O*. The knockout *K* ejects the cap from the punch. It is essential to secure an even edge on the cap. No trimming is required with this type of die.

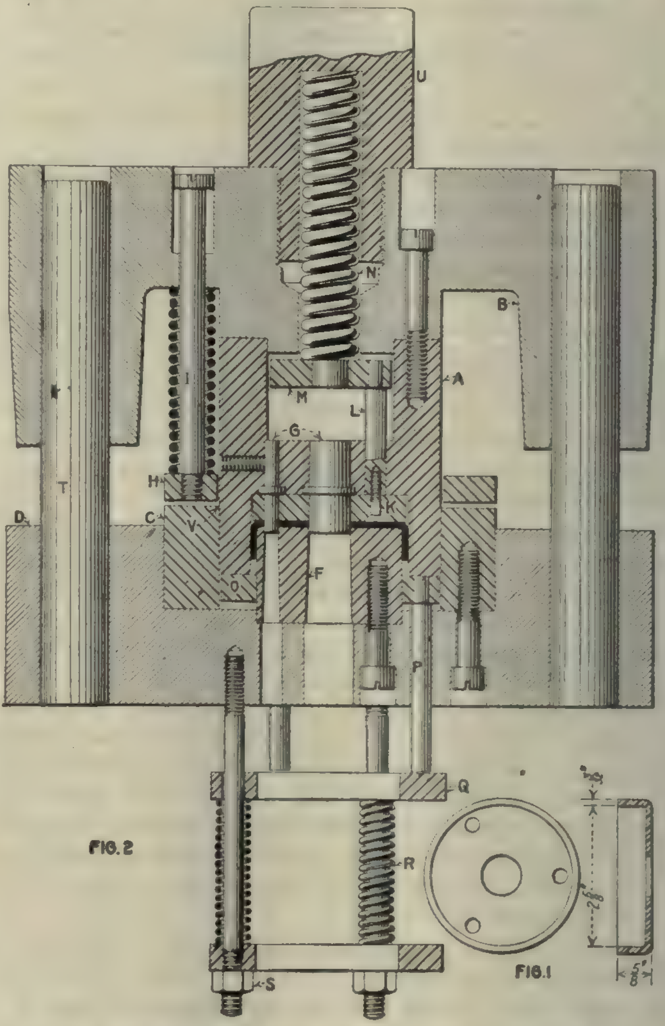


FIG. 2

FIG. 1

FIGS. 1 AND 2. THE CAP AND DETAILS OF THE DIE

Western Railway Club

The following were elected officers of the Western Railway Club at the annual meeting held last month at the Hotel Sherman, Chicago, Ill.: President, A. R. Kipp, mechanical superintendent, Chicago division, Soo Line; first vice president, A. La Mar, master mechanic, Pennsylvania Lines; second vice president, G. S. Goodwin, mechanical engineer, Chicago, Rock Island & Pacific; secretary and treasurer, Joseph W. Taylor.

Harry E. Harris, John H. Barr and William A. Viall have been appointed a committee to coöperate with the National Bureau of Standards in the making of gages for munitions manufacture.

Editorials

Prices and Quantity Buying

NOW that the huge appropriation of $640,000,000 has been passed for aircraft work, there is some evidence that things are really beginning to move. Those who have been on the inside sufficiently to know what was really being done, or perhaps it might be better to say what was not being done, have been a bit discouraged at the failure to place orders for parts which were obviously needed and which might have now been in actual production instead of only being talked about and at keeping the manufacturers guessing as to what orders were actually to be placed. All the training machines, for example, have been ordered without their equipment of instruments, presumably because the price of these instruments seemed high to those who placed the orders, but who did not realize that the reason the prices were high was because the instruments were ordered only in very small lots, which actually prevented any manufacturing methods from being used in their production.

* * *

Then, too, some of the specifications for instruments contain such unusual requirements as seriously to delay production, owing to the inability in some instances of securing the particular material called for in these specifications. If such requirements were at all necessary, there could be no objection to their being demanded; but when these specifications call for devices which are not considered necessary by any of the Allies and which seriously delay the equipment of the machines, it seems to be a time for someone with both authority and good judgment to wield a blue pencil with considerable vigor.

* * *

There is of course usually a reason for all delays of this kind, but this is a time when performance is far more valuable than even the best of excuses. The army and navy bureaus which have been accustomed to ordering supplies of this kind have, on account of small appropriations, necessarily ordered in extremely small quantities, and this practice makes it all the more difficult for them to get into the habit of thinking in large quantities.

As an example, we may cite one instance where a purchasing department that had usually bought in comparatively small quantities for a single barracks was suddenly confronted with the necessity of purchasing supplies running into the millions of dollars. An excellent officer was placed in charge; but he was comparatively helpless, as there was no provision for a suitable staff of clerks and inspectors. With his previous experience at another point, he was enabled to reorganize his department after many trials and tribulations, but the case simply served to show how utterly inadequate are many of the provisions made by the old system.

Some, at least, of the men who are in charge of purchasing supplies do not seem to realize fully the effect of substantial orders on price. This is particularly true in the case of articles that are made especially for the army or navy and have practically no market in regular commercial fields. In such cases it is absolutely necessary to place an order of sufficient size to make it possible to introduce manufacturing methods, if the price is to be made at all reasonable. And not only the price, but the rate of production is also tied up in the same way.

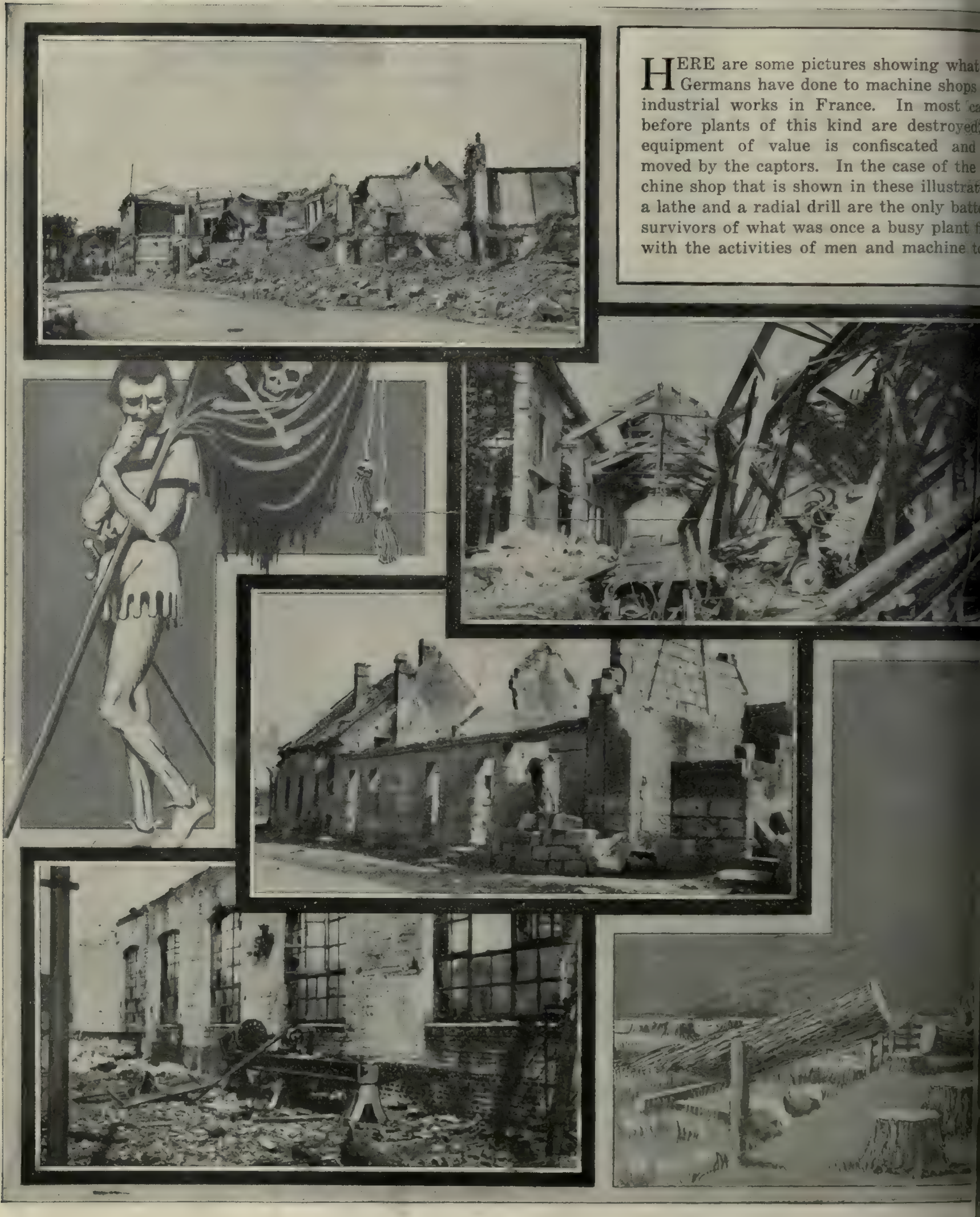
This holds true in the manufacture of airplanes, particularly in the case of a comparatively small factory. According to the manufacturer, it would be far better to place a definite order for so many machines per day, covering a specified period such as a year, than to order fifty or one hundred machines within a specified time, as is now the custom.

* * *

Where a factory knows that it has a definite output for a given period, it is much easier to plan both as to material and workmen. Such a requirement is better in every way than to be obliged to build up a comparatively large working force and then dismiss the men at the end of two or, at the most, three months.

All this serves to indicate that in emergencies like the present, when buying in large quantities becomes absolutely necessary, such buying can be done much more advantageously for all concerned by men who are thoroughly accustomed to doing business in a large way. This is the reason that men like Julius Rosenwald are able to secure such satisfactory results. Mr. Rosenwald has spent his whole business life in buying large quantities of material of various kinds, and it is only natural that he should be better fitted for the purchase of supplies in the immense quantities now necessary than those who have so many other duties to perform that they cannot be thoroughly familiar with the supplies themselves and who are not accustomed to buying in such large quantities and in the open market. This is one of the lessons which we can very well learn from Great Britain. Though she has not entirely succeeded in eliminating all traces of the older system, she has made tremendous strides in this direction and is to be heartily congratulated in many respects.

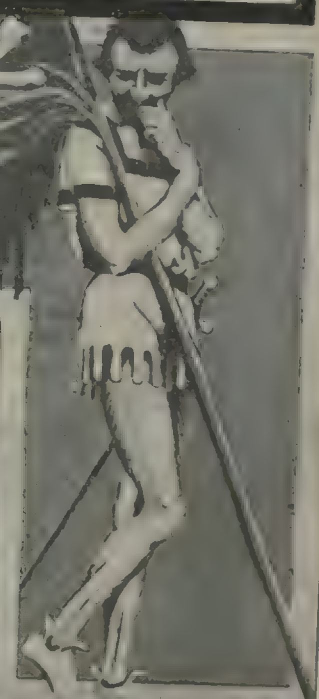
Shattered Machine Shops

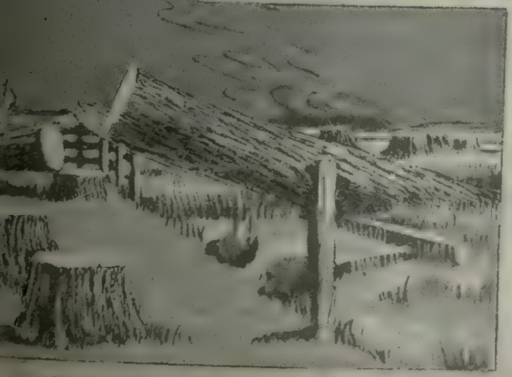


HERE are some pictures showing what
Germans have done to machine shops
industrial works in France. In most ca
before plants of this kind are destroyed
equipment of value is confiscated and
moved by the captors. In the case of the
chine shop that is shown in these illustrat
a lathe and a radial drill are the only batt
survivors of what was once a busy plant f
with the activities of men and machine t

near the French Front

Vhere machinery cannot be carried away or not wanted, no steps are left untaken to eck it completely so that it may never again of service. German thoroughness in this tter surely is on a high plane of efficiency. ne of the illustrations show a chemical ks that looks as if a cyclone had hit it. of America, away from this nightmare of truction, have good reason to work with re- bled energy for the common cause.





Appointing Agents for Belgium—The Other Side of the Question

By GEORGE R. WOODS
Assistant to President, Allied Machinery Company of America

SYNOPSIS — *In this article arguments are advanced to show that American machine tools and machinery are best presented to foreign markets by American agents. Mr. Knowlton, on page 141, took the view that these agents should be native sons of the countries approached. Both of these articles offer food for thought on this timely question.*

READERS of *American Machinist* will remember being confronted on page 141 with a picture of a buxom dame stretching out her hand to Uncle Sam on her right, while she enjoined that gentleman to place his machinery in the arms of a square-headed little gentleman with wooden shoes. The lady referred to represents Belgium, and she feels very kindly toward the man with the wooden footwear because he is, as she says, a "native son."

This picture portrays the burden of a story that appeared under the signature of O. Knowlton in regard to the appointment of machine-tool agents in Belgium after the war; and while that article treated particularly of the Belgian situation, the author made several generalizations and stated in conclusion that he considered it would a very great mistake for American manufacturers to be represented in any foreign country by a firm which was not indigenous to the territory covered.

Mr. Knowlton advances a number of reasons in support of his statement that the "native son" is the best proposition. The principal points he mentions are economy of operation and familiarity with the field. It seems strange, therefore, when a native agent can operate more economically and knows his field better, that it should be necessary for him to resort to a policy of exclusion of alien dealers, as mentioned by Mr. Knowlton; and to show the trend in this direction, he mentions an association of French importers of machine tools.

The best that can be said of this illustration is that it is very flimsy evidence to support the statement made. This association of French importers endeavored to have the French Government restrict its purchases of foreign machine tools to members of this association, all of which were French houses, and Mr. Knowlton prophesies that the same course will be adopted in other countries. He does not mention that the Government flatly turned down the proposal of this association of machine-tool importers; neither does he mention that the largest stocks of American machine tools carried in Paris today are not carried by French houses. If these French importers were so efficient and so anxious to serve their Government, why did not they place large stock orders, as did the English and American machine-tool dealers in Paris? Notwithstanding the advantages which these native houses possessed, they did not grasp the opportunity to help the French Government the way foreign houses did; and the rapid development of the French munitions industry resulted largely from the enterprise shown by some of the larger foreign machine-tool dealers.

The first objection raised against the alien dealer is that his house is usually a branch and that he has to inflate his prices in order to support first, the branch in the country, and second, the head office and branches elsewhere. This statement questions a fundamental merchandising proposition. There should be no necessity for replying at length to this point, because we have so many demonstrations that a large concern can work for smaller returns than a little concern. The expenses of a head office, when proportioned among a number of branches, do not bring the overhead of any particular branch up to as high a figure as the overhead for an isolated concern doing business in one place only. Instances can be cited where certain lines of machine tools are not represented exclusively and are handled by one of Mr. Knowlton's typical "native son" concerns and also by one of the international machine-tool houses, and lower prices are quoted on the same machine by the larger concern.

Our friend now makes three points that should be considered before placing an agency with a foreign dealer and he takes Belgium as his illustration. Among the first questions he raises are queries in regard to the history and previous activity of the agent. He asks whether or not this agent carried stock and whether he was established before the war. In this connection, I wish to ask whether there was any Belgian agent, now in existence, who did not carry German machines as well as American machines before the war. No American manufacturer at any time has ever been able to place his agency in the hands of an agent who handled American machine tools exclusively, and there is only one concern in existence today which pursues the policy just mentioned.

The next point raised is in regard to the capability of the principals of the firm and whether or not they have had technical training and know anything about machine tools. I ask whether any isolated "native son" machine-tool house is going to be able to retain the technically trained machine-tool men that an international house is obliged to have at its headquarters; and I ask further whether a machine-tool house doing business in only one country, and a small one at that, is going to be sufficiently in touch with business movements to know how to purchase advantageously for stock. On this very point, the international machine-tool house has a tremendous advantage. It can purchase for stock when the "native son" house would think twice before taking machines on consignment. With its many outlets for stock machines, with its familiarity with the markets of many countries instead of one, the international house is in a position to stabilize the American machine-tool industry and turn over its machines with at least double the rapidity of a local house.

The third point raised in this series is in regard to the financial backing of the firm being considered and I ask again what local machine-tool house, at any time, in any country, ever commanded the capital that the international machine-tool house commands today and commanded before the war. In normal times in Europe the deciding factor in placing an order for machine tools in many cases is the question as to which dealer can extend the most favorable terms of credit. This was true before the war, and I prophesy right here that after the war the most necessary factor in the success of any machine-tool house is going to be its ability to finance its customers.

From the stress which is laid on the "native son" aspect of this situation, one would think that Belgium and other European countries are seeped in provincialism. On the contrary, some of Belgium's biggest shops before the war were controlled by French and English capital, not to mention the many German investments.

Before the war, the large German machine-tool houses secured the bulk of the business because they rendered service, and firms that render service after the war are going to gain the business. The large international machine-tool houses with their own shipping departments in New York, with their constant contact with the factories are able to take advantage of opportunities and to operate far more cheaply than any local house.

But the most important point in connection with this whole proposition is in regard to the nationality of the seller of American machine tools abroad, and I believe that some American machine-tool salesmen can sell American machine tools under any flag better than any "native son" salesman.

The largest builders of automatic machines in this country have sold direct in Europe for years, and their sales manager is not a "native son." Probably the largest American machine-tool orders ever placed in China, Brazil, Australia and France were not taken by "native sons."

I believe in American machine tools, and I believe Americans are the best men to sell them anywhere; and when I say that Americans can sell them, I mean that they have brains enough to hire "native sons" when that is the best plan, but it is American supervision of the selling of American machine tools that is going to get sufficient business for American machine-tool factories to keep them running year in and year out, regardless of whether that field is Belgium, Siam or Russia.

Professor Marks To Assist Airplane-Engine Design

The National Advisory Committee for Aëronautics has secured for an indefinite period the services of Prof. Lionel S. Marks, head of the combined departments of mechanical engineering of Harvard University and Massachusetts Institute of Technology. He will be assigned to assist in the special work of the Subcommittee on Power Plants and will have charge of certain investigations relating to airplane-engine design conducted by this committee at the Bureau of Standards.

Professor Marks is a recognized expert in thermodynamics, engine cycles and particularly the gas engine, and is probably the best-qualified man in the country to supervise the important investigations proposed.

Sensitive Tap and Die Holder

BY WINFIELD W. BLAKEMAN

A job came along a while ago that did not seem to fit our smallest turret lathe, and we were somewhat worried as to how it was to be done without undue breakage of taps, twisting off shanks, etc.

The pieces are shown in Figs. 1 and 2, and you will agree that the tapping of the No. 6-32 hole to the bottom in tobin bronze does not look real good for as heavy a machine as the No. 4 Bardons & Oliver.

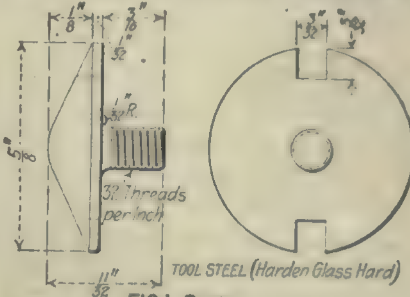


FIG.1 Button

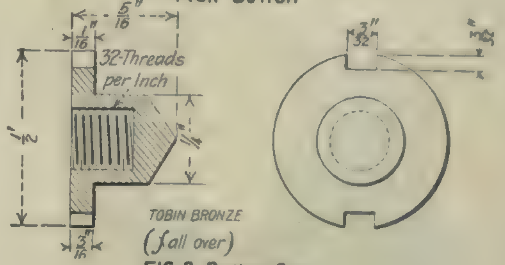


FIG.2 Button Cap

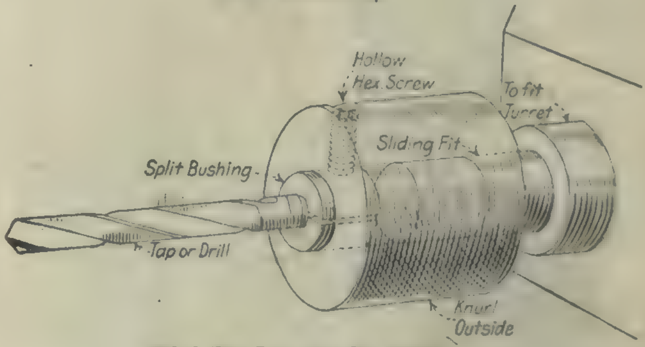


FIG.3 The Tap and Die Holder

FIGS. 1 TO 3. DETAILS OF TAP AND DIE HOLDER

The job was put up to Berry, and he promptly made the holder shown in Fig. 3. This worked so well that it has been used for other similar jobs, like drilling and threading small parts on heavy turret machines.

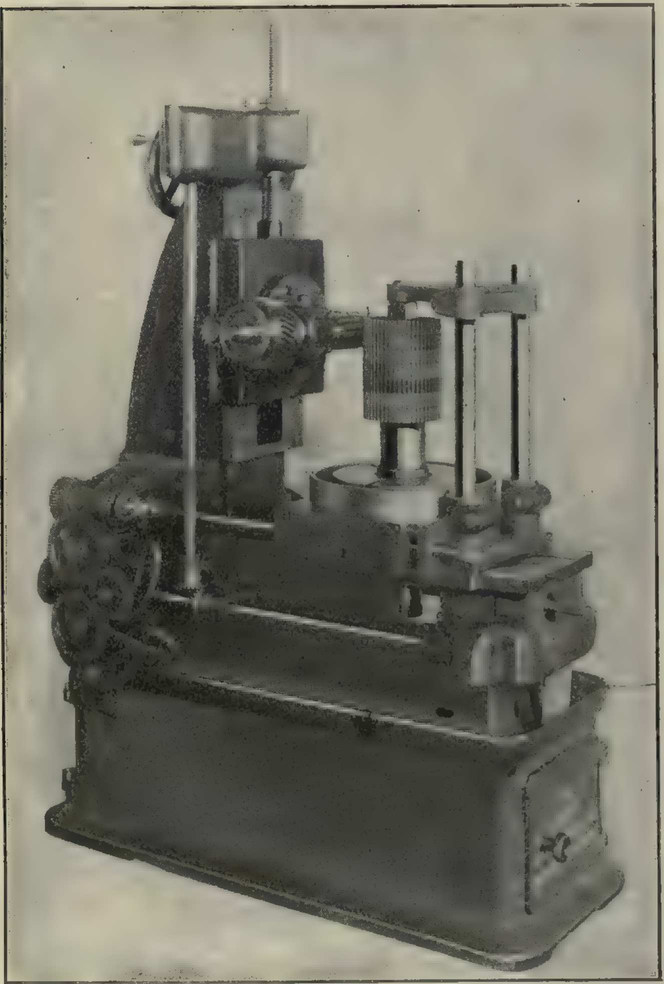
In operation the knurled sleeve with the tap drill or die secured in a suitable bushing is held lightly in the bare hand and fed up against the work. When the hole is tapped to the bottom the sleeve turns around on the shank. This gives one ample time to reverse the machine and acts as a safety device to prevent breakage.

The Sterling Products Co., Inc., of Chicago, distributor of high-speed drills and hacksaw blades, has opened a branch office in St. Louis at 938 Syndicate Trust Building, in charge of R. O. McGraw.

SHOP EQUIPMENT NEWS

Bilton Universal Gear Hobber

The Bilton Machine Tool Co., Bridgeport, Conn., is now building a universal gear hobber. This machine will automatically hob spur, spiral gears, worms and worm gears, together with a large variety of special shapes, which can be hobbed to advantage both as to quantity and quality.



UNIVERSAL GEAR HOBBER

Capacity: Diametral pitch, 10; outside diameter, 10 in.; width of face, 10 in.; countershaft speed, 250 r.p.m.; range of hob speeds, 50 to 250 r.p.m.; range of feed hob per revolution of work, 0.010 to 0.125; countershaft, four-step cone pulley, 2-in. belt; driving pulley, $8\frac{1}{2}$ x 4 in.; net weight, 1100 pounds

The base and column are extremely heavy with liberal reinforcements, so that they absorb any vibrations due to the most heavy duty put on the machine.

The work table is driven by a bronze worm wheel $11\frac{1}{2}$ in. in diameter. The wheel in turn is driven by a steel worm automatically lubricated and fitted with ball-bearing thrust collars, having ample adjustment for wear. The work arbor mounted through the table is $1\frac{3}{8}$ in. in diameter and 24 in. long. The table has three "T" slots to fasten the work or work supports. It also has a deep oil groove around the table, with large drains running to the base of the machine, where the oil reservoir is placed. This can be removed from time to time to clean it out.

The vertical slide is made extra long, having flat ways with large bearing surfaces, which will insure rigidity and long life without rescraping. The vertical slide carries the hob spindle head, which can be set at any angle.

The hob spindle is bored to take a No. 9 Brown & Sharpe taper, carbonized, hardened and ground. It is driven by helical gears, 8-10 pitch, $1\frac{5}{16}$ in. wide. The hob spindle can be adjusted lengthwise to relocate the hob after it has become dull in one place without disturbing the adjustment of the spindle bearings.

The triangular work-arbor support can be quickly raised so that the operator can remove the blanks. The two arbor supports are clamped in the work carriage and when not needed can be removed quickly. The hob speeds range from 50 to 250 r.p.m. The range of hob feed to each revolution of work is 0.010 to 0.125. The machine is driven by a three-step cone pulley having a $2\frac{1}{2}$-in. belt.

Nuttall One-Piece Expansion Joint

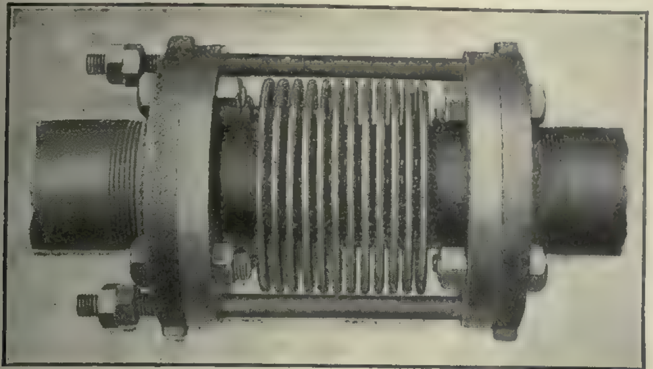
The adjustments in piping to accommodate expansion and contraction present a serious problem to the designing or constructing engineer. It is a problem also of particular importance to architects and contractors on large buildings where an immense amount of piping must be installed in minimum space and where that piping must be trouble-proof.

Loops and U-bends require space and expensive construction; stuffing-box and long-sweep joints require frequent attention and packing to avoid leakage.

A solution to the problem is the Nuttall one-piece expansion joint. As the name implies, this joint is made in one piece, machined inside and out from a solid, hammer-forged steel blank; then oil tempered. No packing is required and there is no possibility of leakage from a joint made in this manner.

The corrugations allow expansion or contraction by the same action as an accordion or bellows. The thin steel walls require most careful machining, but the result is a strong, nonleaking joint, readily responsive to the slightest expansion or contraction of the pipe line, capable of withstanding high internal pressures and giving a long life.

These joints are made in all sizes with standard flanges for either high or low pressure. The high-pressure joints are designed to allow an expansion of 1 in. and a contraction of 1 in. from normal, or a total movement of 2 in. The low pressure allows $\frac{5}{16}$ in. over or under normal, or a total movement of $\frac{5}{8}$ in. Limiting bolts are provided as shown to prevent expansion beyond the safe limit, and a sliding sleeve is also inserted in the high-pressure joints to minimize friction and help support the internal pressure strain.



ONE-PIECE EXPANSION JOINT

This joint is made by the R. D. Nuttall Co., Pittsburgh, Penn.

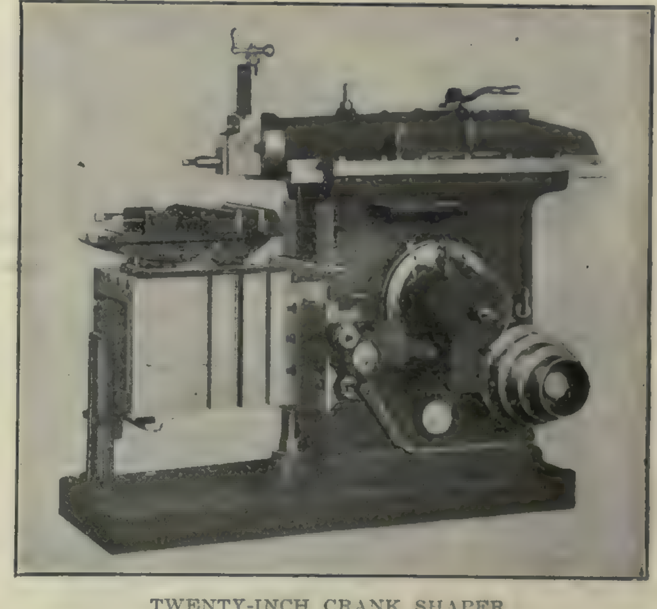
Columbia 20-Inch Crank Shaper

The machine illustrated herewith is so designed as to afford exceptional facility of operation. The base is wide and deep, extending well out in front. It is strongly reinforced and braced, also flanged on the under side. It is of pan construction, with the top fully inclosed, preventing oil from dripping on the floor and adding materially to the strength and rigidity of the machine. The column is large, of heavy box pattern, strongly braced, and made flush in front so as not to interfere with the full traverse of the head when set at any angle. The ways for the cross-rail are V-shaped, the rail being gibbed and locked on the operating side by one lever; the V-shaped guides follow standard miller construction and are extremely effective.

The ram is wide and deep, well braced internally, and properly proportioned to afford stiffness when operating at full stroke. The position of the ram and length of stroke can be readily adjusted from the front side of the machine. The ram is held in place by clamp gibs on top of the column, and an angular gib fitted at one side of the ram provides adjustment for wear. This construction permits easy adjustment when required, and at the same time prevents unnecessary and careless tampering with the gibs by inexperienced operators. Sight-feed oilers provide efficient lubrication for the ram guides. The head has vertical feed with micrometer adjustment; also graduated for angular adjustment.

The driving cone is carried on a bracket securely attached to the column, and runs on a sleeve having a three-point, ring-oiling bearing; this not only insures easy running, but the sleeve can be readily replaced if worn and the original alignment maintained. This construction does away with the need of a separate supporting bracket and the resultant interference when shifting the belt. The driving gear is liberally proportioned and is carried close to the rocker arm, in a bearing of large diameter, insuring ample power for the heaviest work; ring-oiling bearings are provided, with renewable bushings. The machine is back geared, which in connection with the four-step driving cone affords eight changes of speed. The speeds have been carefully calculated to afford the proper range, being in geometrical progression. The rocker arm is exceptionally heavy, the sides being connected by a strong central tie. It is connected to the ram through a heavy link which affords a direct pull on the ram. The rocker block is a steel casting with large bearings, and is provided with a taper gib for adjustment. Provision is made so that bar stock of large diameter can be admitted under the ram for key-seating.

There are eight changes of feed with a range sufficient for all classes of work. They are operated by merely shifting a small handle, conveniently located, and can be made while the machine is running. The arrangement is such that the feed takes place only on the return stroke, a small lever being provided which controls and indicates the direction of the feed. A safety friction is provided to guard against breakages. The feed gears are of steel, hardened and running in oil, and the arrangement throughout is compact, durable and extremely convenient.



TWENTY-INCH CRANK SHAPER

Actual length of stroke, 20½ in.; vertical traverse of table, 15 in.; horizontal traverse of table, 26 in.; maximum distance from ram to table, 17 in.; diameter of head, 8⅜ in.; length of down feed, 8 in.; top of table, 20 x 16 in.; side of table, 20 x 16 in.; ram bearing in column, 34 x 11 in.; rail bearing on column, 17 x 15¼ in.; key-seating capacity, 3½ in.; range of feeds, $^1/_{64}$ to ¼ in.; size of tools, ⅝ x 1¼ in.; size of vise jaws, 13 x 2½ in.; vise opens, 13 in.; driving cone, four steps, 3-in. belt; strokes of ram per minute, 8 to 113; single gear ratio, 4.7 to 1; back gear ratio, 21.5 to 1; size of countershaft pulleys, 13 x 4 in.; speed of countershaft, 300 r.p.m.; weight, skidded, 4060 lb.; weight, boxed, 4500 lb.; cubic feet, about 95

The cross rail is deep and strongly ribbed, and has power vertical feed as well as hand adjustment. The elevating screw is of telescopic construction and is carried on a ball thrust bearing. The table is of box form, extra heavy, and long enough to accommodate work up to the full rated capacity with the head straight or set at an angle. Ample T-slots are provided on the top and both sides of the table. A V-groove is also placed on one side of the table for holding round stock.

A table support is located at the outer end of the table. The bearing surfaces are protected from chips, and the support being clamped both to the base and the table, it is impossible to alter the height of the table unless the support is properly adjusted. The countershaft has large pulleys, the loose pulley being provided with oil reservoir, requiring only occasional oiling. The countershaft boxes are also self-oiling, by means of ring oilers. The hangers are pressed steel, strong, rigid, yet light in weight, so that they can easily be put up.

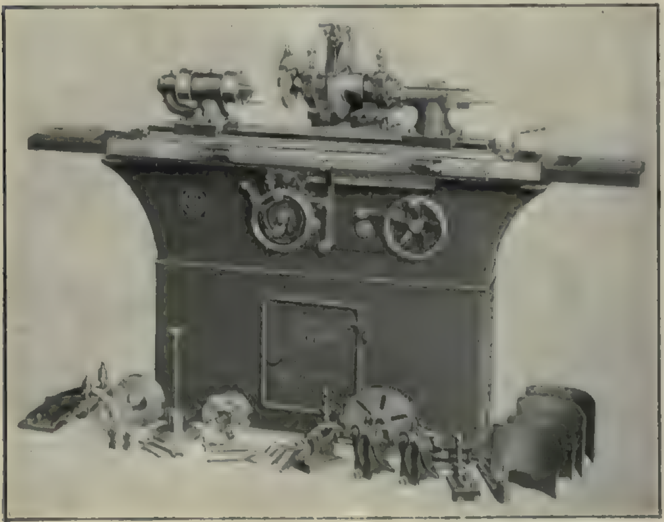
The regular equipment includes double-screw vise, table support, countershaft and wrenches. Single-screw vise can be had if so desired, and 16- and 24-inch sizes are also furnished.

This machine is manufactured by the Columbia Machine Tool Co., Hamilton, Ohio.

Ott Universal Grinder

Numerous improvements have been devised by the Ott Grinder Co., of Indianapolis, Ind., on its No. 2 universal grinding machine.

One of the principal features is the cross-feed mechanism. Simplicity and ease of adjustment have been attained by using a single rocker arm, a spring plunger and a stop screw. At the reversal of the table, the cross-feed rocker arm is tipped to its lowest position by a hardened pin on the reverse lever; as the table reverses the rocker arm is free to move upward, being actuated by a compression spring until the adjusting screw top is reached. At the left-hand end of the rocker arm a pawl engages the cross-feed ratchet wheel and causes it to rotate, giving a feed which can be varied from 0.00025 to 0.003 in.



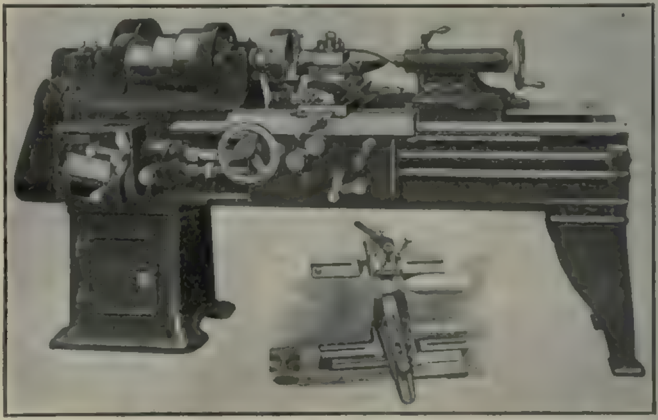
UNIVERSAL GRINDING MACHINE

It will be seen that the grinding wheel is fed in under power, while the spring is relied on only to give the feed adjustment. The feed may be thrown out by rocking over the feed pawl or screwing down the adjusting stop. The feed has an automatic throw out and also a positive stop when feeding by hand. This feed mechanism is simple, and adjustments may be made while the machine is in operation.

Cincinnati 18-Inch Shell Lathe

The lathe illustrated herewith is one of the standard type made by the Cincinnati Lathe and Tool Co., Cincinnati, Ohio, and is fitted with a special shell-turning attachment.

Using special high-speed steel, a shell of about 50-point carbon steel and having a 12-in. radius was machined in 16 min. 48 sec. The depth of cut taken was 1 in. or ½ in. on a side, using a $\frac{1}{32}$-in. feed and a spindle speed of 130 revolutions per minute.



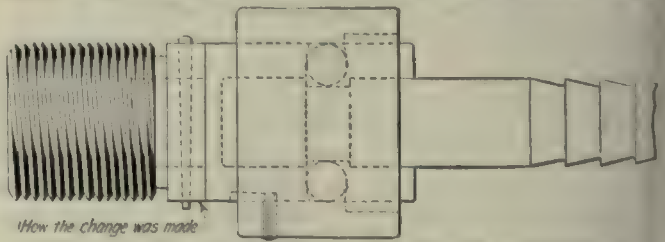
CINCINNATI SHELL LATHE

Swing over bed, 18½ in.; swing over carriage, 11½ in.; front bearing, 3½ x 5 $\frac{9}{16}$ in.; back bearing, 2 $\frac{7}{16}$ x 4½ in.; width of belt, four-step cone, 3½ in.; width of belt, three-step cone, 3⅝ in., hole through spindle, 1 $\frac{9}{16}$ in.; cutting tool size, ⅝ x 1¼ in.; diameter nose of spindle, 2 $\frac{11}{16}$ in.; diameter of tailstock spindle, 2¼ in.; length of carriage bearing on bed, 27 in.; ratio of back gears, 3.27 and 10½ to 1; diameter of countershaft pulleys, 12 x 4 in., cross-feed screw graduated to thousandths; speed of countershaft, 225 to 400 r.p.m.; lengths of bed, 6 to 16 in.; distance between centers 8-ft. bed, 56 in.; weight (net), 6-in. lathe, 2730 lb.; weight per extra foot, 145 lb.; size of box for export, 29 in: x 38 ft. x 115 in., occupies 73 cu.ft., 3215 lb.

Quick-Acting Chuck on the Broaching Machine

By C. L. Olsen

The "Magic" chuck is a time saver in the broaching of round and many other forms of holes, as the broach must be removed each time on this class of work. With this chuck the work can be done almost in the dark. The illustration shows the method of applying the chuck.



ADAPTING THE MAGIC CHUCK TO THE BROACHING MACHINE

Armstrong-Blum Metal Band-Saw

The machine shown in Figs. 1 and 2 is a universal metal-cutting band-saw, the special features of which are tilting or tipping of the blade 45 deg. to right or left, exceptionally high-grade workmanship, ease of operation, great range and capacity. It is known as the "Marvel Metal Band-Saw No. 8" and is made by the Armstrong-Blum Manufacturing Co., 333-357 North Francisco Ave., Chicago, Illinois.

The saw blade is mounted on two flanged wheels supported by a frame of unusual rigidity and stiffness, which in turn is pivotally carried on a frame or cage under the table. This cage is equipped with four hardened roller bearings that travel in planed dirtproof races.

The feed may be thrown in or out instantly by means of a thumb lever at the front. A bronze worm gear with cork inserts, two friction disks, a spring and adjusting nut imparts the required pressure to the blade. For manual operation of feed, a handwheel is provided.

A centrifugal pump (submerged) with two roller-bearing idlers brings the lubricant to the blade at the point of cutting, the lubricant passing directly through the teeth at the point of delivery. The saw-blade rollers are double ball bearing with felt dirtproof rings and are embedded in solid cast-iron cases. The knock-off dog may be shifted to stop the machine at any required depth of the cut. The band-wheels may both be tilted to perfect alignment with the saw blade.

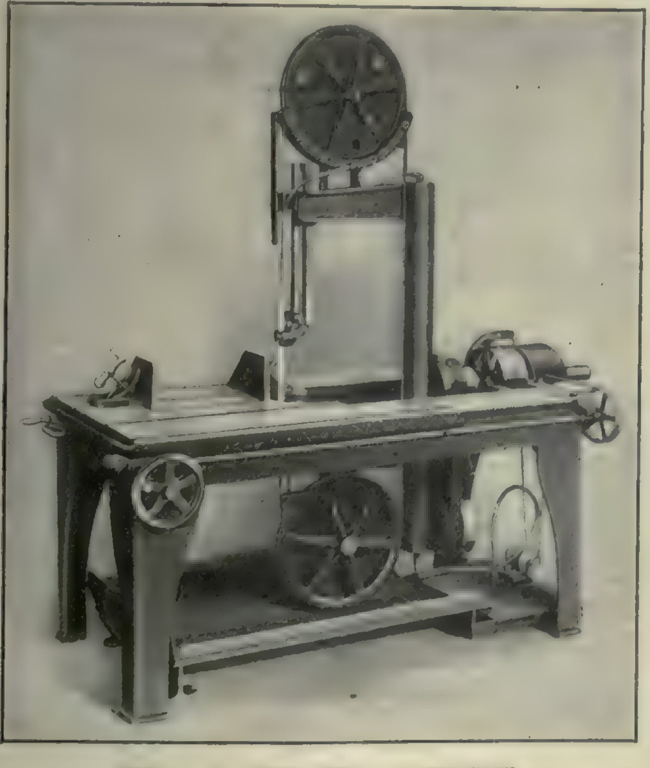


FIG. 1. MARVEL METAL BAND-SAW

Capacity of throat, 18 x 20 in.; takes saw blade 14 ft. 8 in. long by ⅝ in. wide by 0.032 in. thick; speed of tight and loose pulleys, 400 r.p.m.; diameter of pulleys, 10 in.; takes 2-in. belt; floor space, 36 in. by 6½ ft.; height over all, 7 ft.; net weight, 1500 lb.; weight crated, 1760 pounds

The vise jaws are machined accurately, 6 in. high by 12 in. wide, and are of special quick-acting type, either one of which may be shifted instantly to full capacity, or 18 in. They are also reversible and may be shifted to either of the two center slots or removed altogether, leaving the table free to fasten fixtures or work of unusual shapes.

The saw table is surfaced, unusually large and heavy and free from obstruction, being 32 in. wide by 5 ft. long with four ¾-in. T-slots, the two center ones machined and notched to accommodate vise jaws. Sawing angles up to 45 deg. may be done with the work held stationary in the vise by tipping the blade to the required angle indicated by degree graduations.

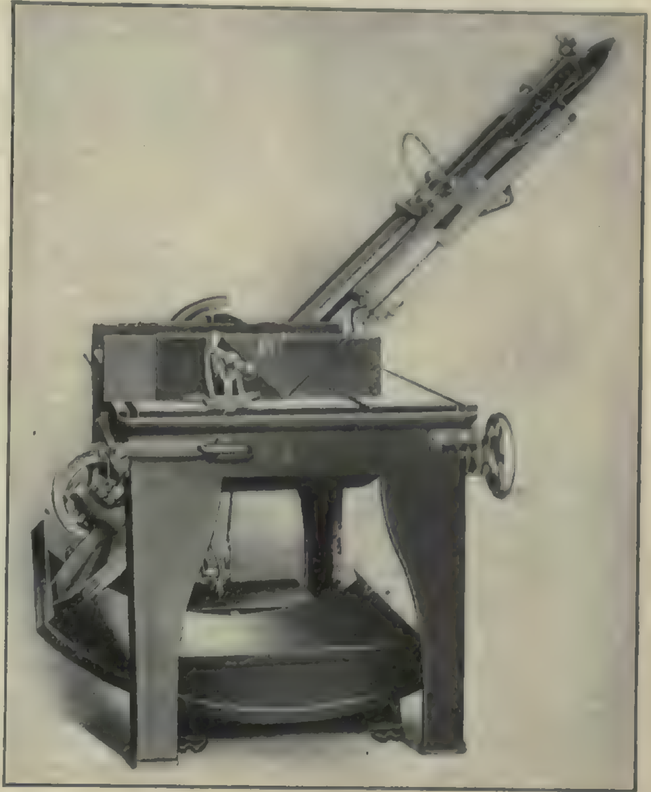


FIG. 2. SAW WITH BLADE AT AN ANGLE

The drip pan is telescopic and designed to catch the drip when the saw blade is swung at 45 deg. either way. The speed of the saw may be increased about 90 per cent. by means of double cone pulleys. Guards are provided at all essential places.

The machine is regularly furnished with pump, connections and pan. It can be furnished without pump for dry cutting, when so specified, and can also be furnished motor driven.

Government Can Now Make Optical Glass

The Bureau of Standards of the Department of Commerce, after two and a half years of continuous study and experiment, has achieved satisfactory results, and is prepared to produce optical glass. Additions are now being made to the working plant requisite to permit larger production to supply the needs of the Government. The matter is one of essential importance to the military services of the nation. Heretofore this material of the best grade has been wholly made in Germany; but the United States is henceforth independent of any foreign supply for this most important product.

Personals

R. T. Gifford, who was equipment engineer with the Pratt & Whitney Co., is now chief engineer for the Colt's Patent Fire Arms Manufacturing Co., Hartford, Conn.

Edgar N. Dollin, organizer and president of the Acme Die-Casting Corporation, has sold his holdings in that company and is retiring from active management.

Donald Tulloch, Jr., is now secretary of the Boston branch of the National Metal Trades Association, with an office in Room 4, 166 Devonshire St., Boston, Massachusetts.

Frank R. Bacon, president Cutler-Hammer Manufacturing Co., Milwaukee, electric controlling devices, has been called into the Federal commissary service as a captain in the quartermaster officers' reserve corps.

R. J. Doty, who for the last 3½ years has been in charge of the steel foundry of the Isaac Johnson Co., Spuyten Duyvil, N. Y., has severed his connections with that company to become associated with the Sivyer Steel Casting Co., Milwaukee, Wis.

John N. Willys, of the Willys-Overland Co., Toledo, Ohio, has been formally elected president of the Curtiss Aëroplane and Motors Corporation of Buffalo. He succeeds Glen H. Curtiss, who has been elected chairman of the board. William A. Morgan, president of the Buffalo Copper and Brass Rolling Mill, Buffalo, has been elected a director to succeed George Palmer, resigned, and was also elected vice president and general manager in charge of all operations. Mr. Willys was made a member of the executive committee, succeeding Harry Evers, of Buffalo.

K. G. Martin, manager of the Service and Publicity Departments of the American Steel Export Co., New York, was granted an honorable discharge from the 22nd Regiment, Corps of Engineers, N. G. N. Y., in order to accept a commission as Captain in the Officers' Reserve Corps, Motor Transport Service. His membership in the American Society of Mechanical Engineers, American Institute of Electrical Engineers, National Electric Light Association, Society of Automobile Engineers, New York Electrical Society and American Museum of Safety indicates his wide acquaintanceship with engineering practice and the knowledge he will be able to bring to bear on military problems.

New Publications

Gisholt Turret Lathe Guide—Two hundred and fifty-four 5¾ x 9-in. pages; profusely illustrated; cloth binding. Published by the Gisholt Machine Co., Madison, Wis. Price $1.

While published by a machine-tool manufacturing company and describing operations of one type of machine tool, this book is in no sense a catalog. It is a compendium of useful information for the user of this well-known type of machine tool and contains a great number of valuable suggestions, both as to manipulation and tooling. All the ideas illustrated have been successfully worked out in practice and are being used today.

Oxyacetylene Welding and Cutting—By B. F. Willis. One hundred and eighty 3¾ x 6-in. pages; 52 illustrations; cloth binding. Published by B. F. Willis, St. Louis, Mo. Price 50c.

This is a very practical little handbook on the subject of oxyacetylene welding and cutting, written from the experience of 10 years in the welding business. It is arranged in the form of questions and answers, which is, perhaps, its chief drawback. On the other hand, there are a number of practical points brought out in a clear and understandable way that will appeal to those desiring information on this subject. As the author remarks in his preface, "This book is sold at a price which precludes the possibility of profit to the author. You pay only for the printing and the paper—subject matter is gratis. Do not look a gift horse in the mouth too closely."

How To Run an Automobile—By Victor W. Pagé. One hundred and seventy-eight 5 x 7½-in. pages; 72 illustrations; cloth bound. Published by the Norman W. Henley Publishing Co., 132 Nassau St., New York City. Price $1.

Readers of the "American Machinist" who are automobile enthusiasts will be interested in this book, which tells, in a very practical manner, the essentials of operating various types of American motor cars.

Business Items

Aall & Co., of Tokyo, the Japanese agents for the American Steel Export Co., have added B. Orum Andresen to their engineering staff.

Trade Catalogs

Motor-Generator Sets. Crocker-Wheeler Co., Ampere, N. J. Bulletin No. 181. Pp. 8; 8½ x 11 in., illustrated.

The "Automatic" Threading Lathe. Automatic Machine Co., Bridgeport, Conn. Catalog. Pp. 32, 6 x 9 in.; illustrated.

Photomicrographic Apparatus. Sauveur & Boylston, Cambridge, Mass. Bulletin. Pp. 24; 6½ x 9½ in.; illustrated.

Gas and Gasoline Driven Air Compressors. Chicago Pneumatic Tool Co., Chicago, Ill. Bulletin 34-Y. Pp. 24; 6 x 9 in.; illustrated.

Die Forming Machines and Cutters. The Anderson Die Machine Co., Bridgeport, Conn. Bulletin No. 5. Pp. 12; 6 x 9 in.; illustrated.

Threading Die Muzzling or Relieving Machine. Anderson Die Machine Co., Bridgeport, Conn. Bulletin No. 6. Pp. 6; 6 x 9 in.; illustrated.

High Resistance Pyrometers. Hoskins Manufacturing Co., 453-471 Lawton Ave., Detroit, Mich. Bulletin 3-A. Pp. 14; 6 x 9 in.; illustrated.

Tycos Base Metal Thermo Electric Pyrometers. Taylor Instruments Companies, Rochester, N. Y. Book No. 4014. Pp. 36; 7 x 10 in.; illustrated.

Oxy-Acetylene Welding and Cutting Apparatus. The Prest-O-Lite Co., Inc., Indianapolis, Ind. Bulletin. Pp. 8; 8½ x 11 in.; illustrated.

Twist Drills, Reamers, Chucks, Sockets, Milling Cutters, etc. Detroit Twist Drill Co., Detroit, Mich. Catalog No. 18. Pp. 250; 5 x 7½ in.; illustrated.

Campbell Hammer-Lock Self Spreading Cotter Pin. American Chain Co., Inc., Bridgeport, Conn. Catalog and Price List. Pp. 10; 3½ x 6 in.; illustrated.

Twist Drills, Reamers, Wrenches, Drop Forgings, etc. The Whitman & Barnes Mfg. Co., Akron, Ohio. Catalog No. 90. Pp. 158; 5 x 7 in.; illustrated.

Improved Rivett Thread Tool. Rivett Lathe and Grinder Co., Brighton, Boston, Mass. Loose Leaf Catalog containing specifications and showing application of tool to lathe.

Cranes. Whiting Foundry Equipment Co., Harvey, Ill. Catalog No. 130. Pp. 80; 8½ x 11 in.; illustrated. This describes the various types of cranes showing latest improved construction.

Automatic Gear Milling Machines, Gear Hobbing Machines, Automatic Milling Machines, Drilling Machines, Riveting Machines, etc. The Bilton Machine Tool Co., Bridgeport, Conn. Loose leaf catalog. 9 x 12 in.; illustrated.

Oxy-Acetylene Welding, Cutting and Decarbonizing Equipment. The Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago, Ill. Catalog No. 140. Pp. 36; 7 x 10 in.; illustrated. A new line of lead burning equipment is also shown.

Solvay Alkali—Its Various Forms and Uses. The Solvay Process Co., Syracuse, N. Y. Treatise. Pp. 56; 7½ x 10 in.; illustrated. This contains a chapter on soda as a cleansing agent and tables on the specific gravity of solutions of pure caustic soda.

Oakite Munitions Service. Oakley Chemical Co., 22 Thames St., New York. Information Sheet No. 857. Pp. 28; 4½ x 6½ in.; illustrated. This contains information on the uses of Oakite and Oakite Compounds in connection with munitions manufacturing.

Oil Burners and Oil Burning Systems. Hammel Oil Burning Equipment Co., Inc., 409 Pine St., Providence, R. I. Catalog. Pp. 32; 7 x 10 in.; illustrated. This contains pictures of several boiler rooms in which these burners are installed and information and data which ought to be of value to those interested.

Forthcoming Meetings

The twelfth annual exhibit of foundry and machine-shop equipment and supplies will be held under the auspices of the American Foundrymen's Association in the Mechanics Building, Boston, Mass., from Sept. 25 to 28, 1917. The officers of the exhibit committee are: President, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; vice president, Benjamin D. Fuller, Westinghouse Electric and Manufacturing Co., Cleveland, Ohio; secretary and treasurer, A. O. Backert, 12th and Chestnut Sts., Cleveland, Ohio; manager of the department of exhibits, C. E. Hoyt, 123 West Madison St., Chicago, Illinois.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

The American and Canadian engineers and architects of Norwegian birth and descent will hold an informal congress and reunion at the Chicago Norske Klub, Logan Square, Chicago, Ill., Sept. 27 to 29, 1917.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

The annual congress of purchasing agents, under the auspices of the national association, will be held at Pittsburgh, Oct. 9 to 11. The program includes business sessions for the mornings and visitation and inspection of industrial works during the afternoons. Special features are: Tour of Pittsburgh's principal business districts by automobile during the late afternoon of the first day, and cabaret dinner in the evening, to be held at one of the country clubs. The banquet will be held at the Convention Hotel the evening of the second day, Oct. 10, with speakers of national prominence in attendance.

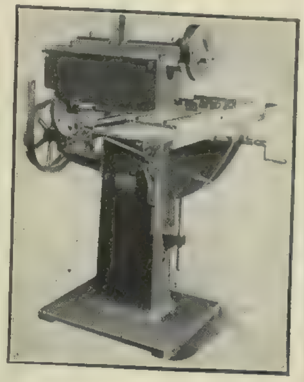
All purchasing agents as well as others interested are welcome and expected to attend and participate in the activities of the convention. Special arrangements are planned for the entertainment of the ladies.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

GRINDER, SURFACE (HARTFORD)

National Machine Co., Hartford, Conn.

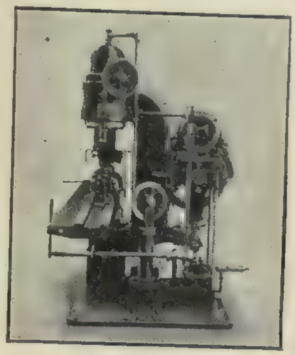


"American Machinist," Aug. 2, 1917

Grinding wheel, maximum 8 in. in diameter, 1-in. face and 1¼-in. hole; surface of table, 8 x 37 in.; traversing distance of grinding wheel, 10 in.; movement of table, longitudinal, 30 in.; traverse, 4 in.; vertical without wheel, 14 in.; distance center of spindle to table with table at lowest point, 16 in.; height to center of spindle, 47 in. from floor; floor space required, 42 x 49 in.; weight of machine, net, 1200 pounds

PRESS, HYDRAULIC, STRAIGHTENING

Metalwood Manufacturing Co., Detroit, Mich.

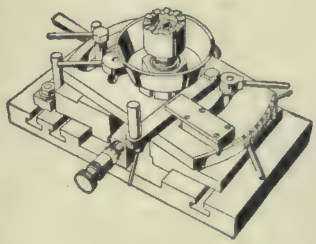


"American Machinist," Aug. 2, 1917

Built in 20- and 35-ton sizes, and in three styles—motor drive, belt drive from lineshaft and accumulator drive. The press is controlled by a Metalwood single-lever, quick-operating valve, which controls the speed of the ram, the pressure applied and the return of the ram

ATTACHMENT, CLUTCH MILLING (ADAMS)

William C. Adams, 40 Cleveland Ave., Hartford, Conn

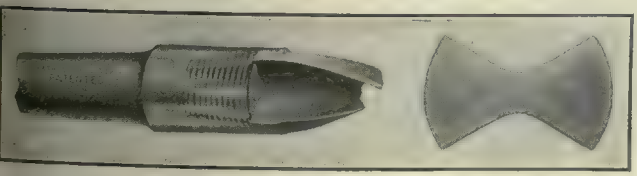


"American Machinist," July 26, 1917

For milling dog clutches on a hand miller. Cuts clutches with any number of teeth up to 32. Other indexing jobs of a similar character may also be handled. The spindle is machined for a standard taper holder

DRILLS, HIGH-SPEED (LATROBE)

McKenna Brothers, Pittsburgh, Penn



"American Machinist," July 26, 1917

A phantom view and a section of the high-speed drill being manufactured. The drilling section is screwed and brazed into he carbon-steel shank. Drills of this type are made in sizes of from $\frac{37}{64}$ to 3 inches

LIGHT, PORTABLE FLOOD

Coffin Valve Co., Boston, Mass.

"American Machinist," Aug. 2, 1917

Is made with either a floor stand or with a small base fitted with two T-head bolts, by means of which it may be fastened to a machine table or lathe. The fixture may be adjusted to throw the light in any required direction

LATHE, CLOSE-COUPLED 12-IN.

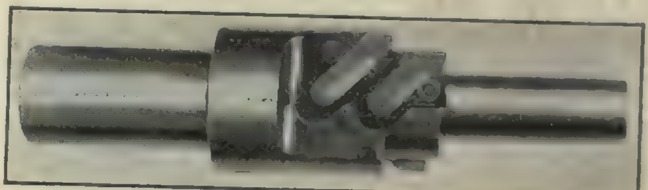
W. P. Davis Machine Co., Rochester, N. Y.

"American Machinist," Aug. 2, 1917

Swings over bed, 13⅝ in.; over carriage, 8½ in.; takes between centers, on 5-ft. 6-in. bed, 29 in.; hole in spindle, 1⅛ in.; centers, No. 3 Morse; cone diameters, 4 to 9 in.; width of face, 2 in.; ratio back gears, 8 to 1; nose spindle, diameter 2⅜ in.; number of threads, 6; size of tool, ½ x 1 in.; cut threads, 1½ to 80; floor space, 28 in. x 6 ft.; net weight, 1350 pounds

TOOL, BORING AND REAMING

Kelly Reamer Co., Cleveland, Ohio

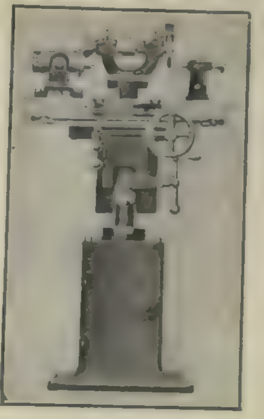


"American Machinist, July 26, 1917

Are adapted for boring, facing and reaming, the one shown being equipped with a hardened pilot to insure accurate work. It is intended for machining a number of shoulders in close proximity to each other, the work being done in an automatic. The tools are made in a variety of sizes and types

GRINDER, UNIVERSAL TOOL (STERLING)

McDonough Mfg. Co., Eau Claire, Wis.



"American Machinist," July 26, 1917

Spindle, 1 in. diameter; bronze bearings, 3 in. long; table, 36 in. long, takes 16 in. c. to c. and swings 9 in.; power feed with automatic reverse for table can be supplied from countershaft if ordered. Machine is supplied with countershaft, universal headstock, tailstock with center, sleeve, center, universal vise, internal grinder, metal saw chuck, three-jaw chuck, dogs and wrenches

Patent Applied For

WEEKLY PRICE GUIDE C

IRON AND STEEL

PIG IRON—Qutations were current as follows at the points and dates indicated:

	Aug. 3, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$47.00	$40.00	$14.00
No. 2X Northern Foundry, Buffalo.....	53.00	46.00	19.75
No. 2 Northern Foundry, Chicago......	55.00	47.00	19.00
*Bessemer, Pittsburgh	55.95	50.95	21.95
*Basic, Pittsburgh	52.95	45.00	18.95
No. 2X, Philadelphia	54.50	45.50	19.75
*No. 2, Valley	53.95	45.00	18.25
No. 2, Southern Cincinnati	49.90	42.90	16.90
Basic, Eastern Pennsylvania	50.00	42.50	19.00

*Delivered Pittsburgh; f.o.b. Valley, 95% less.

STEEL SHAPES—The following base prices in cents per pound are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Aug. 3, 1917	One Month Ago	One Year Ago	Aug. 3, 1917	One Year Ago	Aug. 3, 1917	One Year Ago
Structural shapes ...	5.25	5.00	3.25	4.50	3.25	5.00	3.10
Soft steel bars......	5.00	4.75	3.30	5.00	3.25	4.50	3.10
Soft steel bar shapes.	5.00	4.75	3.25	4.50	3.25	4.50	3.10
Plates, ¼ to 1 in. thick	9.00	8.00	4.00	8.00	3.65	8.00	3.50

BAR IRON—Prices in cents per pound at the places named are as follows:

	Aug. 3, 1917	One Year Ago
Pittsburgh, mill	5.25	2.50
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Aug. 3, 1917	One Month Ago	One Year Ago	Aug. 3, 1917	One Year Ago	Aug. 3, 1917	One Year Ago
*No. 28 black......	8.75	10.50	10.00	3.65	9.00	3.20	10.00	3.20
*No. 26 black......	8.65	10.40	9.90	3.55	8.90	3.10	9.90	3.10
*Nos. 22 and 24 black	8.60	10.35	9.85	3.50	8.85	3.05	9.85	3.05
Nos. 18 and 20 black	8.55	10.30	9.80	4.45	9.20	3.70	9.80	3.00
No. 16 blue annealed.	9.10	10.20	9.70	4.45	9.20	3.70	10.20	3.60
No. 14 blue annealed.	8.85	10.10	9.60	4.35	9.10	3.60	10.10	3.50
No. 12 blue annealed.	8.65	10.05	9.55	4.30	9.05	3.55	10.05	3.45
No. 10 byue annealed.	8.25	10.00	9.50	4.25	9.00	3.50	10.00	3.40
*No. 28 galvanized..	10.75	13.00	13.00	5.40	10.75	5.20	11.50	5.10
*No. 26 galvanized...	10.45	12.70	12.70	5.10	19.45	4.90	11.20	4.80
*No. 24 galvanized..	10.30	12.55	12.55	4.95	10.30	4.75	11.05	4.65

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring fair-sized lots, the following quotations hold:

	Aug. 3, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	40%	45%
Cleveland	40%	45%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—This material per 100 lb. sells as follows:

	July 27, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	13.30	6.30
Chicago	12.50	5.25

In coils an advance of 50c. usually is charged.
Note—Stock scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire*	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

*Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Aug. 3, 1917	Cleveland Aug. 3, 1917	Chicago Aug. 3, 1917
Tire	5.00	5.00	4.50
Toe calk	5.00	5.50	4.75
Openhearth spring steel...	7.00	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Ordinary carbon tool steel, base price	14.00	13.00	15.00
Special base cast steel....	18.00	20.00	....

*In bars.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

	Steel			Iron	
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	42%	15½%	¾ to 1½.....	33%	17%
½	46%	31½%			
LAP WELD					
2	42%	15½%	2	26%	12%
2½ to 6.....	45%	31½%	2½ to 6......	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	38%	20½%	¾ to 1½.....	33%	18%
½	43%	30½%			
¾ to 1½......	47%	34½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4......	43%	31½%	2¼ to 4......	29%	17%
4½ to 6......	42%	30½%	4½ to 6......	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	29%	15%	38.8%	24.8%
3½ to 6 in. steel lap welded	28%	10%	36%	21%	42.8%	27.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 27 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound:

	Aug. 3, 1917	One Month Ago	One Year Ago
Copper, electrolytic (carload lots).....	27.50*	30.00	27.00
Tin	63.75	62.00	38.00
Lead	11.00	11.50	6.00
Spelter	8.50	9.25	9.75

*Fourth-quarter copper; for spot copper the market price is 29c.

ST. LOUIS

Lead	10.75	11.25	5.87½
Spelter	8.25	9.00	9.50

At the places named, the following prices in cents per pound prevail:

	New York			Cleveland		Chicago	
	Aug. 3, 1917	One Month Ago	One Year Ago	Aug. 3, 1917	One Year Ago	Aug. 3, 1917	One Year Ago
Copper sheets, base	38.00–40.00	42.00	35.50	40.00	35.50	39.40	37.50
Copper wire (carload lots)	38.50	39.50	30.00	39.00	33.00	38.50	35.00
Brass pipe, base...	43.00–45.00	47.50	46.50	46.00	45.00	46.50	45.00
Brass sheets	40.00	45.00	44.50	36.00	42.00	42.00	39.00
Solder ½ and ½ (case lots)	39.25	39.50	24.12½	39.50	24.50	39.25	24.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Aug. 3, 1917	One Year Ago
Mill	$42.00	$42.00
New York	45.50	45.50
Cleveland	38.00	38.00
Chicago	42.50	42.50

ZINC SHEETS—The following prices in cents per pound prevail:
Carload lots f.o.b. mill.............................. 19.0

	In Casks		Broken Lots	
	Aug. 3, 1917	One Year Ago	Aug. 3, 1917	One Year Ag
New York	21.00	17.00	21.50	18.00
Cleveland	23.00	16.50	23.25	17.50
Chicago	22.50	17.00	23.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per poun for spot delivery, duty paid:

	Aug. 3, 1917	One Year Ag
New York	15.00	13.00
Cleveland	17.50	16.00
Chicago	16.50	15.25

PRECISION THREAD GAGES

By

E. A. Suverkrop

SYNOPSIS — *This article is one of the very few ever published giving an insight into the actual making of precision thread gages from the shop man's point of view. Interesting details are given from the time the steel is cut from the bar to the final inspection of the finished gage.*

THE men behind the "man behind the gun"—the workers in the munitions plants—have already been pictured, and justly so, as being as essential in the prosecution of modern warfare as the actual field force. There is still another class of workers "behind the men behind the men behind the guns" that is entitled to a high degree of recognition in a broad analysis of the mechanics of war—the gagemakers whose mechanical skill and precision workmanship make possible the production of gages upon which finally depend the rapid and accurate manufacture of munitions in the huge quantities demanded. Except for those immediately associated with munition production, there are probably few who appreciate the skill and accuracy required in the manufacture of munition gages. The term "manufacture" is used advisedly in connection with munition gages, as will be understood when it is related that the Allies during one fortnight of an offensive on the western front last spring fired one million five hundred thousand 3-in. shells alone. On a 3-in. shell, provided with the commonly used form of fuse, cartridge case and primer, there are about 350 gages used. On an average, an inspection gage in such work is good for but from 10,000 to 15,000 applications before the wear incident to such a number of inspections terminates its life. Therefore, in that fortnight alone there were used up for inspection purposes only 42,000 gages on just one size of shell. This does not take into account the gages for the other sizes of shells fired during the same period nor the considerably larger number of shop gages. At that rate it will readily be understood that the gage production necessary to keep up with the appalling expenditure of shells during the present gigantic conflict must be reduced to a manufacturing basis. And in reducing to a manufacturing basis a product that is held to such limits as 0.0002 in. there is a problem that at once necessitates the mobilization of the highest mechanical skill available.

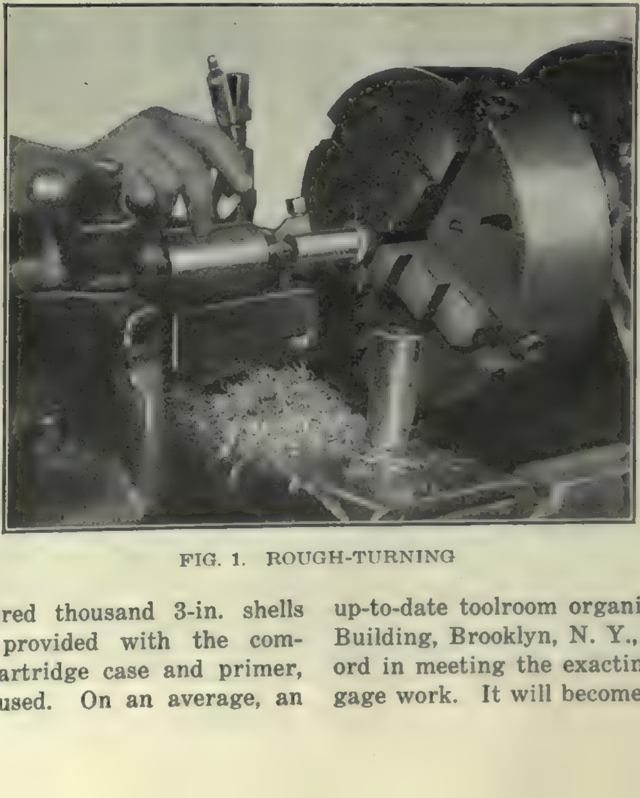


FIG. 1. ROUGH-TURNING

Although American manufacturers had been preëminent in the economical quantity-production of machinery for the past half century they undeniably "fell down" on the first large war orders that came to them from abroad. The reason was not far to seek—their standards of accuracy did not measure up with the requirements of munition work. At once the question of gages became dominant, and in this article it is intended to give the reader an idea of the skill and superior toolroom methods necessary to the production of munition gages, particularly those of the thread type. The methods shown are those developed and followed by the Presto Machine Works, whose up-to-date toolroom organization in the modern Sperry Building, Brooklyn, N. Y., has made a conspicuous record in meeting the exacting requirements of munition-gage work. It will become apparent that certain of the mechanical methods developed to replace the hand skill of the toolmaker sprang from a production demand that was out of all keeping with the available supply of toolmakers sufficiently trained and experienced to work to the tolerance previously mentioned.

That there is a difference between gagemaking and manufacturing is fairly well known to munitions contractors. Among other facts which have been learned by many of these contractors through bitter experience are that a toolmaker is not necessarily a gagemaker, and that it is generally disappointing to try to make gages in the toolroom even with the best of toolroom help and equipment, as compared with buying them from those who are specialists in gage manufacture.

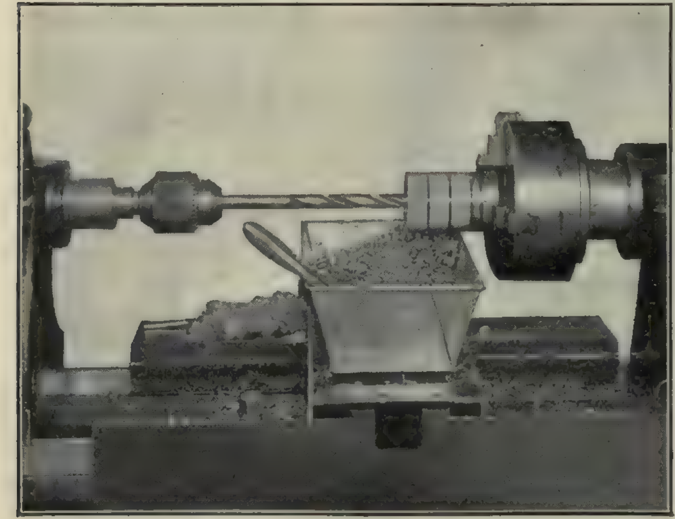


FIG. 2. MAKING FEMALE GAGE BLANKS

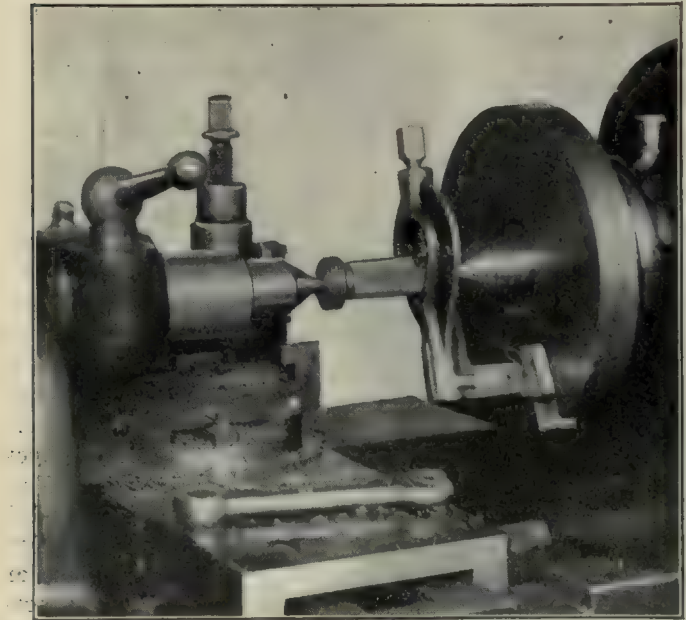


FIG. 3. THREADING GAGES

MATERIAL USED FOR GAGES

Three materials are commonly used in the manufacture of gages—carbonized machine steel, tool steel and high-speed steel, the latter, however, not to any great extent.

The preliminary operations in gage manufacture are very simple and do not require any great amount of skill.

The stock comes in bar lengths and is cut to gage length in a sawing machine. Occasionally the larger gages are forged, to save material and machine work. As a general thing it can be stated that it is not good practice to make gages from forgings, especially those which for one reason or another are difficult to finish after hardening, as for instance internal thread gages. The reason for this is that stresses are set up in the forging operation which even careful and repeated annealings do not entirely eliminate. When the gage is finally hardened, after machining it there may be either excessive expansion or contraction, resulting in insufficient or excessive metal to clean up to size.

After cutting to length, the plug-gage blanks are centered on one end, the other end being gripped in the chuck; they are then rough-turned all over. This is shown in Fig. 1, the centered plug thread-gage blank on the carriage and the work in the chuck.

Female ring thread gages are made up a number at a time from short bars, as shown in Fig. 2. The bar is turned and knurled the whole length beyond the chuck. It is then parted in rings nearly to the center. The lathe hand then drills the core out, which separates the individual blanks. The final drilling of the core is shown in Fig. 2. The roughing of both male and female gages brings them to about $\frac{1}{16}$ in. of finished size. They are then annealed, after which they are threaded in the lathe, as shown in Figs. 3 and 4, to within 0.012 to 0.010 in. of size. After threading, they are inspected to see whether sufficient allowance has been made for grinding and lapping. The centers of the male gages are carefully reamed before hardening so that they can be lapped easily after that operation.

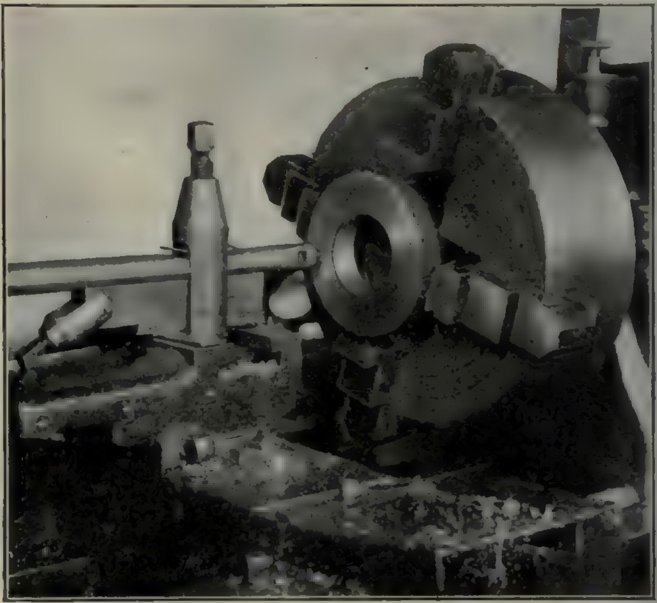


FIG. 4. THREADING FEMALE GAGES

The hardening room, Fig. 5, is partitioned off from the main shop and is equipped with two American gas furnaces, a lead pot and oil and water quenching tanks. The furnaces are provided with electric pyrometers. Raw bone is used for gages which are carburized.

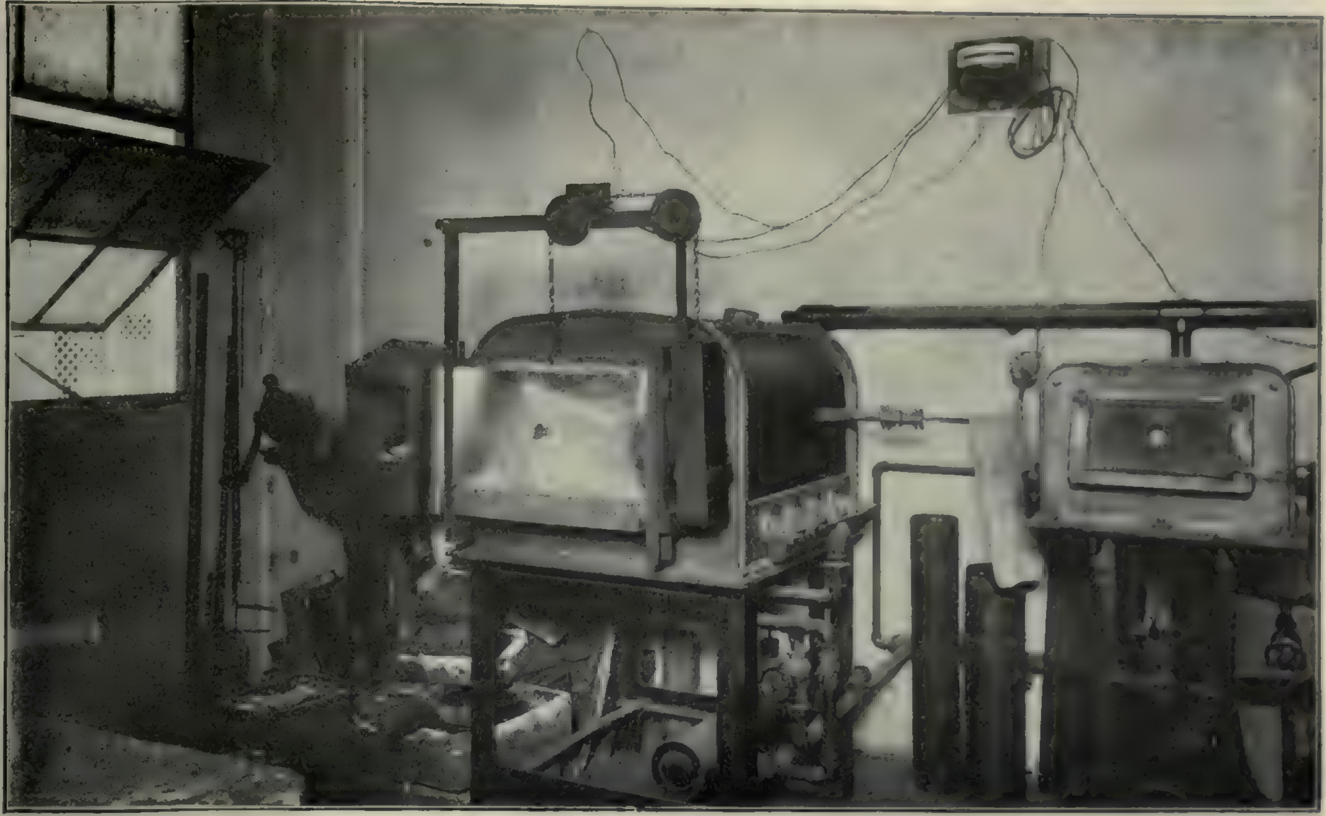


FIG. 5. HARDENING DEPARTMENT

Hardening temperatures, carburizing times, etc., are determined by the steel used and the size of the work, so they will not be mentioned here.

With a precision lathe having a correct lead screw and accurate change gears a skilled toolmaker should be able to make an accurate screw. But thread gages are required to be hard, and after a lot of time has been put in cutting an accurate screw on the blank it is liable to be distorted in hardening so that excessive lapping is required. Further, the laps for male threads, in the smaller sizes, are usually made of cast iron. These must be tapped, and as the lap is hardened after

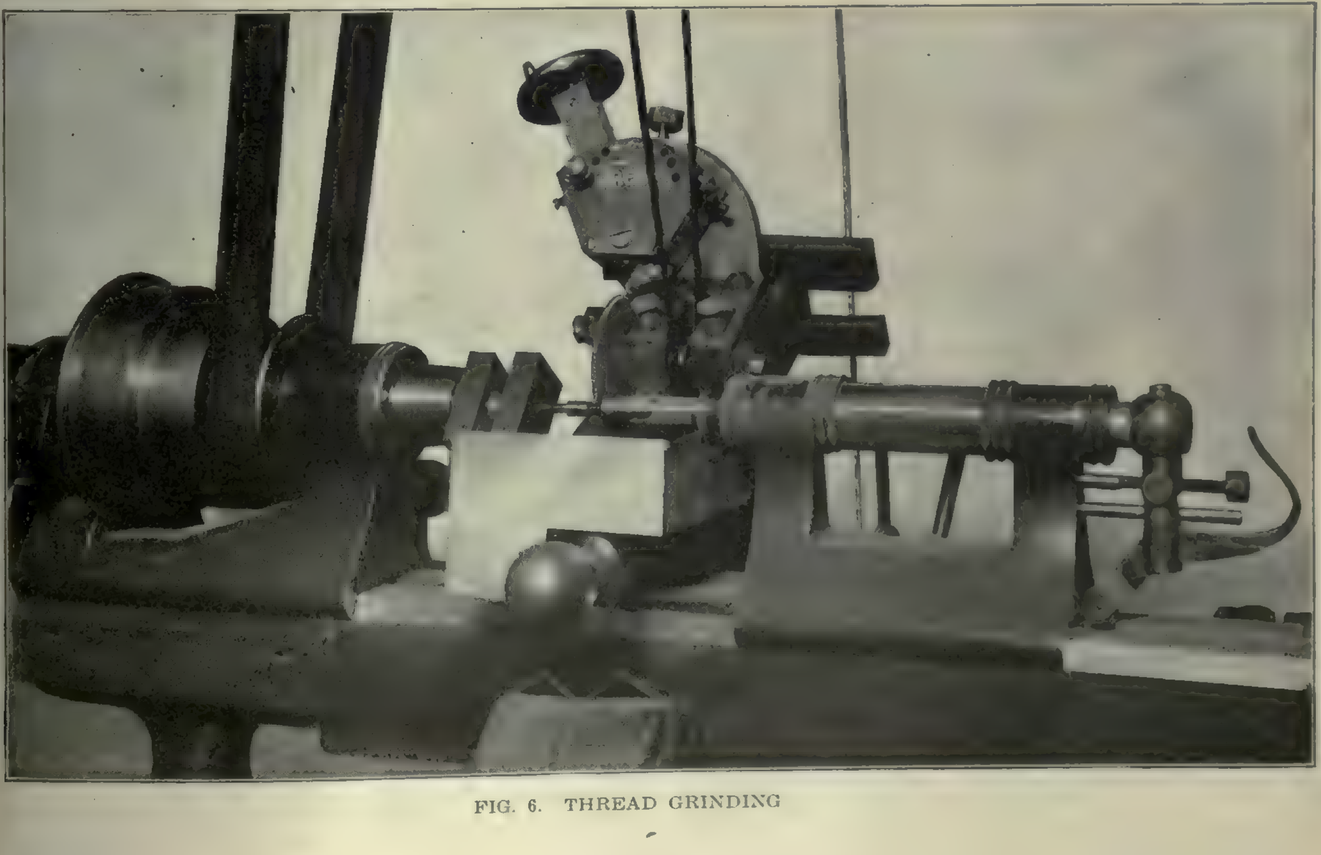


FIG. 6. THREAD GRINDING

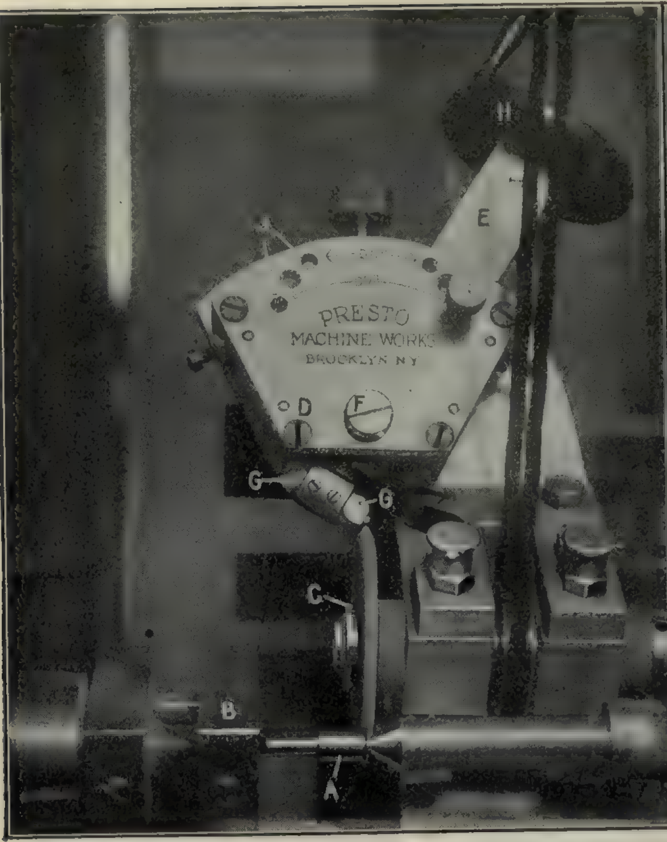


FIG. 7. TAP BLANK AND GRINDING ATTACHMENT

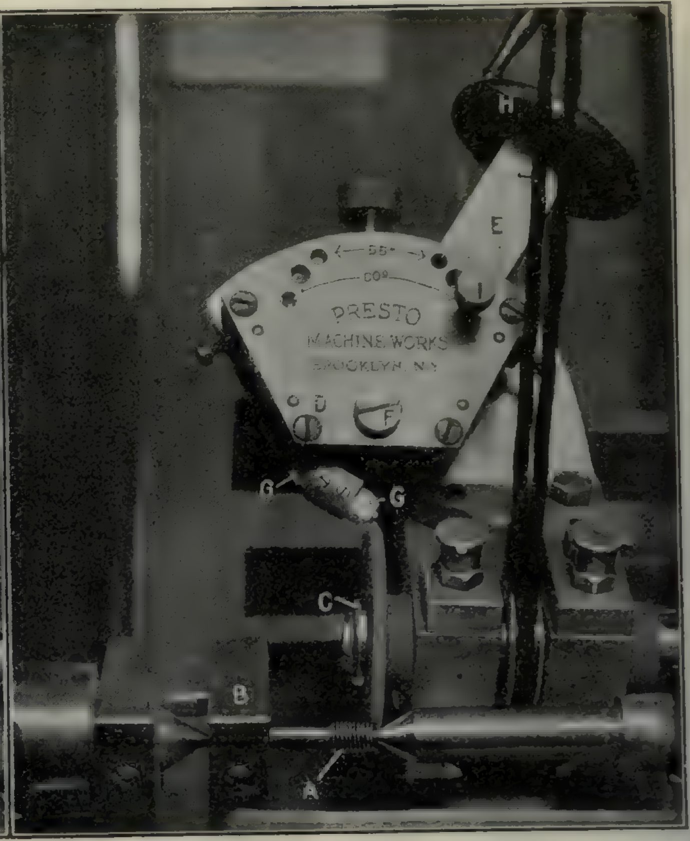


FIG. 8. FINISHED TAP THREAD

the thread is cut, it also is liable to be distorted, producing a distorted lap. Under the most favorable conditions and with perfect tools lapping is a slow process. With work distorted in one unknown direction and a lap made with a tap distorted in another unknown direction, the difficulties are very greatly multiplied.

Appreciating this the engineer of the Presto Machine Works devised a thread-grinding attachment for a Cataract bench lathe. This attachment has handled male screw gages and taps from 0.157 in. in diameter, 36 threads, to 4 in. in diameter, 4 threads per inch. The threads of the coarser pitches are cut in the usual way

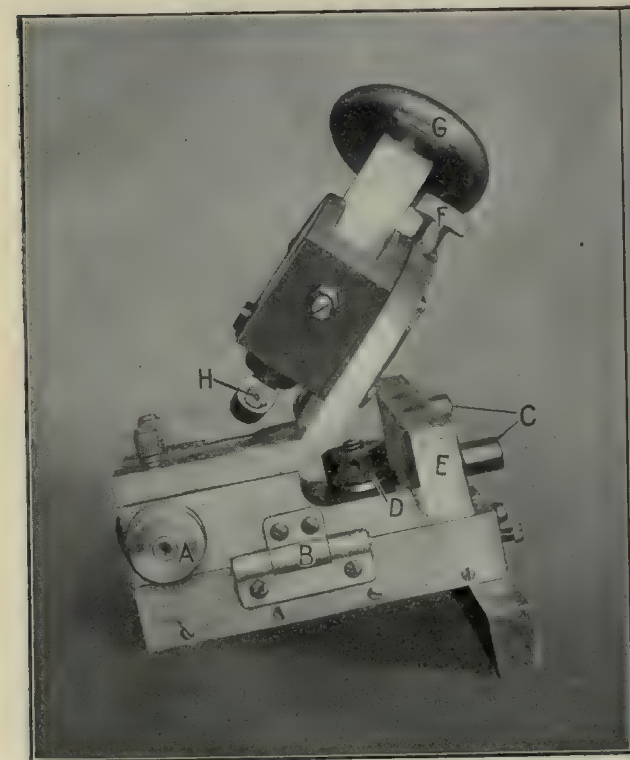


FIG. 9. SIDE VIEW OF THREAD-GRINDING ATTACHMENT

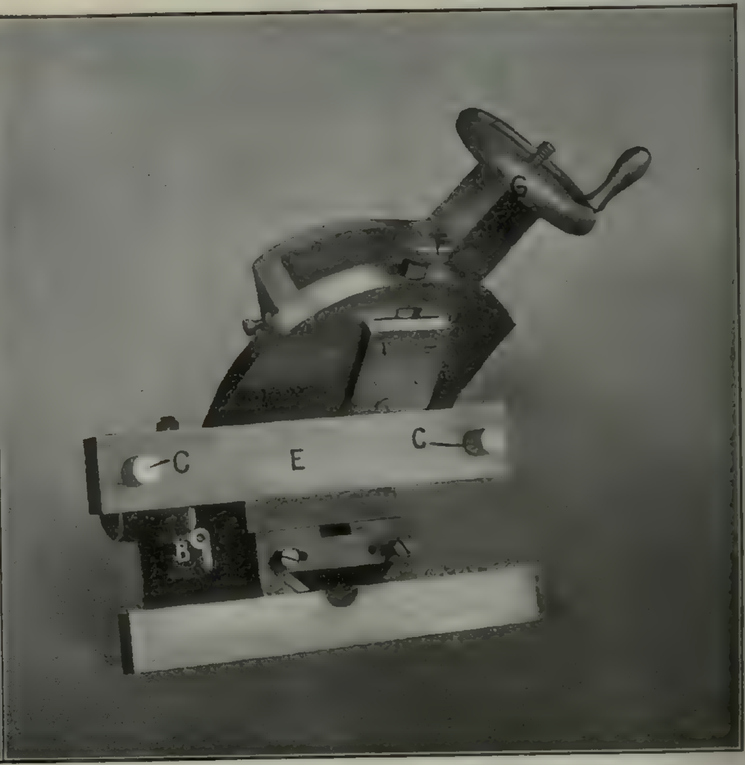


FIG. 10. REAR VIEW OF THREAD-GRINDING ATTACHMENT

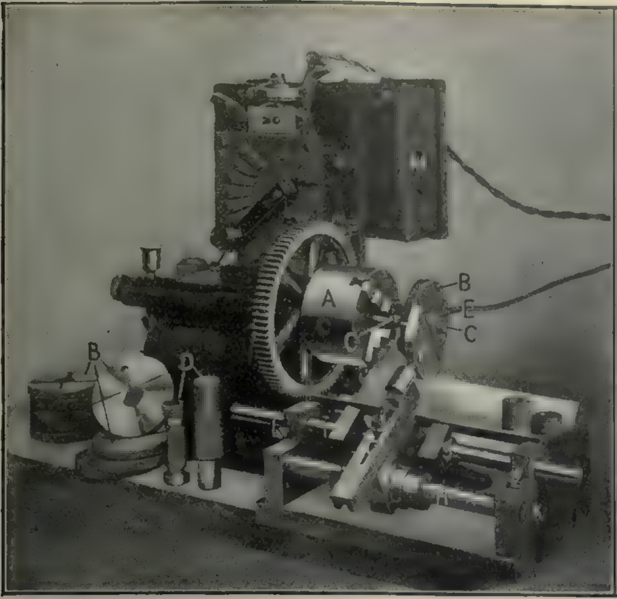


FIG. 11. FRONT OF GAGE-LAPPING MACHINE

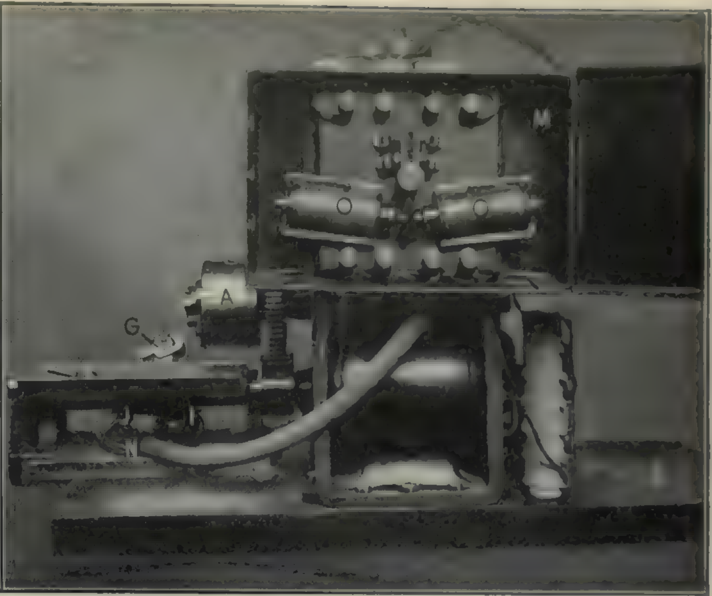


FIG. 12. REAR OF GAGE-LAPPING MACHINE

before hardening, with a sufficient allowance for any distortion that can possibly take place. The finer pitches are cut by grinding the thread in the hardened and ground cylindrical blank. By this method with an accurate lead screw precision gages and taps are produced. Those gages which are specified to be lapped leave the grinder accurate in every dimension with the exception of the allowance of 0.0002 to 0.0003 in. for lapping. Gages which are not required to be lapped are finished to size by grinding, as are also the precision taps used for making laps. It may be mentioned that gages thus ground to size are accepted by the Imperial Munitions Board at Ottawa.

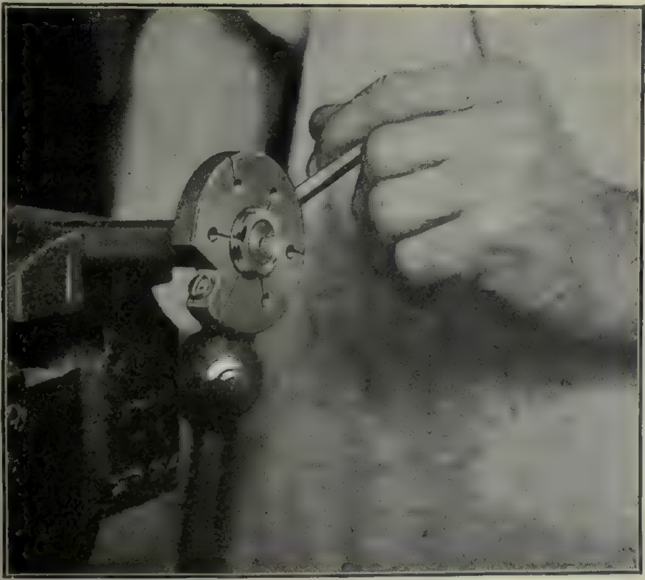


FIG. 13. HAND-LAPPING A PLUG GAGE

The Cataract lathe with the grinding attachment is shown in Fig. 6. With the exception of the hob, the chasing attachment which carries the grinding attachment is the one usually furnished with the machine. The hob is special and has a buttress thread which allows the nut to engage as easily as it would with the V-, or acme, form of thread; but as the flat side is the working side, there is no tendency to lift, as there is with the V-form of thread. The hobs are very accurately cut, carefully hardened, ground true on the inside where they seat on the bar, and then the thread is ground to the required accuracy. The tolerance permitted in the lead of these hobs is less than that permitted on the gages they are to produce, many of them being required with a maximum error in lead of 0.0002 in. per inch of length. In Figs. 7 and 8 a front view of the grinding attachment is shown. The work *A* is a tap 0.300 in. in diameter, 24 threads. It is held between centers and driven by a somewhat heavy and rigid dog *B*. The wheel *C* is driven from the overhead. On thread grinding with this attachment it has been found that a surface speed of 2 to 4 ft. per min. for the work and a wheel speed of 5500 ft. are satisfactory. The depth of cut varies from the lightest contact to 0.002 inch.

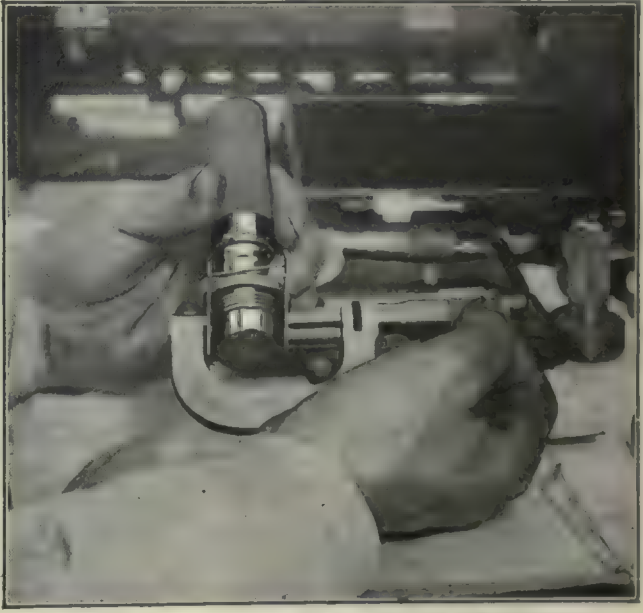


FIG. 14. THREE-WIRE METHOD OF MEASURING

Permanently mounted with the grinding attachment is the dressing fixture *D*. The slide *E* pivots on the

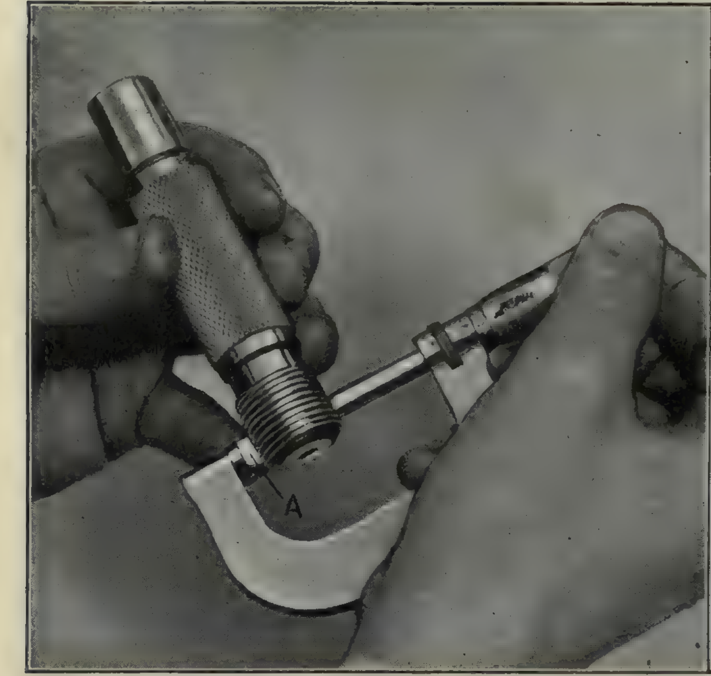


FIG. 15. MEASURING OUTSIDE DIAMETER OF GAGE

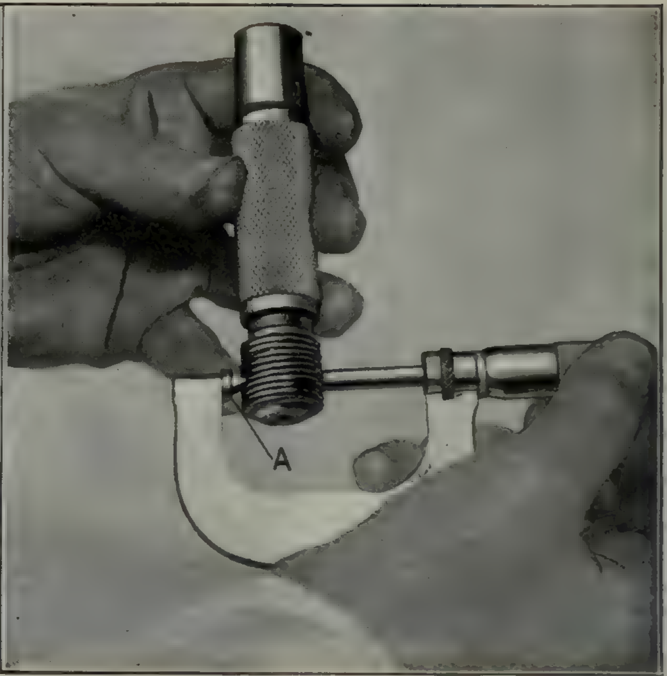


FIG. 16. MEASURING SINGLE DEPTH OF THREAD

screw *F* and carries a bar on the end of which are mounted the two diamond tools *G*. The diamond tools are traversed obliquely across the edge of the wheel by a screw and handwheel *H*. The angle to which the face of the wheel is dressed is controlled by the stop *I*, the bushings *J* and corresponding bushings in the slide *E*. The auxiliary plates *D* with the bushings *J* provide means whereby the threads of taps for laps can be ground to angles other than U. S. S. 60 deg. and Whitworth standard 55 deg. Laps thus made are used to correct errors that creep in during the lapping operation. It will be understood that the slide *E* after being used in the position shown is swung over so that the index pin *I* enters the hole *J*, to dress the other edge.

On the work shown a Norton 38-200 I-wheel is used. This is dressed before starting the thread, again within 0.010 in. of finished size and again when the work is within 0.001 to 0.002 in. of finished size.

It has been found that the grain and grade of wheel to give the best results in thread grinding must vary with the diameter of the work and the lead of the thread. Thus as the diameter and lead decrease the grain should be finer. In the table are given a few sizes and leads of thread gages together with the Norton wheels which have given satisfaction in producing them.

FIG. 17. GAGES AWAITING INSPECTION

In Figs. 9 and 10 are shown side and rear views of the thread-grinding attachment and wheel-dressing fixture. The upper part, carrying the spindle *A*, is hinged at B, to the lower part, which is secured to the chasing bar. The object of the hinge is to permit the wheel to be tilted to the angle of the helix of the thread to be ground. In order that this may be accurately and rapidly done the upper part, carrying the wheel spindle, is, at the back, provided with a 5-in. sine bar *E* with buttons *C*. The feed of the wheel-dressing fixture to and from the wheel is by means of the knurled screw *F*. The handwheel *G*, Figs. 9 and 10, is the same as that shown at *H*, Figs. 7 and 8. The diamond holder *H*, Fig. 9, is the same as that shown at *G*, Figs. 7 and 8.

AN AUTOMATIC LAPPING MACHINE

In Figs. 11 and 12 is shown an automatic thread-gage lapping machine, also developed in the works. A motor-driven chuck *A* holds the lap arbor *C* when thread female gages *B* are being lapped, or when male gages *D* are lapped they are held in.

The lap shown at *E* and *F* is a driver for the gage *B*. A pin from *F* is secured in the holder *G*, which is free to slide on the bar *H*. At *I* and *J* are two stops which slide in holes in the frame *K* and can be set and secured as desired by the screws *L*. Electrical contacts are provided on the holder *G* and on the stops *I* and *J*. The stops *I* and *J* are connected by the wires *N* to the solenoids *O* in the box *M*. The solenoids operate the reversing mechanism.

The operation of the lapping machine is as follows: The arbor, lap and work are secured as previously described. The operator then sets the stops *I* and *J* so that the gage will have the correct traverse on the lap. The motor is then started, and as the holder *G* makes contact with the stop *I* or *J*, the solenoids become operative, and the direction of rotation of the spindle, and consequently the direction of traverse of the work, is reversed. From time to time the machine is stopped and the work removed and gaged. Lapping compound is applied to the lap in the usual way.

In Fig. 13 is shown the hand-lapping of a male thread gage. In Fig. 14 is shown the measuring of a gage by the three-wire system. This is so well known that no comment is necessary. In Figs. 15 and 16 is shown the application of a V-shaped micrometer anvil devised by the inspector at the Presto Machine Works. The little V-shaped cap *A* snaps over the anvil of the micrometer. While it is a snug fit on the anvil, it is free enough to turn so that it can be used as in Fig. 15, to measure the outside diameter of the gage, or as in Fig. 16, to measure the single depth of thread. Double the single depth of thread subtracted from the outside diameter gives the root diameter of the thread.

GRAIN AND GRADE OF WHEELS USED FOR GRINDING THREAD GAGES

Gage		Norton Wheel	
Diameter	Threads per In.	Grain	Grade
1.997	14	38–100	J
1.375	14	38–120	J
1.200	14	38–150	J
1.087	14	38–150	I
0.8663	14	38–150	J
0.750	12	38–150	I
0.687	14	38–180	J
0.600	24	38–180	J
0.580	18	38–150	J
0.505	24	38–180	J
0.300	24	38–180	I
0.250	20	38–180	J
0.197	24	38–200	I
0.160	24	38–F F	I

In Fig. 17 are shown a few of the over 500 types and varieties of gages manufactured in the shops of the Presto machine works.

Forming an Awkward Radius in Sheet Steel

By W. D. Forbes

On page 178, Vol. 46, was illustrated and described a piece of sheet metal formed up as shown in the illustration accompanying the article, and readers of the paper were asked how the job could be done without making any tools.

There were certain conditions that had to be met. First, the job was to be made of unannealed sheet metal, and second, the inside of the radius was not to be filed or scraped to a fit.

On page 476, Vol. 46, Charles E. Miller, of Pittsburgh, Penn., told how he would do the job. He came very close to describing the method employed.

Mr. Miller's method would have enabled him to know the exact radius—whether it was to measurement, or large or small—but it did not comply with the requirement that the piece should be made of sheet steel which, of course, has a peculiar surface. Mr. Miller's method would not have given this surface.

However, his plan was very clever and is fundamentally the one by which the job was done, except that my toolmaker took a piece of cold-drawn seamless tubing (which is in fact a piece of sheet steel rolled up) and, after cutting it to the proper length and measuring the diameter of the interior of the tube he knew whether the radius was large, small or exact.

He parted it with a milling cutter, then proceeded exactly as Mr. Miller described. The other replies gave methods which either did not comply with the conditions or were impracticable.

I think that the value of seamless drawn-steel tubing for experimental and general machine-shop use is not thoroughly appreciated. There are today several makers of tubing who offer three qualities of solid drawn tubes—a standard quality, a precision quality and a tool-steel quality. I have used all of these and found them to run marvelously close to size. While not always precisely cylindrical, they varied but little.

Some time ago the *American Machinist* commented editorially on the advisability of making standard bushings as a commercial product. It is quite difficult to make a bushing. The material has to be chucked, drilled, reamed, turned off on an arbor, hardened and ground.

By using any steel tubing of the qualities mentioned in the foregoing—hardening the tool-steel quality in the usual way or cyaniding the two other qualities—much time is saved and the results are satisfactory. Of course, it is not possible to obtain all sizes of tubings, but there is quite a range to select from with varying wall thickness.

The price, too, is so moderate that a few feet of each size can be kept in stock. If the bushing is made from the solid stock, it has to be kept on hand any way.

I have used the tool-steel tubing for counterbores and various other tools and have found them to stand up as well as those made from ordinary tool steel.

Today the price of tubing, like all other materials, is very high, so is labor; therefore, anything that can be saved in labor is an advantage, and when used as suggested steel tubing saves time.

Hardening High-Speed Steel Tools

By J. E. Rogers
Secretary and metallurgical expert, A. Hankey & Co., Rochdale, Mass.

A method of hardening high-speed steel tools, which we have found most successful and economical, requires very much less time and equipment than the way proposed by Mr. Korff or that suggested by Mr. Hartley.

We have experimented with the carbonizing treatment and have found that it is very difficult to regulate the thickness and uniformity of the skin. We have also found that the carbonized portion has a tendency to lift away from the rest of the body; and since the carbonizing extends over a considerable space of time, there is a decided leaning to grain growth in the carbonized section, which yields a very coarse and brittle edge. The increasing brittleness with increasing carbon content also must not be disregarded.

In the treatment of high-speed steel the first essential is to have a heat in which the atmosphere is not of a decarbonizing nature. Decarbonizing leads to oxidation, and oxidation causes heavy scaling. Blower or compressed air or dry steam is a suitable atomizer, but an excess of fuel should be used to prevent excessive oxidation and scaling, which would prove ruinous to small fine tools.

The method of heat-treatment described applies to all our tools, from the smallest to the largest, which include heavy formed milling cutters, punches and dies, circular formed tools, taps and chaser dies. We have never been troubled with excessive scaling or changing in size, and microphotographs show a perfect, uniform, true hardness to the very center of the tool.

First, our tools are preheated to 1600 to 1700 deg. F. (the greater the cross-section of the tool the higher the temperature) in an overfired furnace in which oil is used as a fuel and steam as an atomizing agent. This heat-treating shortens the length of time for the hardening heat, which follows, and assures perfect and uniform assimilation of that heat.

The temperature of the hardening furnace, which is similar to the one used as a preheater, depends on the analysis of the steel, which, of course, must be known before any heat-treatment is attempted. The steels of lower tungsten content harden at much lower temperatures than those which contain the higher percentages. Having worked on all brands of steel, we have found that the temperatures can safely be included within the limits of 1950 to 2300 deg. F. The correct furnace temperature is essential, and the use of accurate, foolproof pyrometers equipped with rare-metal thermocouples cannot be too strongly advised. Even in the small shop an expensive tool saved will more than offset the entire cost of the equipment.

The length of time in the hardening heat depends wholly on the size of the tool being hardened. It is essential to shorten this period of time as much as possible, and the piece should be allowed to stay in the furnace but a very short time after reaching the determined temperature. Moving the piece around in the furnace will promote uniform heating. Soaking at the hardening temperature may be essential on the larger sections, but should never be practiced on the smaller finer tools.

The universal quenching medium for high-speed steel is oil of such character that prolonged use will not cause it to thicken, for an extremely nonviscous mass must be used to insure the speedy transmission of the heat from the tool to the bath.

The chemical composition of high-speed steel permits the use of a higher tempering point than in ordinary carbon steels. It is essential to use the maximum temperature, for tempering will preclude the possibility of cracking and will give a much tougher, stronger tool. Most high-speed steels will stand a temperature of 1000 deg. While it is not necessary to temper to this point, it is strongly recommended to use a temperature of 600 to 700 degrees.

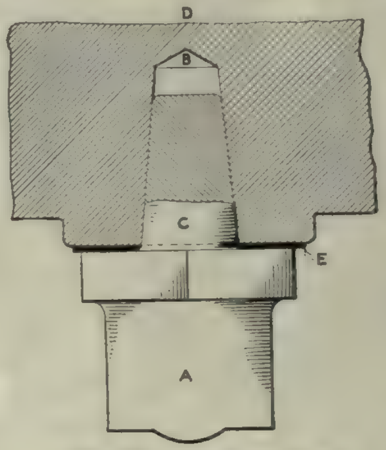
This method can be carried out in any muffle to semimuffle furnace, at the very front of which the preheating may be done satisfactorily, where the temperature ranges within preheating limits. For the hardening heat, it is only necessary to move the tool farther back on the hearth, where the desired heat may be obtained. Our loss by this method has been practically negligible. We have handled the finest and most particular tools, and from actual shop tests the efficiency of a tool heat-treated in this way is far greater than that of the tool heat-treated in any other way that we have ever used in our shop.

Supporting Taper-Shank Punches

By Charles Doescher

A common way of holding small piercing or forming punches *A* is by the taper-shank method. While this method cannot be called an ideal one, it answers the purpose.

It often happens that there is a slight variation in the size of the tapered holes *B* in the different presses, or a variation in the size of the taper shanks *C* of the punches. The result is that the punch shoulder does not rest against the gate *D* of the press as it should. Here is where a tool setter falls down, unless he knows his business. Instead of letting the taper shank take the force of the blow when the shoulder of the punch is somewhat away from the gate of the press, he will, if he is wise, use a thin steel washer *E* to make up the difference, as shown in the illustration. This simple kink not only helps to prevent the shank of the punch from being broken off on a forming job that requires a hard blow, but prevents the shank of the forming punch from being driven farther into the taper hole in the gate of the press with the result that a number of pieces are apt to be run through only partly formed to the required shape. If the shank is driven in, the socket may be enlarged enough to cause trouble with smaller shanks.



PUNCH SUPPORTED BY A WASHER

Specifications for Controllers for Alternating-Current Industrial Motors

BY A. G. POPCKE
Industrial Engineer, Westinghouse Electric and Manufacturing Co.

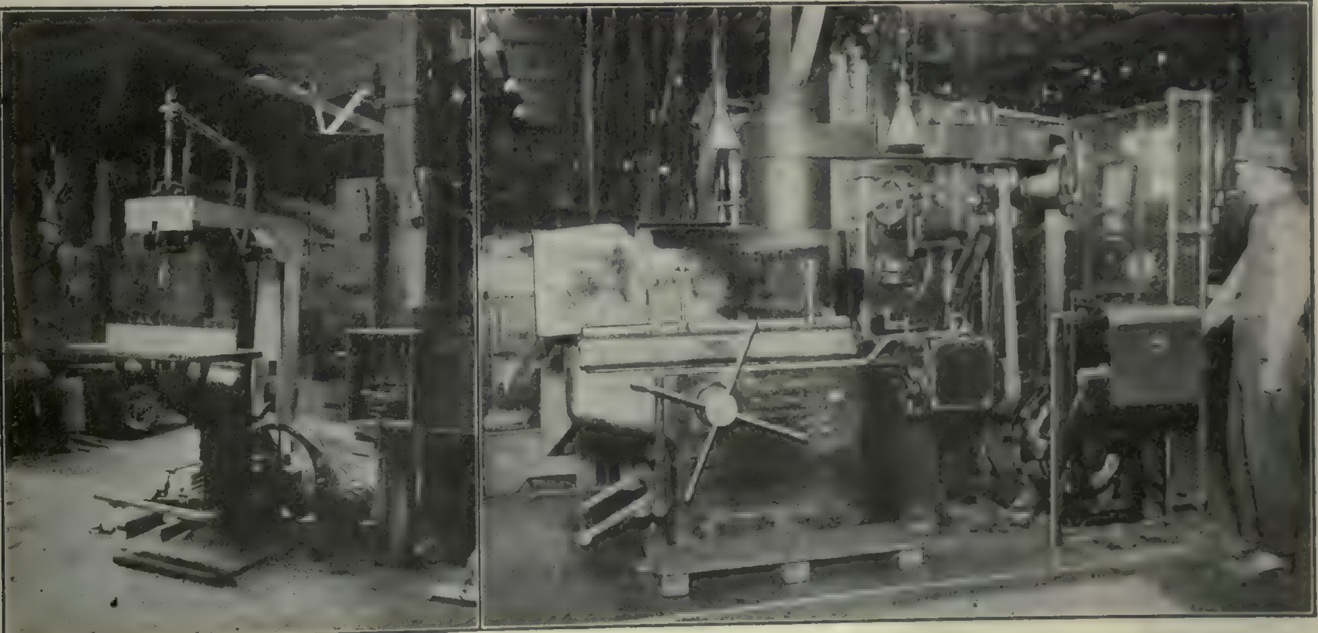
SYNOPSIS — *Characteristics of alternating-current motors as regards control. Apparatus for controlling small motors, including the inclosed starter. Controllers for wound rotor motors, automatic controllers of magnetic type and two types of resistors are also described and illustrated.*

ALTERNATING-CURRENT motors can be classified as follows:

Polyphase Induction Type—(1) Squirrel cage, which may be of constant-speed, varying-speed or multispeed form; (2) wound secondary, which may be of constant-speed or varying-speed form.

Single phase—(1) Split phase, (2) repulsion induction, (3) repulsion.

The majority of alternating-current motors in use are of the squirrel-cage induction type. Up to 5 hp. inclusive these are almost universally started by connecting them directly to full line voltage. For this purpose a simple knife switch can be provided. Unless the motors start with little or no load, it is not possible to protect the motor against overloads, because a fuse suitable for protecting against 25 to 50 per cent. overload will blow when starting the motor. For this reason, to properly protect the motor a double-throw switch must be supplied. When starting the motor, no fuses are used; after the motor has attained full speed, the switch is thrown over so as to connect a set of fuses to protect the motor against overloads. Fig. 1 shows an installation with a double-throw switch. This is mounted inside an inclosing case, to meet safety requirements.



FIGS. 1 AND 2. TWO TYPES OF STARTERS

Fig. 1—Double-throw knife switch in inclosing case; starts 3-hp. motor of single-spindle borer. Fig. 2—Squirrel-cage induction-motor starter applied to grinder. Wire is run to starter in its conduits. There are no exposed electrical connections

There are on the market starting switches for motors of these smaller sizes that do not require a double-throw action. A time-element overload device is furnished, which will not open a circuit during a period of heavy current when the motor is started, but will open the circuit if the motor is overloaded 25 to 50 per cent. while operating.

To start a motor of the 7.5-hp. and larger sizes, it is customary to start the motor at reduced voltage—at 50, 65 or 80 per cent. of normal, depending upon the amount of torque necessary to start the machine or driven line shafting. After the motor has attained speed, it is thrown on to full line voltage. Fig. 2 shows the type of starter commonly installed.

This form of starter possesses many protective features that have been developed based on experience with the application of squirrel-cage motors in the past 25 years. In the early days these motors in the larger sizes were started by means of double-throw knife switches at reduced voltages. These switches require considerable expense for maintenance, on account of burning and pitting. The most severe objection was the danger of operators coming in contact with the exposed blade.

The inclosed starter was then introduced in which the switch mechanism was immersed in oil and included in the same case with the voltage-reducing transformer. This arrangement was a decided improvement, because it lessened the number of accidents to operators and also the cost of maintenance. In designing these starters originally, manufacturers gave no special thought to the motor to be controlled, the fundamental idea being to produce a starter.

From experience in operation it was found that motors burned out and accidents were caused both to machinery and operators, because of lack of protection against low voltage. To remedy this defect, the low-voltage relay was developed, which on failure of voltage automatically throws the starter to the off position. It was also found that a great many motors were damaged because one fuse would blow, allowing the motor to run single phase. To remove this trouble, an overload relay was developed, which protects all three phases of the motor. Fig. 3 gives a view of a starter in which all these features are incorporated.

Varying-speed squirrel-cage motors are used where frequent reversing and heavy starting torque are encountered—for example, in elevator service, turntables and small hoists. Motors for this service are connected directly to full line voltage by means of a drum switch, with which the motor is reversed by plugging.

Multispeed induction motors are usually of the squirrel-cage type. They have two or more windings of a different number of poles, which enables them to be operated at two or more (commercially, not more than four) different speeds. These motors are started in the same way as the standard squirrel-cage motors just discussed. In addition to the starter a controller is required, with which the proper connections are made to apply voltage to the winding of the desired pole combination. On two-speed motors a double-throw knife switch is ordinarily employed.

Controllers for Wound Rotor Motors

Wound rotor motors are started and their speed is varied by inserting resistance in the rotor circuit by means of a controller, which is connected to the collector rings of the motor. Wound rotor motors are applied to two classes of service—constant speed and varying speed. The motors for both services are identical in construction, but the controllers differ slightly. For constant-speed service it is generally not necessary to reverse the motor. The motors are commonly employed where the starting torque is heavy, but may be used in a few cases where the starting torque is light, but line conditions necessitate low starting current. The motor supplied is for starting duty only and cannot be used for running continuously at speeds below normal. For this reason a faceplate-type starter with resistance mounted inside the starter is usually employed, Fig. 4.

For varying-speed service resistance is inserted in the rotor by means of a drum controller, Fig. 5, to obtain the desired speed below normal. The relations of speed and torque with various resistances in the rotor circuit are similar to those shown on page 203, Vol. 46, for direct-current motors. The points brought out in the discussion of direct-current motors below normal speed also apply in this case. On account of the large capacity of resistance required with varying-speed motors, it cannot be mounted inside the controller, but must be mounted separately.

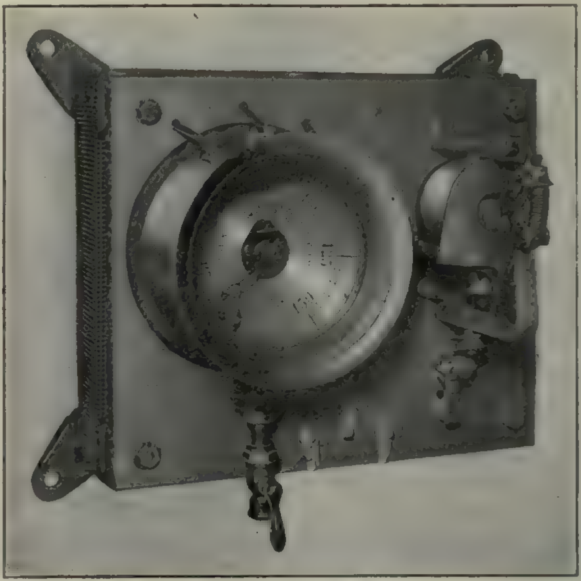
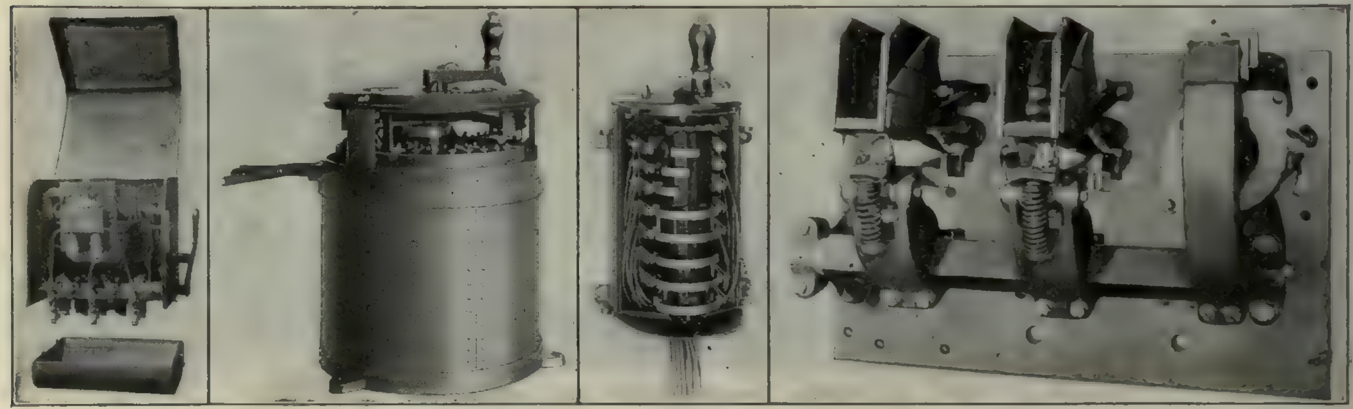


FIG. 7. PRESSURE REGULATOR; STARTS MOTOR FROM REMOTE POINT BY MEANS OF MAGNETIC CONTROLLER

Single-phase motors of the split-phase type are made in capacities of 1 hp. and smaller and are connected to full line voltage by a knife switch or snap switch. Repulsion-induction type motors are also connected to full line voltage; but where it is desired to reduce the starting current (sacrificing starting torque), a rheostat similar to that for direct-current motors is installed. Where repulsion-type motors are used, they

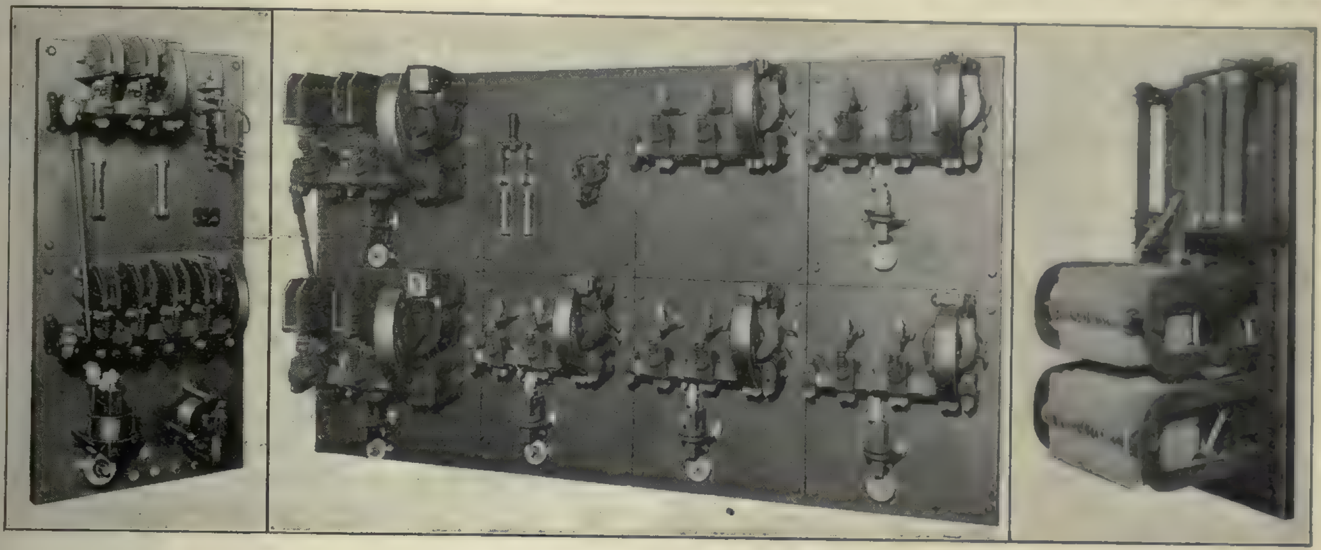


FIGS. 3 TO 6. A NUMBER OF STARTERS FOR VARIOUS TYPES OF MOTORS

Fig. 3—Internal view of squirrel-cage motor starter. Fig. 4—Starter for round rotor induction motor. Fig. 5—Drum controller for varying speed of wound rotor motor. Fig. 6—Magnetic starter; starts small squirrel-cage induction motors from a remote point

are started by applying full-load voltage on the smaller sizes, or a rheostat similar to that for direct-current motors is employed to reduce starting current.

Automatic controllers of the magnetic type, similar to those discussed under direct-current controllers, have also been developed for use with alternating-current motors. The same advantages as outlined for the direct-current controllers hold. For starting squirrel-cage motors, up to 5 hp. inclusive, from a remote point a magnetic switch, Fig. 6, is selected. For example, by a starter of this kind, a 5-hp. motor operating a compressor or pump can be started automatically when the pressure in the storage tank drops below a desired normal. The operation of the starter is automatically controlled by a gage-type pressure regulator, Fig. 7. Larger motors are first impressed with low voltage from transformers or are connected to the line through resistance, so that in either case the starting current is reduced. When the motor has accelerated to the point where the starting current has decreased sufficiently, the motor is then connected directly to the line.



FIGS. 8 TO 10. MAGNETIC CONTROLLERS

Fig. 8—Magnetic controller for starting squirrel-cage induction motor. Fig. 9—Magnetic reversing-controller for starting or varying speed of wound rotor motor. Fig. 10—Rear view of control panel, showing tube and grid resistors

Rheostatic starters can be purchased at lower prices than those having transformers for producing reduced voltage for starting; but the latter are better for most installations, because it is possible to obtain a starting current through the motor four or five times the normal running current, while taking only two to three times the normal current from the line. With a rheostatic starter the current is the same in both motor and line. Fig. 8 shows an automatic starter for squirrel-cage motors; the transformers are mounted on the back of the panel.

For controlling wound rotor motors a controller of the construction seen in Fig. 9 is used. The illustration shows a reversing controller. The two large contactors at the left control the direction of rotation. The other contactors are for accelerating the motor by cutting out the resistance in the rotor circuits.

The possible failure of power makes it essential to provide protection to both operators and machines againist return of power. As was explained under the discussion of direct-current controllers, purchasers should specify whether low voltage protection or low voltage release is desired. These controllers can be supplied with either.

To meet the various service requirements encountered in industrial applications two different forms of resistors are employed—tubes and grids. The selection of each depends upon the amount of current handled, the amount of resistance required and also upon whether the resistor is required for starting duty, intermittent duty or continuous duty. Tube resistance, which consists of resistance wire wound on porcelain or iron tubes, Fig. 10, are usually employed for starting duty up to approximately 15 hp. Grids, also shown in Fig. 10, are suitable for starting motors of larger capacity. For intermittnet duty to vary the speed of motors, tubes are used to approximately 7 to 10 hp. and for continuous duty to 5 hp., grids being chosen for larger sizes. In general, tube resistors are adapted to equipments requiring comparatively high ohmic resistance with small current-carrying capacity, whereas grids prove most economical where the current capacity exceeds 15 amp. continuous duty.

To summarize, the trend of the control of apparatus is toward safety first, and in specifying electric equipments for operating machinery in industrial establishments too much stress cannot be laid on the importance of selecting the proper control equipment therefor. The likelihood of obtaining all possible advantages from electric drive depends largely on whether or not the proper controller has been selected.

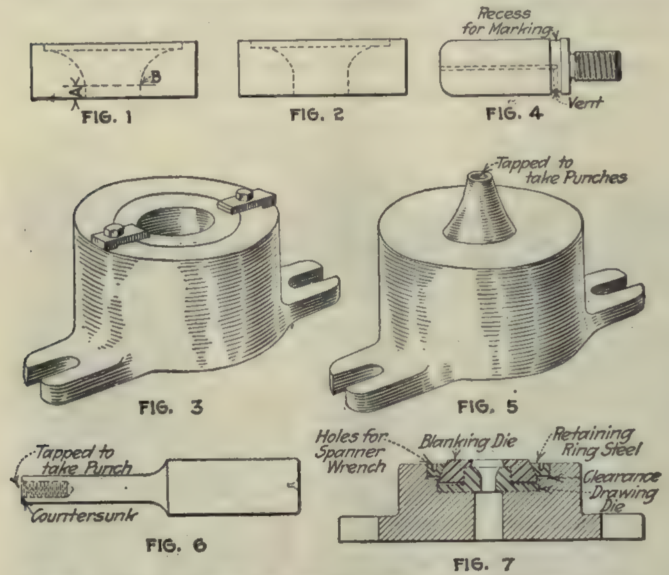
Some Press-Tool Pointers

By Herman F. Salomon

I believe that there exists no greater diversity of opinion regarding the design of equipment than is to be found in shops that operate presses. During my experience I have encountered much equipment that was altogether too expensive, because it was not designed with an idea of being universal and for that reason was, to me, impractical.

It will be my object in the following to show what I believe to be the best practice in blanking, drawing and double-action equipment.

In Fig. 1 is shown a die for drawing shells, first operation. The recess in the upper side is made to the proper size for the blank. It need not be the full depth of the thickness of the stock, but merely enough to catch and center it. Dimension *A* is the length of the ironing surface. This will differ somewhat, according to the thickness of the stock, but need never be over $\frac{1}{4}$ in. for stock up to $\frac{3}{16}$ in. In machining, bore out the die about 0.015 in. smaller than the finished size, giving it an even curve as in Fig. 1.



FIGS. 1 TO 7. DETAILS OF DIE, PUNCH AND HOLDERS

Fig. 1—Correct curve. Fig. 2—Incorrect curve. Fig. 3—Die holder with die in place. Fig. 4—Drawing punch. Fig. 5—Fixture for turning and grinding punches. Fig. 6—Punch holder. Fig. 7—Double-action die and holder

Fig. 2 shows the wrong curve in drawing dies; this has a great tendency to stretch and thin the stock. At point *B*, Fig. 1, the die should measure what it will when finished, leaving the ironing surface to be finished after hardening, by grinding. The curve can be finished in the lathe with a three-cornered scraper, then polished with a carborundum pencil and kerosene, and finally with fine emery cloth and oil. The quality of work turned out and the life of the die depend a great deal on the curve and its finish.

The die blanks can all be turned in a turret lathe. It is then only necessary for the toolmaker to true up the blank, bore out the die and polish.

About three sizes of die blanks will be found enough for the average run of work. This necessitates only three different sizes of die holders, and I believe the one shown in Fig. 3 will be found about as handy and inexpensive as could be desired. It is made of cast iron, bored out a sliding fit for the die blanks, and two holes tapped on opposite sides for capscrews, which draw down on the straps and hold the die in place. The ears on the holder provide means for keeping the die holder on the bolster plate. When it is necessary to change dies, loosen the straps, lift out the die, slip in another, and the job is again ready to run.

Drawing punches are another interesting feature of press-tool equipment. The one shown in Fig. 4 will be found economical from every standpoint.

First decide upon the necessary sizes for the threaded end. Let us say $\frac{7}{16}$ in., $\frac{5}{8}$ in., $\frac{7}{8}$ in. These can be turned in the turret lathe, then cut off to the proper length for the punch. When it is desired to make up a set of punches, these pieces can be given to the toolmaker along with a suitable holder to strap on the faceplate. One of the small cast-iron die holders with hardened-steel plug in the center makes a good one (see Fig. 5). It is then a simple matter to true up the holder and turn as many punches as desired with one setting. Drawing punches should be ground slightly tapering, so that the work will strip more readily when withdrawing the punch.

Fig. 6 shows the punch holder, which needs little explanation. When changing punches, fasten a dog onto the punch; a few blows with a hammer on the dog will loosen or tighten the punch. The punch holder should be hardened and ground all over.

I prefer the two-piece double-action dies, Fig. 7, which shows the dies in the holder with the retaining ring in place. They are self-centering throughout. The chief features in their favor are that when one-half breaks or wears out it can be replaced, and the die is as good as new. When experimenting with a new job either half can be ground larger and "doctored up" to get the desired result, something quite impossible with a one-piece die.

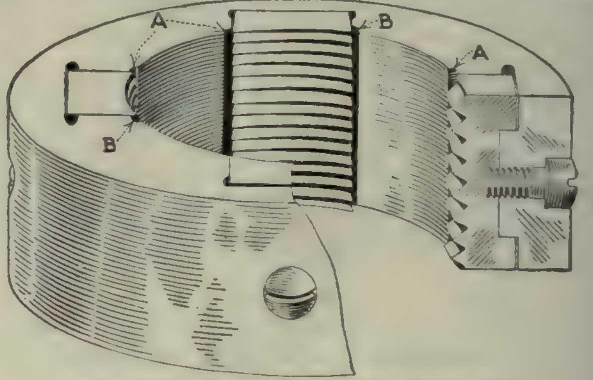
After a drawing die has run awhile, it will be quite likely to allow the work to come back with the punch. This is because the lower edge has become rounded. To remedy this, grind the under side by holding both edges of the hole against the circumference of an emery wheel, which will make it slightly cup shaped and give it a sharp edge to strip the work.

Ring Gage for Large Threaded Pipe

By Adolph Starr

The body of the ring gage shown is close-grained cast iron. The steel pieces, or inserts, are made of Ketos steel, fitted in place as shown, after which the thread is cut to a master gage. The pieces are then marked, removed and hardened in oil and put back in their respective places.

The master gage is fitted a little tight before the pieces are hardened, so that they can be lapped in place after the gage is put together. When the gage wears, a piece of tin foil can be placed under the insert and the gage lapped to the master again. The corners at *A* and *B* are cut away so the inserts will clean off any dirt or chips that may be on the piece being gaged.



RING GAGE WITH INSERTED LANDS

Graphical Solution for Circular Forming Tools

By G. E. Zugelter

The purpose of this article is to describe and illustrate a graphical method whereby the various cutting diameters of circular forming tools of the type used on automatic screw machines, may be obtained quickly and accurately. In Fig. 1 is shown the type of tool that is under consideration. A is the step cut in the work, B the distance between center lines of the work and the tool, R the outside radius of the tool, r the required radius of the tool corresponding to the step A.

From Fig. 1 the following relations are evident: $W = \sqrt{R^2 - B^2}$, $Y = W - A$, or $Y = \sqrt{R^2 - B^2} - A$ and $r = \sqrt{Y^2 + B^2}$. Substituting the value for Y^2 in the last equation, the value for r becomes $r = \sqrt{R^2 + A^2 - 2A\sqrt{R^2 - B^2}}$. This is the type of equation that must be solved to obtain each cutting diameter of the tool. The solution of this equation is a long and tedious process and one in which it is very easy to make an error, and the work is not materially shortened by the use of tables of squares. Some means to reduce the time and labor required for the calculation of these tools is therefore necessary where many of them must be designed.

There are two methods whereby this may be accomplished—by the compilation of tables, or graphically. Tables, in order to be serviceable, ought to give the diameters for differences of 0.001 in. in steps. The compilation of such tables represents a great deal of work and consumes much time, and the chances for error are great. When finished, these tables do not entirely eliminate calculation, because diameters corresponding to steps given to four decimal places must be obtained by interpolation. The foregoing faults are not present in the graphical method.

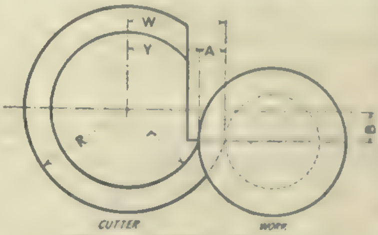


FIG. 1. TYPE OF TOOL

It will be found that within the range of the steps used on the ordinary forming tools the equation for the diameter will represent a series of straight lines when plotted. Hence, it is evident that comparatively few points need be calculated for any one machine. The time required for the production of one of these charts

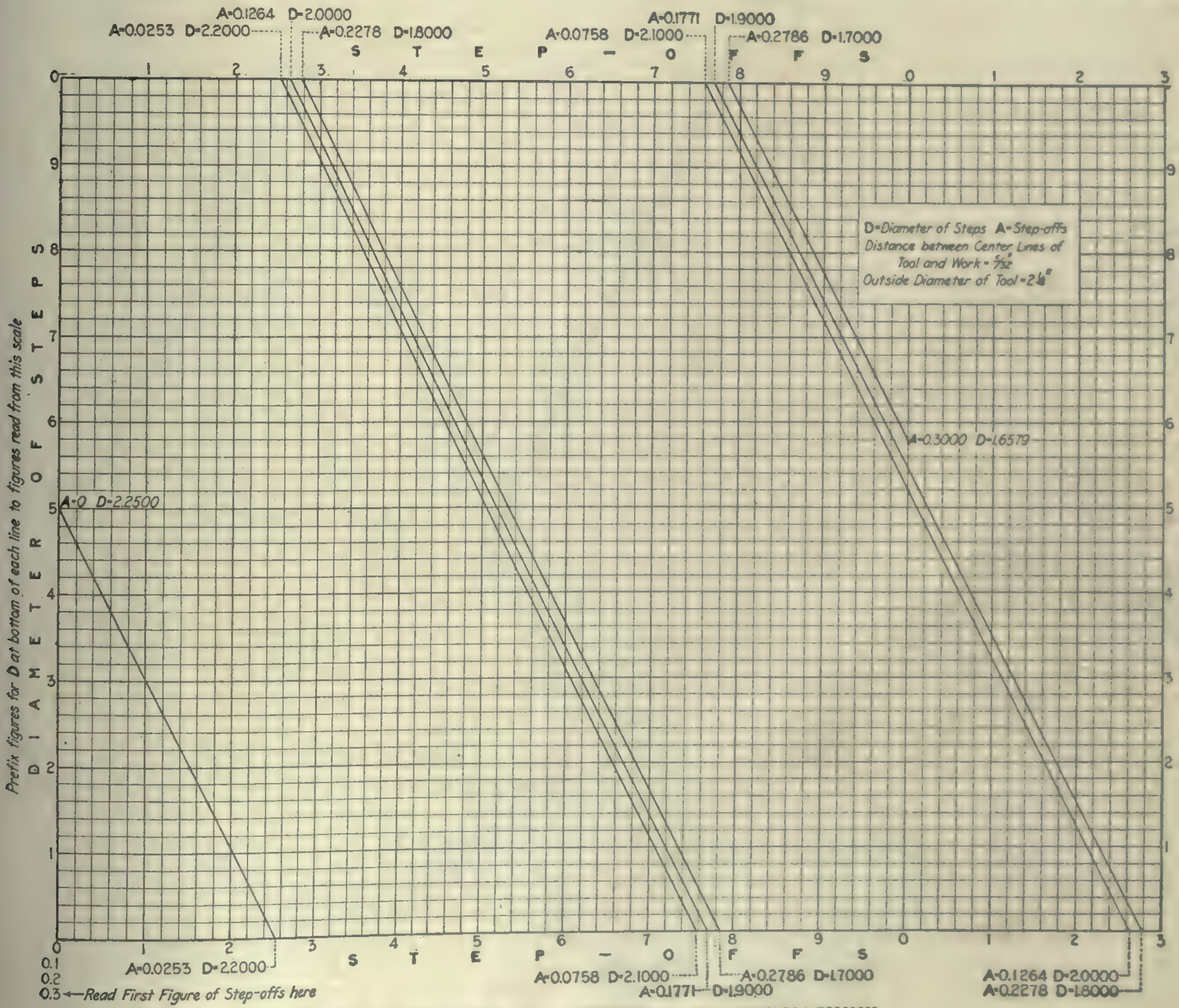


FIG. 2. CHART FOR NO. 0 BROWN & SHARPE MACHINE

is therefore small, and in a plant having many automatics of different sizes and makes a series of charts covering all the machines can be prepared in a short time. The charts when completed will be accurate enough for all practical purposes and will eliminate all interpolation, which is necessary in the ordinary form of table.

Charts, Figs. 2 to 4, are given for the following machines: No. 0 Brown & Sharpe, 1¼- and 2-in. Cleveland and No. 53 Acme. The use of these charts is not necessarily limited to the particular machine given. They will serve for any tools whose outside diameters and distances between center lines agree with those on the charts, and they provide a means of finding the step corresponding to a given diameter of the cutting edge.

An explanation of the construction and use of the charts follows: The method adopted in plotting is that of breaking the curve into sections and defining the limits of each section. The entire curve can thus be confined in a single quadrant, or if convenient some of the sections can be run slightly into the adjacent quadrant. Due to this method of plotting, it is evident that the horizontal scale changes with the limits at the ends of the curves. To indicate this, the figures 0.1, 0.2, 0.3, 0.4 and so on, have been placed under the left-hand zero of the charts. This shows that the units and tens order must be read under the zeros of the horizontal scale, and the hundreds, thousands and ten-thousands places read on the scale proper. For instance, the figures 0.0523, 0.1523, 0.2523, all represent the same point on the horizontal scale. Those parts of the curves which are continued into the next quadrant must be read in connection with the horizontal scale in that quadrant.

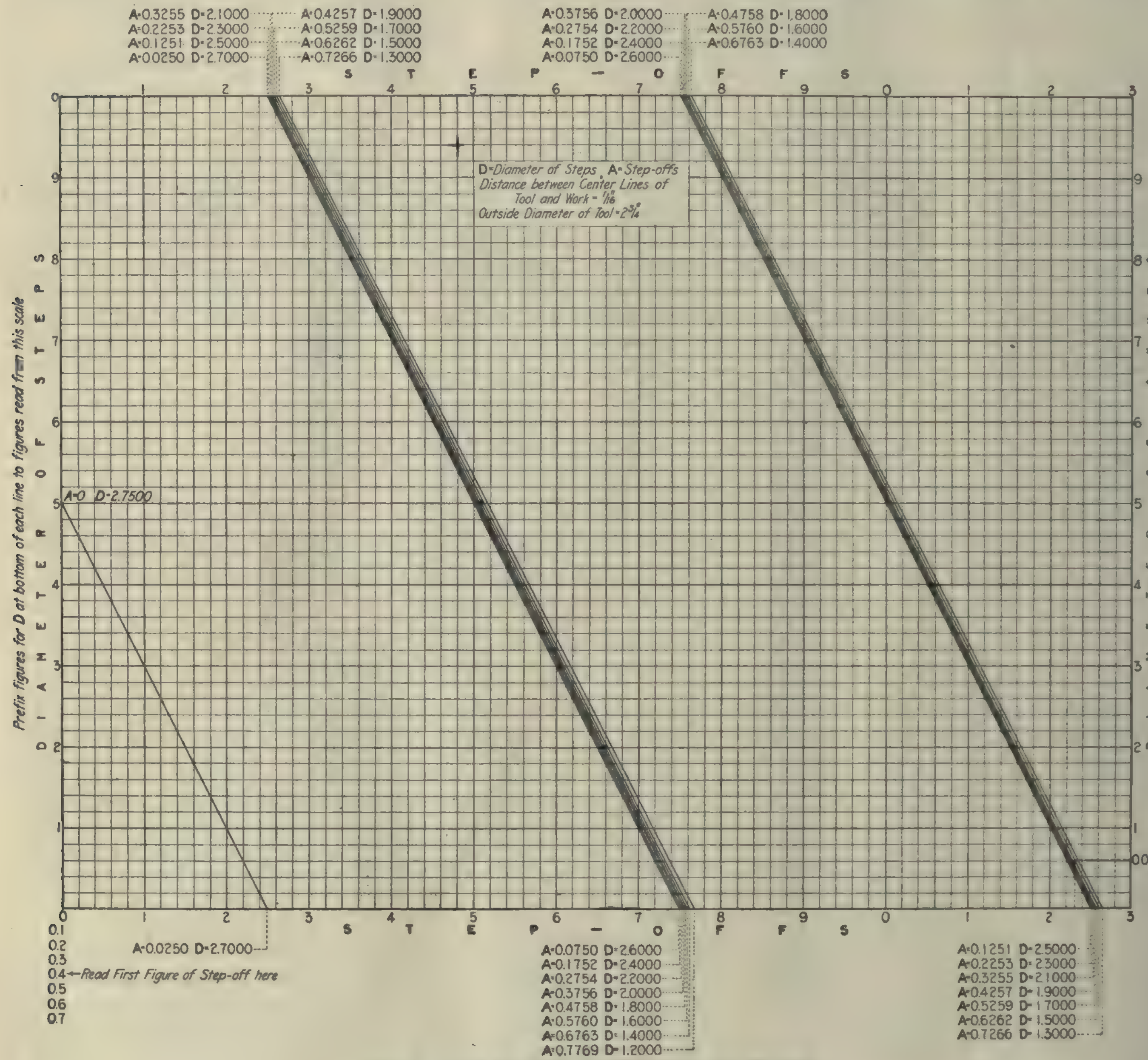


FIG. 3. CHART FOR CLEVELAND MACHINES

The following definitions will aid in understanding the charts: Step-offs (designated on the charts by the letter *A*) are the distances from the outermost cutting edge of the tool to other cutting edges back of it, measured on a line with the center line of the work. The step-offs are determined from the steps to be cut in the work. Diameters of steps (designated on the charts by the letter *D*) are the diameters of the circles corresponding to the steps or cutting edges of the tool. Step-offs are plotted on the horizontal, and diameters of steps on the vertical, axis of the charts.

The total extent on the horizontal and vertical axes of the charts is one-tenth. This length is divided into 10 main parts, each representing one one-hundredth. Each main division is subdivided into 20 parts, so that each small division represents 0.0005, or each two small divisions is one-thousandth.[1] The latter can be subdivided again by estimation, thus allowing the step-offs and diameters of steps to be read to the fourth decimal place very closely.

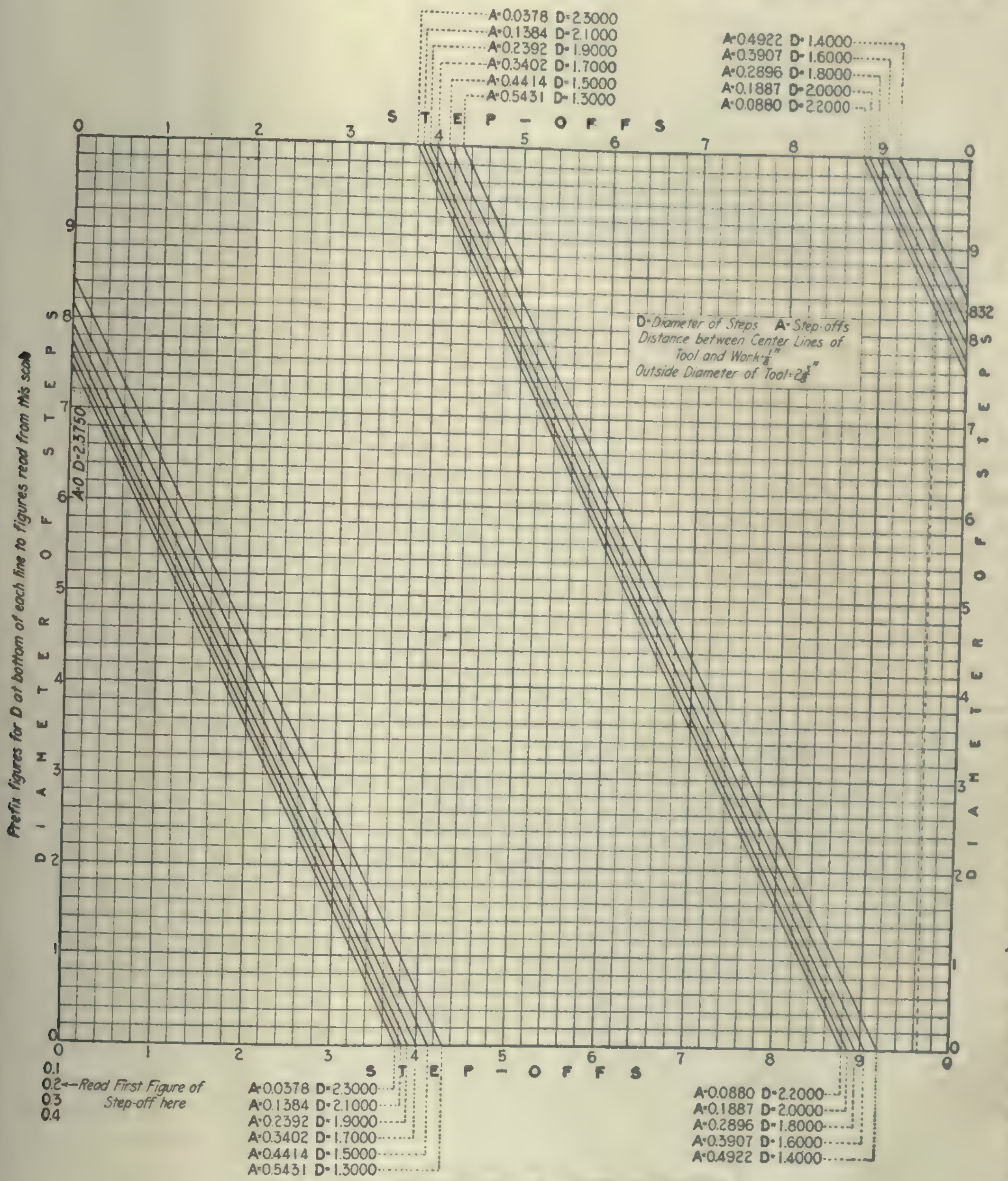


FIG. 4. CHART FOR NO. 53 ACME MACHINE

From the nature of the scales it is evident that only the hundredth, thousandth and ten-thousandth decimal places can be read directly from them, the preceding figures being obtained from the limits given at the extremities of each curve as can be seen by careful examination of them.

The method of finding the diameter of step for a given step-off is as follows: Select the curve on the chart between whose limits of step-offs the given step-off lies. Read the given value of *A* on the horizontal scale. Follow this value vertically to where it intersects the chosen curve and read the corresponding figures on the vertical scale. Prefix to the figures taken from the vertical scale the first two figures for *D* at the lower end of the chosen curve. The result is the diameter of the step for the given step-off. Solving two examples will make clear the manner of using the charts: 1. Find the diameter of step for a 0.0965-in. step-off on the No. 53 Acme. 2. Find the diameter of step for a 0.6231-in. step-off on the 2-in. Cleveland. Taking the first example, 0.0965 lies on the curve whose upper limit is $A = 0.0880$, $D = 2.2000$, and whose limit is $A = 0.1384$, $D = 2.1000$. Read 0.0965 on the horizontal scale as follows: Read the zero to the left, as indicated by the note on the chart; the 9 under the heavy line so marked; the 6, twelve light divisions to the right of the 9, and the 5 one more division to the right. This last line represents the step 0.0965. Follow this line vertically to where it cuts the chosen curve and read the figures 832 from the vertical scale. Prefix 2.1, as given for *D* at the lower end of the curve and the desired diameter of the step-off is 2.1832 (by calculation this is 2.183164). By the same process as above, the diameter of step in the second example is found from the chart to be 1.5061 and by calculation 1.506152.

A most valuable bibliography pertaining to a matter of common interest is a compilation of titles of books, technical articles and patent titles covering submarines and torpedo construction and operations. It has been compiled by David B. Rushmore, of the General Electric Co., assisted by William H. Lanman and Eric A. Lof.

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[1] Due to a 4 to 1 reduction in printing, only one-quarter of the number of subdivisions referred to above appear in the cuts.

How To Avoid Cracks in Hardening

By Donald A. Hampson

In these days of scientific heat treatment and the complete equipment available for this kind of work, the success of any hardening proposition in quantities can be guaranteed before the fuel is turned on. But what of the small plant that has no money for equipment—the machine shop of a manufacturing establishment or the country blacksmith shop, perhaps? The men in these places are called upon to harden one or a few pieces of a kind and are expected to produce results. The term "harden" is here applied to carbon-steel—tool-steel—parts that normally are hardened first and then tempered. The class of shops mentioned usually boasts the equipment of the country blacksmith—that is, forge, anvil, tongs and tub of water—and is expected to do work on some very important parts. When an especially "tricky" piece is to be hardened, the job is given to one man who has been successful with such work, often the "old hardener" who scoffed at science but got away with it just the same.

Practically all of these men who could be bought have been attracted by the high wages paid in various centers, and the new generation that has taken their places is struggling with that bugbear of the hardener—the crack. Now, the design of some pieces is such that they can not be hardened under any circumstances without cracking, and then there are poor steels and steels too high in carbon for most purposes. Nevertheless, the average job can be hardened without loss if a few simple precautions are taken. In fact a loss of from 5 to 10 per cent. will be large.

Use One Brand of Steel

To avoid losses in hardening, begin in the shop by selecting a good brand of steel and sticking to it for all work—taps and reamers, punches and dies, cutters, etc. Except on special production work, the advantage of a certain-purpose steel does not offset the advantage of knowing how to harden a steel only slightly inferior to it. Pieces are sometimes spoiled by too many heats or overheats in trying to harden a decarbonized portion; annealed tool steel should have a cut $\frac{1}{16}$ in. deep taken off over all of the skin surface to insure reaching metal of a proper quality.

The unwritten law of hardening is "to heat the steel to only the lowest temperature at which it will harden in water," which is but half stated in the direction, "Don't burn it." And the corollary is, "Always heat slowly." The lowest hardening temperature is at the point of decalescence, or temperature at which the steel loses its magnetism. It may be determined by experiment and experience; and by bringing the reddening steel near a suspended magnet in a sort of "heat-and-try" process. Every shop man knows that steel will harden at a cherry red; but as the definition and the shade of that color have not yet been universally settled, it is only an approximate guide and not to be rigidly followed. A man put to work at a forge out of doors or in too bright a light will invariably overheat tools until he gets accustomed to hardening them at what appears to be a dull red or black.

Exposure to the air is known to be productive of checked surfaces and cracks, and to avoid this, workmen often bury the parts deep in the fire with the blast on. This is a mistake, for in so doing the parts are brought in direct contact with the air of the blast, which does more damage to the steel than the outside air. If the blast strikes the steel at all, it should be before a red heat is reached. It is far better to rush the work at the beginning than at the end, and the lesser evil of the two is to use the blast to bring the work up to a black heat and then cut it off entirely, leaving the heat of the fire to "soak" slowly through the work. The thin sections of parts made up of light and heavy portions will rarely be overheated if this method is religiously followed. Other ways of avoiding the ill effects of air (not the outside air) are to put the piece or pieces being hardened in a tube or piece of pipe or other metal receptacle laid in the fire; such receptacles have a further value because their interiors and the work therein heat more slowly than their exterior surfaces.

The Quenching Bath

The quenching bath that we are considering is a tub of water standing by the forge. A pail of fish oil or other animal oil is apt to be found alongside the tub for work that is to be oil-hardened. Running water and brine are likely to prove more of a hindrance than a help to the average hardener doing general work. The greatest safeguard against cracks is the use of warm water as a bath, and a pail or can for this should be kept on hand. Only clean water should be used, and this should be heated to a temperature as hot as the hand will bear. Then when an expensive die is brought in to be hardened, let the warm water be the last link in the chain of steps, simple and inexpensive, that will bring it out of the bath guaranteed hard and without a crack. Water almost up to the boiling point will harden steel as well as and far more safely than cold water.

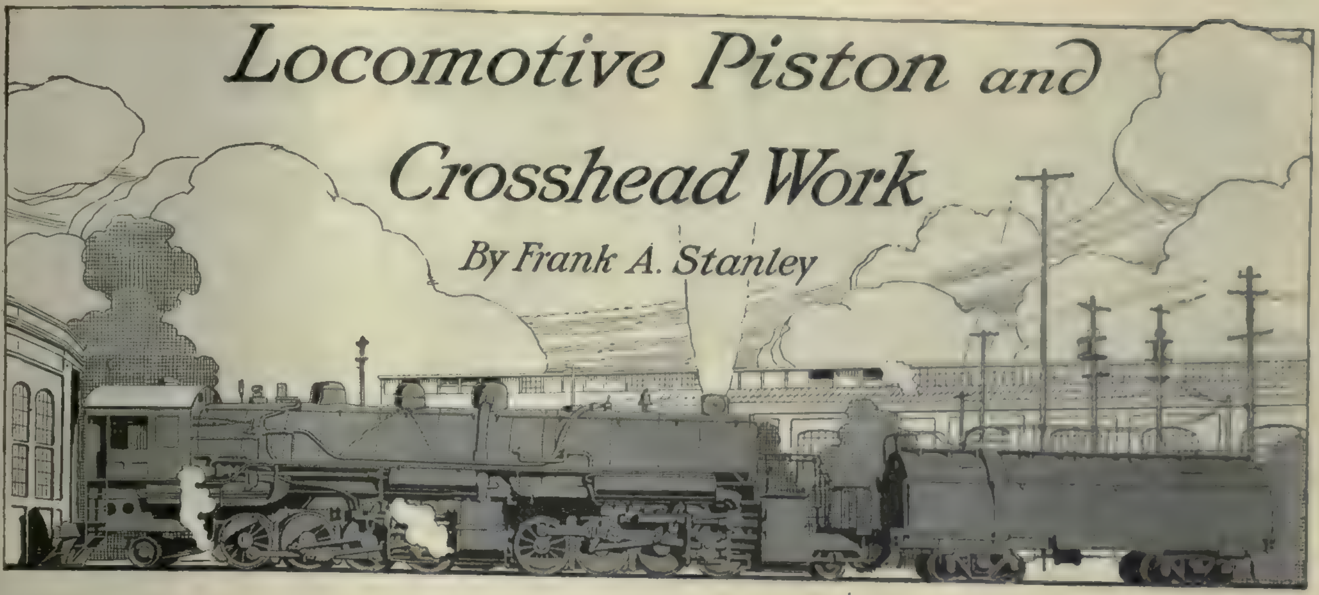
Hardened pieces should have their temper "drawn" as soon as possible, to anticipate any cracks that may develop after cooling as the steel finally settles itself and to release strains. When this cannot be done and some hours may elapse before drawing, it is a good plan to withdraw the work from the bath soon after the "boiling" ceases, or before it has cooled to the temperature of the bath. A sure way of doing this is to put the other hand in the water and, by cautiously feeling, determine the highest heat at which the work may be held in the hand and withdrawing it at that heat. Work so taken out may stand for any length of time before tempering. This is also a safe way of avoiding hardening cracks if the work is dipped in cold water.

Work with Many Holes

A solid piece of steel is easier to harden safely than one with many holes and recesses in it. Indeed, it is on pieces of the latter sort that most hardeners have trouble. This trouble may be overcome in a majority of cases by the simple expedient of filling the holes with asbestos cement. This is mixed in small quantities with water and the stiff mixture pressed into holes and deep recesses. It will stay in place during the hardening process and is easily removed afterward. For some parts, such as, for instance, drill bushings, which require a glass-hard interior, this treatment will not do.

Locomotive Piston and Crosshead Work

By Frank A. Stanley



SYNOPSIS—*Some operations on pistons, crosshead and guides, as handled in the Southern Pacific division shops at Sparks, Nev., are illustrated in the following article.*

A VIEW in a corner of the shop devoted to lathe and boring-mill work, Fig. 1, shows one of the vertical boring machines set up for turning and boring piston heads. This illustration also indicates clearly the arrangement of motor drives for various machines and certain equipment in the line of cranes, hoists, etc., for facilitating the handling of work in and out of the tools. The photograph reproduced in Fig. 2 shows the method of assembling the piston on its rod. Here the rod is secured in horizontal position in a pair of V-blocks mounted upon wooden blocks on the shop floor, a pair of stiff straps across the top of the rod effectually preventing it from turning while the piston is being secured in place. The end of the rod is threaded for the nut shown lying upon the edge of the piston, and the thread is thoroughly coated with white lead before the nut is run into place. The piston and rod end are snugly fitted together; and when the nut is run on and drawn up tight, the piston is held securely against liability of coming loose.

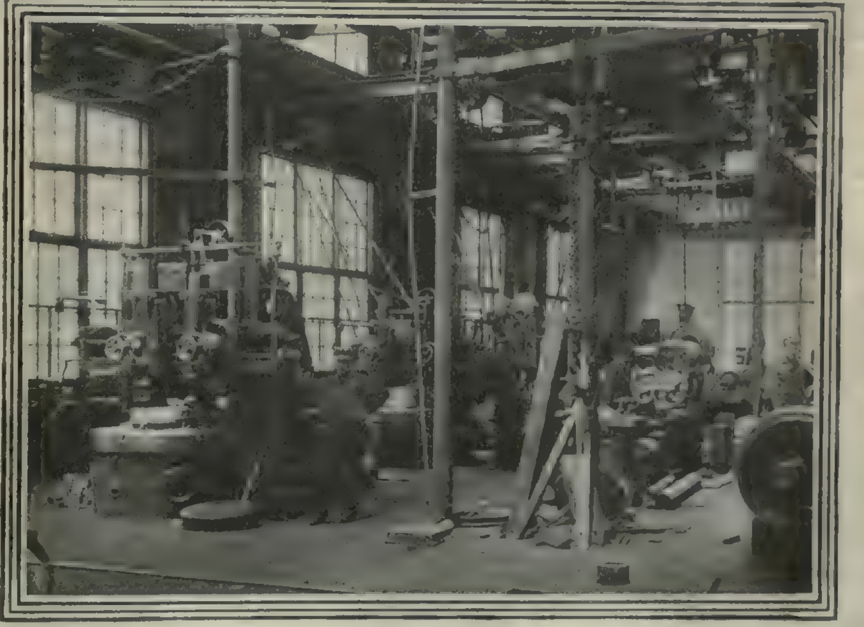


FIG. 1. VERTICAL BORING MILLS SET UP ON LOCOMOTIVE PISTONS

The wrench for tightening the nut is shown in front of the blocks. With its long pipe handle it enables the mechanics to apply as much force as necessary to screw the nut up dead tight. A cotter pin is put through nut and rod end after the nut is fast in place, to keep it from jarring free and turning back upon its thread.

Fig. 3 shows the assembled piston and rod in the lathe for the finishing of certain surfaces on the piston head. The work is mounted on centers, the purpose of the chuck being to rotate the work through the medium of the cross-key, which is placed through the tapered end of the rod so that one side of the key comes in contact with one of the chuck jaws and thus acts as a dog for driving. The crosshead in Fig. 4 is represented in position on the table of the horizontal boring machine for the taper reaming of the wristpin hole. The crosshead rests upon the machine table, but is securely strapped against parallels held to the upright face of an angle plate. The body of the pin, as shown by Fig. 5, is 4 in. in diameter, and the taper portion is ¼ in. taper in 5 in., or 0.6 in. per foot. The body of the crosshead is of cast steel, and the bearing surfaces for the guides are babbitted in the manner indicated—that is, the babbitt is poured into 12 dovetailed seats formed in sides and bottom of the bearing surfaces, the relative areas of babbitt and

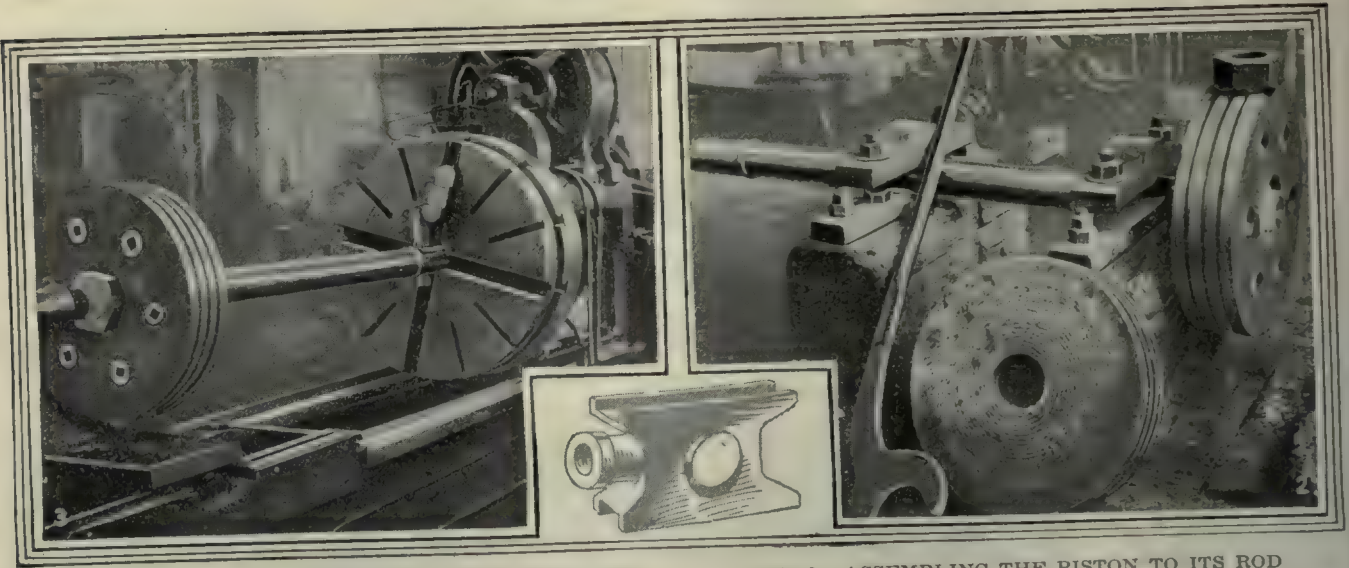


FIG. 3. PISTON CHUCKED IN LATHE FOR FINAL CUT

FIG. 2. ASSEMBLING THE PISTON TO ITS ROD

casting forming the bearing being clearly illustrated. The piston rod, as will be seen, is connected to the crosshead by taper fit and held further by the large flat taper key shown in the detail in Fig. 5. The key measures over the wedge proper $9\frac{1}{2}$ in. long and is $\frac{3}{4}$ in. thick. Its taper is $\frac{3}{16}$ in. in 8 in. (the distance through the neck of the crasshead), or $\frac{9}{32}$ in. per foot.

This taper key is locked endwise by a No. 4 taper pin. The drawings show all these features and others of interest. Fig. 6 shows the crosshead assembled with the piston rod and piston, ready for the planing of the bearing surfaces. For this operation the rod is located in a pair of V-blocks formed of angle irons with V-clamps at the top. The angle irons are provided

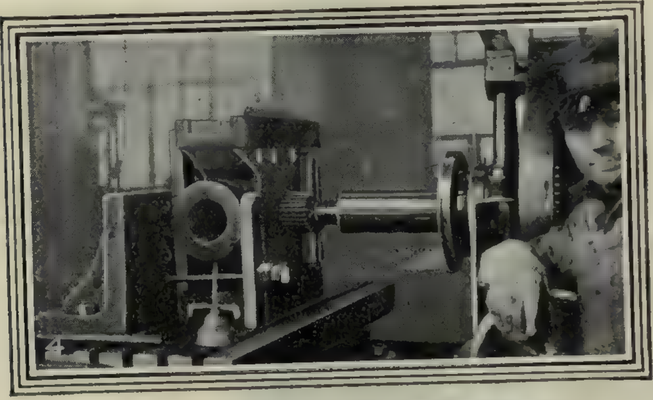


FIG. 4. TAPER-REAMING CROSSHEADS

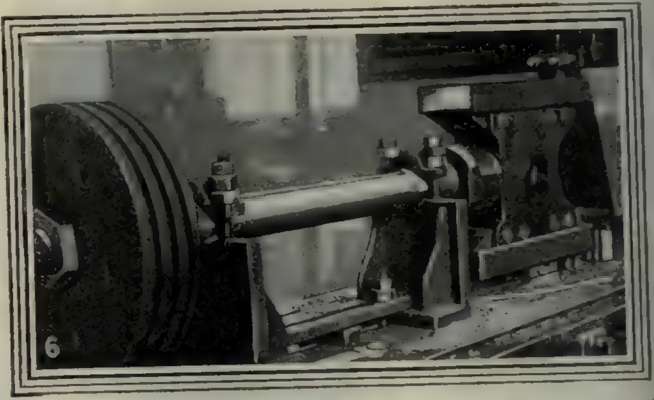
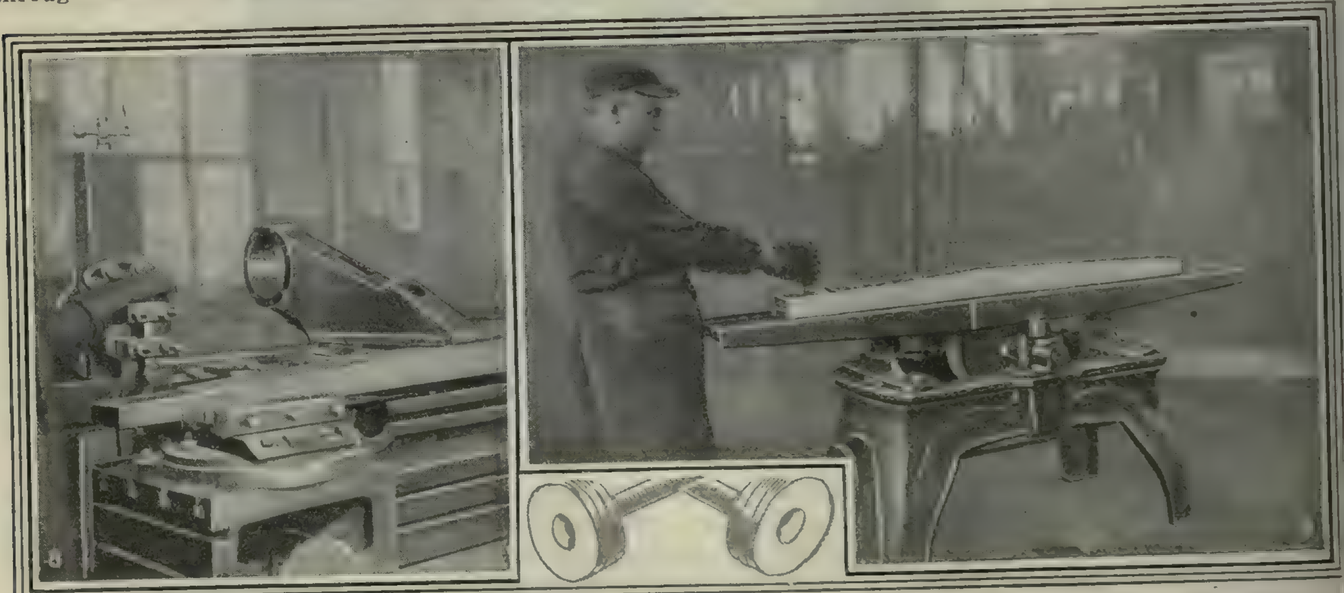


FIG. 6. RIGGING FOR PLANING SHOE SEATS



FIGS. 8 AND 9. OPERATIONS IN MACHINING LOCOMOTIVE CROSSHEAD GUIDES. NOTICE THE METHOD

with aligning tongues at the bottom to fit into the platen slots, and this method of locating the work on the planer platen assures the planing of the guide bearings exactly in line with the piston rod.

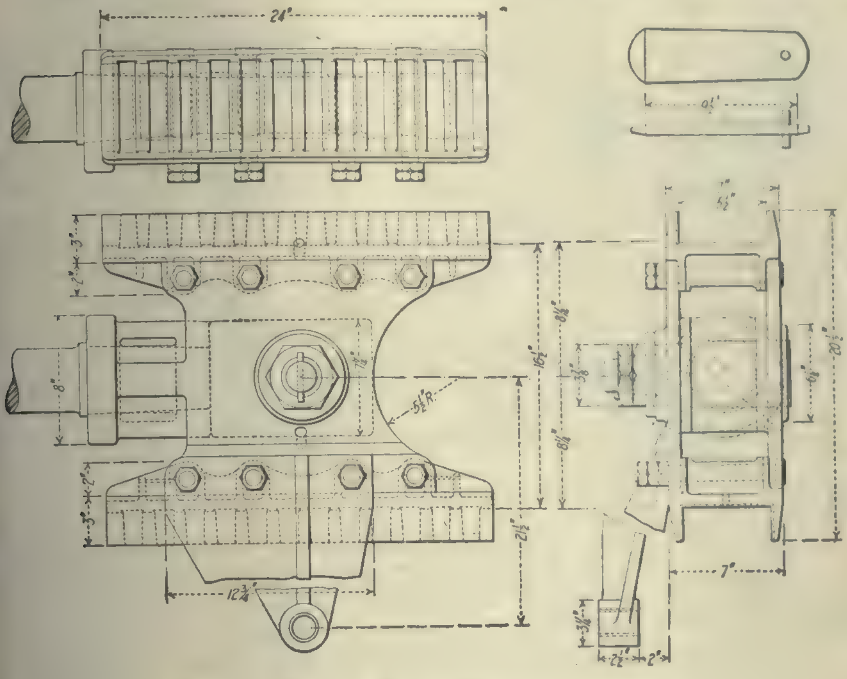


FIG. 5. DETAILS OF LOCOMOTIVE CROSSHEAD

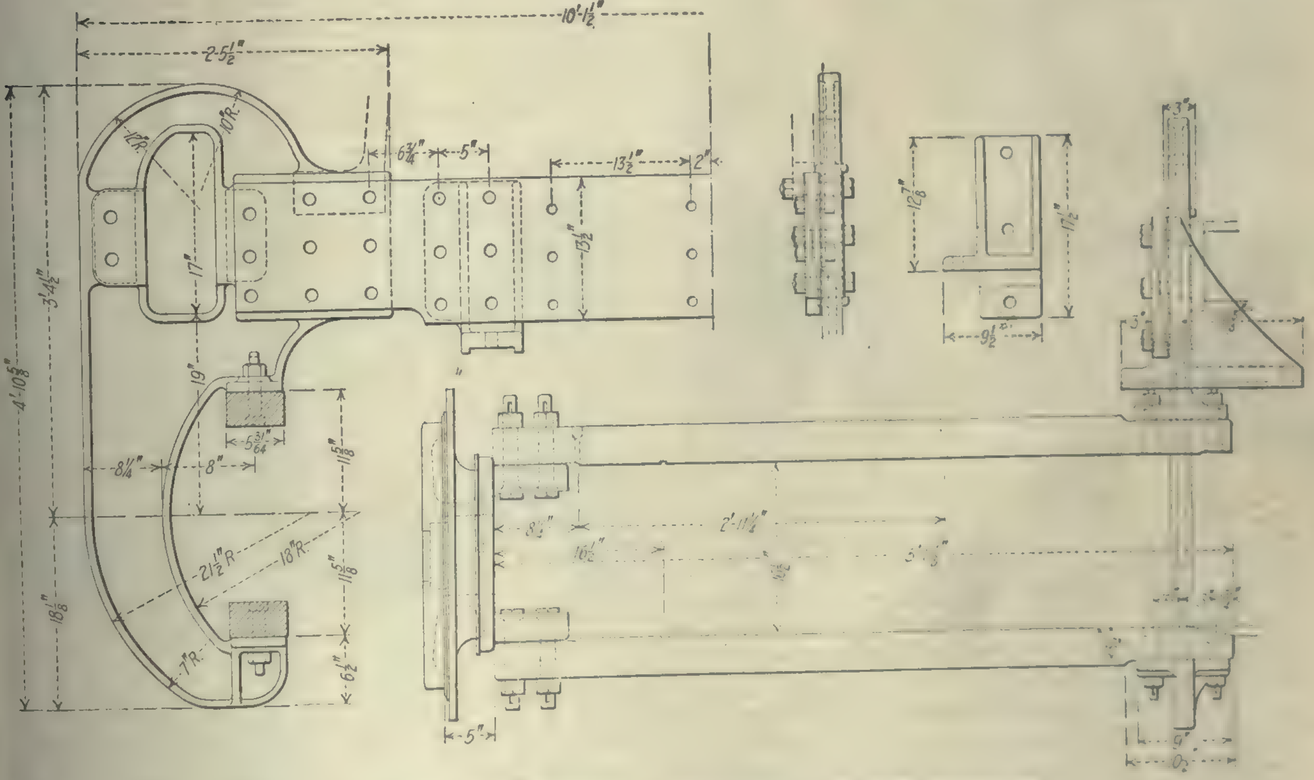


FIG. 7. DETAILS OF LOCOMOTIVE CROSSHEAD GUIDES AND GIBS

Fig. 7 illustrates the form and dimensions of a typical crosshead guide and yoke, and Figs. 8 and 9 show some operations in the machining of the guides. These are of openhearth steel and are 70⅛ in. long, or practically 6 ft. from end to end. In section they are about 5½ x 3¾ in.

The seats at the ends for yoke and cylinder-head connections are formed in the shaper with the guide held in the vise in the manner shown in Fig. 8. The body of the guide is finished by grinding on the machine illustrated in Fig. 9. This forms a surface grinder with the wheel operating below the table, but with the top of its arc just passing up clear through the upper face of the work table. As the wheel wears, the table may be adjusted to maintain the cut on the work; and the depth of cut is of course varied at any moment, as required, by adjustment of the table-controlling device. The guide that is to be ground is drawn back and forth across the wheel top by means of a handle placed in one of the stud holes at the end of the work. Where a guide comes into the shop for overhauling, with the working surfaces pretty badly worn, the first operation is to plane it down smooth and square. Then it is placed on this grinder for finishing. In cases where the guide is not badly worn, it is sent immediately to the grinder for resurfacing without preliminary operations on the planer. This process of grinding leaves the guide surface in excellent condition for the operation of the crosshead in service, and the work of grinding is accomplished economically and effectively.

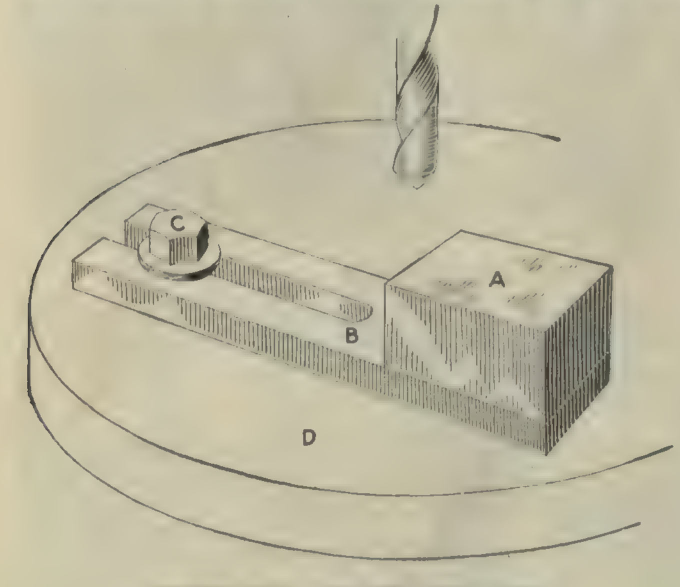
While considering Fig. 9, it may be of interest to call attention to the height of the belt guard at the rear in the photograph. This guard is for a machine with a slanting belt, and the pipe rails forming the guard are carried up to a height where it is impossible for a workman to bring any part of his body into contact with the running belt without deliberate carelessness upon his part. Vertical and sloping belts are only too often guarded by rails and inclosures too low to form an adequate protection to head and shoulders of passing operatives. The systematic manner in which all classes of belts and apparatus likely to prove more or less dangerous to workmen have been guarded in these shops constitutes one of the many important features of interest to visitors to the plant.

Positively Located Drill Jig

By Joseph Calcaterra

While reading the *American Machinist*, I took particular notice of the article on page 387, Vol. 46, "Positively Located Drill Jigs." The suggestions in the article are very good, but I think I have a device that is a little better and somewhat easier to make and handle. With my contrivance a piece with any number of holes may be jigged and drilled without any possibility of the jig rotating and becoming dangerous to the operator. The drawing shows the arrangement.

A is the jig proper; *B* is a piece slotted as shown. It may be part of the jig or a piece attached to it in any manner best adapted to the general shape of the jig, so that it lies flat with the jig on the drill table. At *C* is a bolt threaded within the thickness of the piece *B* from the head of the bolt and having a diameter equal to the width of the slot, so that the piece can slide in any direction around the bolt.



POSITIVELY LOCATED DRILL JIG

The bolt is screwed into a hole tapped at one end of the drill table *D*. Then the jig can be slid to bring any hole into position directly beneath the drill, and the bolt will act as a stop and prevent the jig from rotating and working loose while drilling.

The jig can easily be taken from the table for inserting the work and may be dipped in a pail of washing soda for cleaning. The jig is easily positioned and easily handled.

Ratios for Gear Trains

By L. R. Mayo

On pages 1079 and 1113, Vol. 43, were published some tables of change gear combinations with their corresponding logarithms, for use in calculating the change gears required to give a desired ratio.

I have found these tables of great value in the gearing of various special machine tools and have never experienced any serious difficulty in obtaining sufficiently accurate results within their range.

However, I have frequently found that the range of the ratios obtainable with these tables is not great enough to take care of the extra-large and the extra-small ratios, and as many machines have change gears with as few as 24 teeth, I have made up the accompanying extension of those tables, giving the ratios which are larger and smaller than the ones previously published in the *American Machinist*.

TABLE OF RATIOS FOR GEAR TRAINS

Giving All Ratios from 100:24 to 100:30 and from 30:100 to 24:100

100:24	0.6197888	29:97	0.4756263—1
99:24	0.6154240	26:87	0.4754540—1
98:24	0.6110149	28:94	0.4740301—1
97:24	0.6065605	25:84	0.4736607—1
96:24	0.6020600	27:91	0.4723224—1
100:25	0.6020600	24:81	0.4717262—1
99:25	0.5976952	29:98	0.4711719—1
95:24	0.5975124	26:88	0.4704906—1
98:25	0.5932861	28:95	0.4694344—1
94:24	0.5929167	25:85	0.4685211—1
97:25	0.5888317	27:92	0.4675760—1
93:24	0.5882717	29:99	0.4667628—1
100:26	0.5850267	24:82	0.4663973—1
96:25	0.5843312	26:89	0.4655833—1
92:24	0.5835766	28:96	0.4648868—1
99:26	0.5806619	25:86	0.4634415—1
95:25	0.5797836	27:93	0.4628809—1
91:24	0.5788902	29:100	0.4623980—1
98:26	0.5762528	24:83	0.4611331—1
94:25	0.5751879	26:90	0.4607308—1
90:24	0.5740313	28:97	0.4603863—1
97:26	0.5717984	25:87	0.4584207—1
93:25	0.5705429	27:94	0.4582359—1
89:24	0.5691788	28:98	0.4559319—1
100:27	0.5686362	26:91	0.4559319—1
96:26	0.5672979	24:84	0.4559319—1
92:25	0.5658478	27:95	0.4536402—1
99:27	0.5642714	25:88	0.4534573—1
88:24	0.5642715	28:99	0.4515228—1
95:26	0.5627503	26:92	0.4511855—1
91:25	0.5611014	24:85	0.4507923—1
98:27	0.5598623	27:96	0.4490926—1
87:24	0.5593081	25:89	0.4485500—1
94:26	0.5581546	28:100	0.4471580—1
90:25	0.5563025	26:93	0.4464904—1
97:27	0.5554079	24:86	0.4457127—1
86:24	0.5542873	27:97	0.4445921—1
93:26	0.5535096	25:90	0.4436975—1
100:28	0.5528420	26:94	0.4418454—1
89:25	0.5514500	24:87	0.4406919—1
96:27	0.5509074	27:98	0.4401377—1
85:24	0.5492077	25:91	0.4388986—1
92:26	0.5488145	26:95	0.4372497—1
99:28	0.5484772	27:99	0.4357286—1
88:25	0.5465427	24:88	0.4357285—1
95:27	0.5463598	25:92	0.4341522—1
91:26	0.5440681	26:96	0.4327021—1
98:28	0.5440681	27:100	0.4313638—1
84:24	0.5440681	24:89	0.4308212—1
94:27	0.5417641	25:93	0.4294571—1
87:25	0.5415793	26:97	0.4282016—1
97:28	0.5396137	24:90	0.4259687—1
90:26	0.5392692	25:94	0.4248121—1
83:24	0.5388669	26:98	0.4237472—1
100:29	0.5376020	24:91	0.4211698—1
93:27	0.5371191	25:95	0.4202164—1
86:25	0.5365585	26:99	0.4193381—1
96:28	0.5351132	24:92	0.4164234—1
89:26	0.5344167	25:96	0.4156688—1
82:24	0.5336027	26:100	0.4149733—1
99:29	0.5332372	24:93	0.4117283—1
92:27	0.5324240	25:97	0.4111683—1
85:25	0.5314789	24:94	0.4070833—1
95:28	0.5305656	25:98	0.4067139—1
88:26	0.5295094	24:95	0.4024876—1
98:29	0.5288281	25:99	0.4023048—1
81:24	0.5282738	25:100	0.3979400—1
91:27	0.5276776	24:96	0.3979400—1
84:25	0.5263393	24:97	0.3934395—1
94:28	0.5259699	24:98	0.3889851—1
87:26	0.5245460	24:99	0.3845760—1
97:29	0.5243737	24:100	0.3802112—1

This increases the maximum ratio obtainable, when using four gears in the usual way, from 10.645 + : to 16.5: 1, and will perhaps be of interest to those who have used the original tables.

The Panoramic Sight

By

W. L. Olmstead

SYNOPSIS—*A continued description of the panoramic sight, the disassembled units of the headpiece, body and elbow groups and the methods, jigs, tools and fixtures used in their manufacture. A number of the small component parts are of particular interest.*

THE rotating-head parts illustrated in Fig. 7 comprise the headpiece group. The prism holder upon which the worm segment is cut is shown removed from the headpiece in Fig. 9. The stop rings *F*, Fig. 7, control the length of travel of the worm *I* on the worm segment *A*, Fig. 13, which is cut in the prism holder. Each ring has a small tongue *W*, Fig. 7, the edge of which engages, at each revolution of the wormshaft, with the edge of the tongue on the adjacent ring. Each ring is thus engaged in its turn at each revolution of the wormshaft until six revolutions have been made, six revolutions of the worm being necessary to complete the distance to be traveled by the worm along the worm segment designated as *A* in the illustration, Fig. 13.

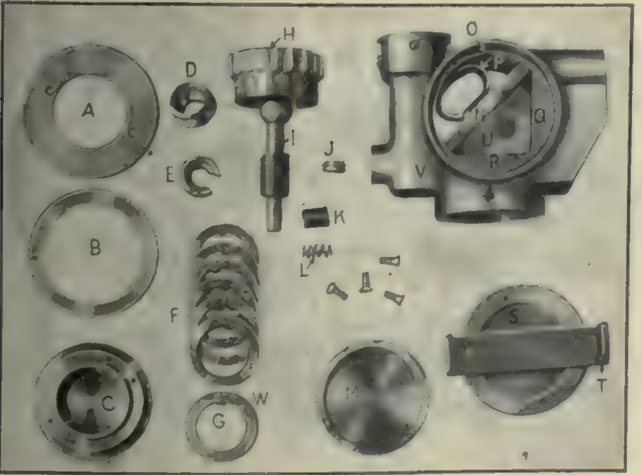


FIG. 7. ROTATING-HEAD GROUP

A, elevation index. B, support retaining ring. C, elevation-index support. D, elevation worm-ball cap. E, elevation worm-ball socket. F, stop ring. G, stop ring with holes. H, elevation micrometer. I, elevation worm. J, worm-plunger spring retainer. K, elevation worm plunger. L, worm-plunger spring. M, prism-holder cover. N, prism support (back). O, prism holder. P, prism spring. Q, prism support (front). R, prism support (bottom). S, rotating-head cover. T, open sight. U, rotating-head prism. V, rotating head. W, tongue for take-up

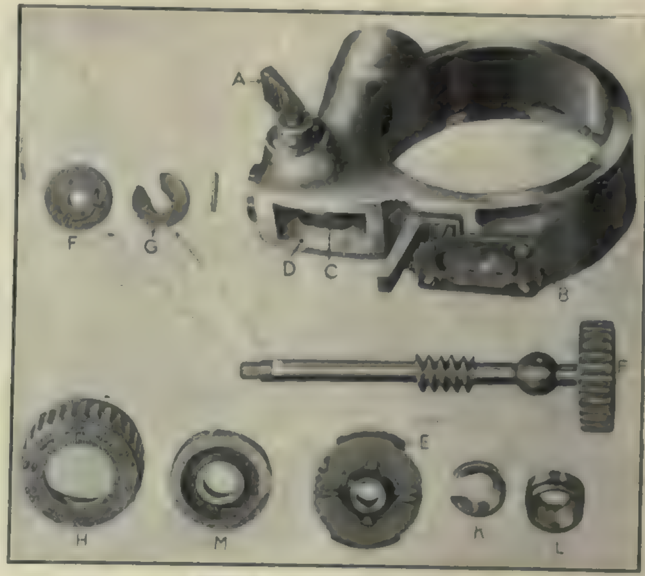
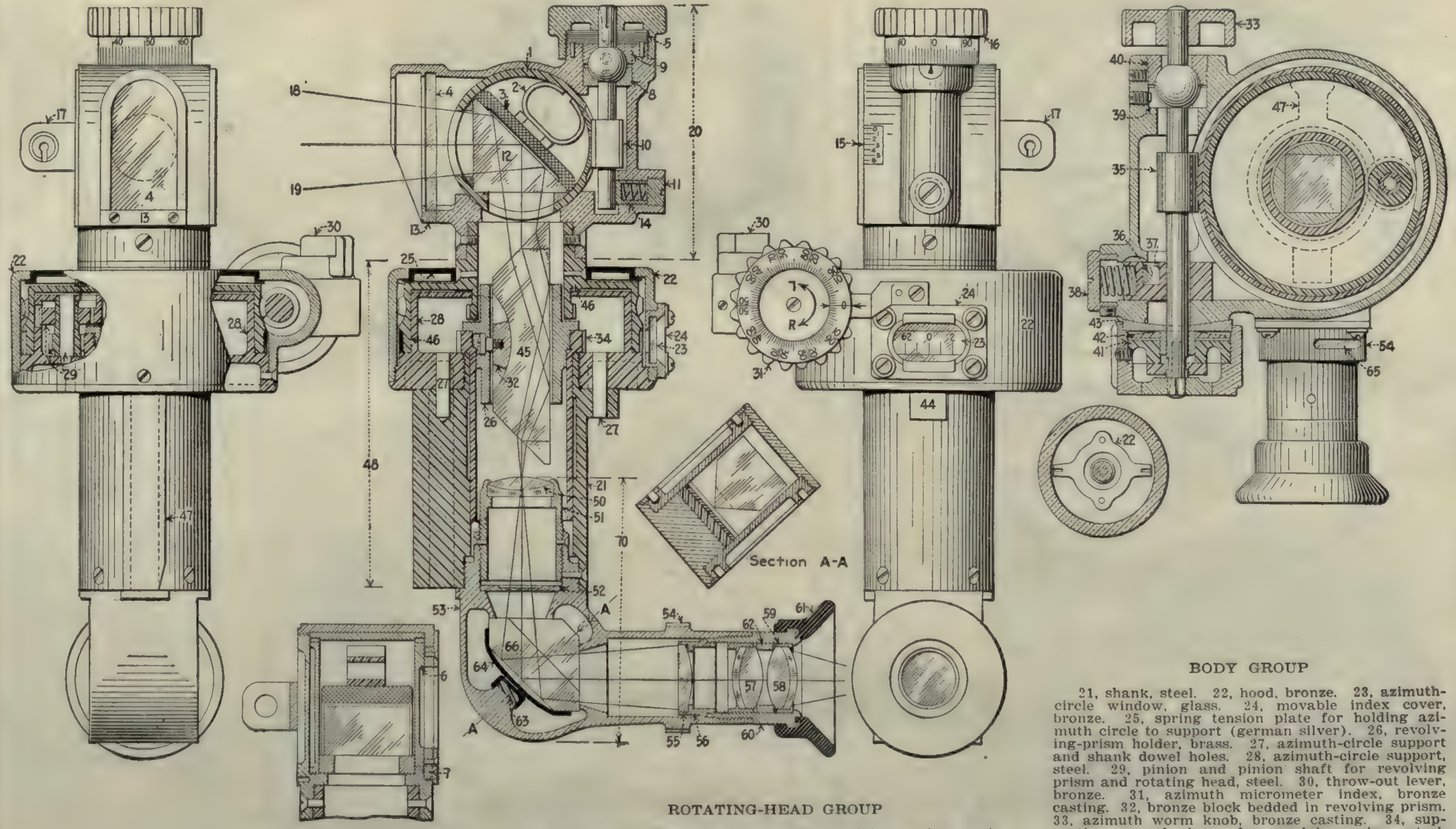


FIG. 9. HOOD DETAILS

A, throw-out lever. B, movable index plate. C, elongated clearance throw-out slot. D, side bearings for E. E, movable steel slide bearing for throw-out. F, micrometer index. G, retainer washer. H, azimuth micrometer. J, locking spring. K, ball socket. L, ball cap. M, locking plate

The circumference of the azimuth circle *C*, Fig. 11, is divided into 64 equal divisions. One complete turn of the worm *I*, Fig. 7, moves the rotating head and its prism through one of these divisions on the azimuth scale, or $\frac{1}{64}$ of a circle. The front end of the wormshaft carries the worm index, which is graduated into 100 equal parts. One of these subdivisions equals $\frac{1}{100}$ of a division of the main scale or marks a movement of the rotating head and its prism through $\frac{1}{6400}$ of a circle. An angular movement of the line of sight through $\frac{1}{6400}$ of a circle practically corresponds to a lateral displacement of $\frac{1}{1000}$ of the range. Each subdivision is called a millieme, or mil, and is considered as a point



ELBOW GROUP

50, objective lens. 51, objective-lens cell, brass. 52, diaphragm, brass. 53, elbow, bronze casting. 54, slotted knurled shutter, brass. 55, reticule, glass. 56, reticule cell brass. 57, field lens, glass. 58, eye lens. 59, eye-lens cell. 60, eyepiece, bronze. 61, soft-rubber eye protector. 62, lens separator, brass. 63, taper wedge, steel. 64, prism (spring) holder. 65, slot for night illumination. 66, lower reflecting prism. 70, elbow group

ROTATING-HEAD GROUP

1, prism holder, steel. 2, prism retaining spring, spring steel. 3, back prism support, aluminum. 4, prism shield, glass. 5, stop rings (7), brass. 6, elevation-index support. 7, index-support retaining ring, brass. 8, ball socket, bronze. 9, ball cap, bronze. 10, elevation wormshaft, steel. 11, spring retainer, brass. 12, rotating-head prism. 13, shield retainer, brass. 14, spring plunger for worm tension, steel. 15, elevation index. 16, elevation micrometer index, german silver. 17, open sight, bronze. 18, upper ray. 19, lower ray. 20, rotating-head group

BODY GROUP

21, shank, steel. 22, hood, bronze. 23, azimuth-circle window, glass. 24, movable index cover, bronze. 25, spring tension plate for holding azimuth circle to support (german silver). 26, revolving-prism holder, brass. 27, azimuth-circle support and shank dowel holes. 28, azimuth-circle support, steel. 29, pinion and pinion shaft for revolving prism and rotating head, steel. 30, throw-out lever, bronze. 31, azimuth micrometer index, bronze casting. 32, bronze block bedded in revolving prism. 33, azimuth worm knob, bronze casting. 34, supporting geared sleeve for revolving prism, steel. 35, azimuth worm and wormshaft, steel. 36, throw-out cam and slot in plunger steel. 37, throw-out plunger, steel. 38, spring retaining nut, bronze. 39, bearing socket, brass. 40, bearing cap. 41, deflection locking plate, steel. 42, locking spring, steel. 43, movable steel slide bearing for throw-out. 44, machined boss for dowel-pin hole. 45, revolving prism, glass. 46, azimuth circle, steel. 47, T-lug. 48, body group

FIG. 8. ELEVATIONS AND CROSS-SECTIONS SHOWING DETAILS OF 1917 PANORAMIC GUN SIGHT

equal to $\frac{1}{1000}$ of the range. The same ratio is held by the graduation on the elevation scale on the rotating head, which is in units of 100 mils each, and those on the elevation micrometer *H*, Fig. 7, which are in units of one mil each, a complete turn of the elevation micrometer worm equaling one division on the elevation scale.

The azimuth micrometer knob *H*, Fig. 9, shows graduated lines with engraved figures for reading both ways from zero. When readings are taken, the right-hand deflection movement of the azimuth circle is read on the azimuth micrometer knob, the engraved figures of which are filled in with Japan black. The figures for the left-hand deflection are filled with red. The right- and left-hand letters on the micrometer index *F* are made the same way.

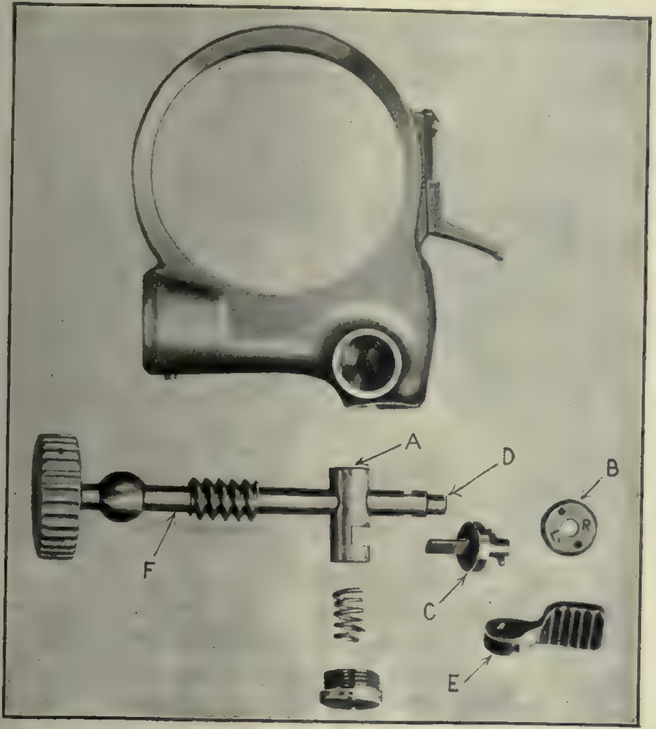


FIG. 10. WORM DETAILS AND THEIR RELATION TO THE HOOD

A, throw-out plunger. B, micrometer index. C, throw-out eccentric. D, slitted end for micrometer index. E, throw-out lever F, azimuth wormshaft

When either the azimuth or the elevation micrometer dials show a backlash error exceeding one mil at any point the errors in graduation or in machining the worm and gears must be corrected so that the error will show within a tolerance of plus or minus one mil.

Assembled and sectional illustrations of the parts are presented in Fig. 8, which also shows a simple diagram of the light rays entering the headpiece. In this figure the numbers 18 and 19 are the upper and lower rays respectively. The axis or central ray is shown between them. The prisms 12, 45 and 66 are made from optical glass, highly polished and transparent, the reflecting surfaces of each prism forming an angle with each other. Rays of light can be bent easily by sending them at an angle through the surface of some other medium of greater density than air. The greater the angle at which the ray strikes the denser medium the more it is bent. The ray, on entering, is bent in toward the perpendicular, and in leaving is bent away. In the preceding article a short description has been given of the ray's passage through the instrument. No appreciable loss in power of the light ray is occasioned by its passage through the prisms, but in its passage through the lenses there is slight loss. The power of the lens itself is its greater or less capacity to bend or deviate the rays that pass through it.

LENS ADJUSTMENTS

In the sectional view, Fig. 8, the adjustable objective-lens cell 51 is assembled to the elbow at the proper focal distance and kept securely in position by small retaining screws. The reticule-lens cell 56 carries the reticule lens, which is made of plate glass, upon which crosslines have been etched. The process of seating this lens in its cell, or collimating the reticule, will be described in detail later. The collimating of the reticule lens is an assembling operation during which the lens cell is rebored on a false plug in a bench lathe until the desired focal depth is secured. This is determined by observing the etched lines on the reticule lens, which is assembled temporarily in the eyepiece, through a collimating telescope and boring the lens cell to the depth required to bring the crosslines on the lens to clear and sharp definition. The lens is then cemented and sealed in its shell by burnishing.

The objective lens 50, Fig. 8, the field lens 57 and the eye lens 58 are achromatic lenses—that is, devoid of color. Each of these lenses is made in two parts, one of crown glass and one of flint glass, cemented together. This construction eliminates the color rays, and the process will be described later. Thus uniting crown and flint glass so as to refract light without decomposing it into its constituent colors gives the quality called achromatism, and this lens is achromatic.

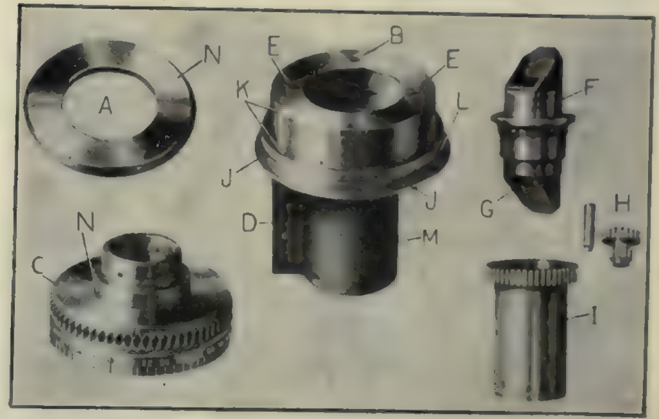


FIG. 11. PROMINENT COMPONENTS OF THE BODY GROUP

A, spring tension plate for holding azimuth circle against bearings. B, pinion-shaft holes. C, azimuth circle. D, T-lug and shank. E, clearance holes for dowel pins. F, rotating-prism holder. G, revolving prism. H, double pinion and pinion shaft. I, supporting sleeve. J, azimuth-circle support. K, bearing and seat for azimuth circle. L, thread and seat for hood. M, shank. N, seat for rotating head

The adjustment of the mechanical axis to the optical axis is made before the lenses are cemented together. This operation is performed by revolving the lens, held upon heated sealing wax attached to a holder in the bench lathe, and with the aid of a T-rest and sharpened stick pressed against the revolving lens causing the reflected images to appear as if stationary. When this condition is obtained, the outside diameter is ground true, thus uniting the optical with the mechanical axis.

The threaded parts, such as those joining the elbow 53 and the shank 21, the azimuth-circle support 28 and the shank, and the rotating head and the azimuth circle 46, are so threaded that each part will be in correct alignment when screwed into position. Small locating marks are placed so as to be easily recognized when it becomes necessary to disassemble the parts. Retaining screws are inserted to hold the parts in permanent alignment. The shank and the azimuth-circle support are permanently doweled in position, as shown in Fig. 8.

The finished prisms are transparent, highly polished and fragile, therefore easily scratched or broken. The use of wooden or steel dummy prisms is therefore necessary during the assembling and fitting operations. It is also necessary to scrape all prism bases so that they will be perfectly flat. Great care is required in seating the prisms and in placing the springs and wedges. Extra pressure of the spring against a prism that is seated on a cocked bearing will crack the prism.

When the final assembly of the rotating-head prism is made, two thin round cork pads are attached with glue, one to each side of the prism. They act as buffers against the side covers that are screwed in the prism holder to keep the prism and its supports in position.

The prism-holding spring 2, Fig. 8, in the rotating head is fitted and adjusted so that its pressure is sufficient to secure the prism in place without causing the prism shell to become out of round.

The hood details, Fig. 9, are grouped to show the relative positions of the wormshaft parts when assembled to the wormshaft. The eccentric throw-out details of the wormshaft are in their assembled positions in the hood. The detail *M* is threaded on the outside to fit an internal thread cut within the micrometer knob *H* and when screwed into position against the shoulder therein, is held in place by a retaining screw. There are one hundred 90-deg. ratchet teeth cut upon the face of the locking plate *M* near the outside edge, in which the teeth of the locking spring *J* operate. The locking spring is riveted to the movable slide *E*, which carries the three parts *H*, *M* and *J*, when the throw-out lever is used, and acts as a dustproof and moistureproof cover for the worm box. It is tongued to make a sliding fit at the sides *D*.

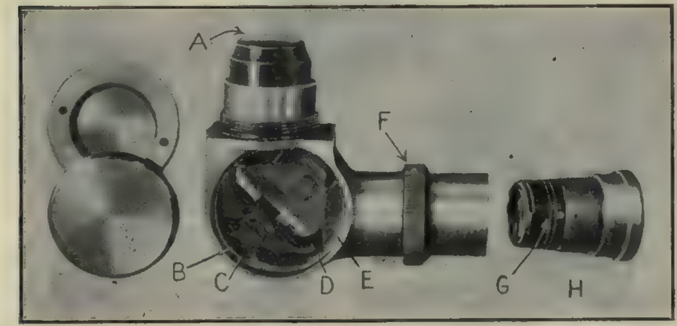


FIG. 12. ELBOW GROUP AND ASSEMBLED EYEPIECE

A, objective lens. B, wedge, steel. C, spring-steel prism retainer. D, lower reflecting prism retainer. D, lower reflecting prism. E, cork protector. F, night-illumination shutter. G, reticule lens with cross-lines. H, eyepiece

The ball socket *K* is slotted so that, in assembling, it can be slipped over the shaft between the worm and the ball. The ball cap *L* is threaded on its outside diameter and has spanner-wrench holes drilled in the back. When assembled in position, it is held in place by a retaining screw. The bearings *K* and *L* are fitted snugly to the wormshaft ball, which forms the outer bearing from which the throw-out mechanism swings. The movement of the throw-out plunger is arranged so that the worm can be entirely disengaged from the azimuth-circle wormwheel.

In Fig. 10 are shown the wormshaft and its relative position to the hood. In this view the throw-out mechanism details may also be seen. The throw-out plunger *A* is made with a slotted or elongated hole to allow for free movement of the shaft while being disengaged. It also has a milled slot in which the eccentric *C* engages.

The spring tension plate *A*, Fig. 11, is made of german silver. In the order of assembly the azimuth circle *C* is placed on the azimuth-circle support *J*. The tension plate is placed on the azimuth-circle, and the hood, Fig. 9, is screwed into position. The pressure of the azimuth circle against its bearings is regulated by the spring tension of the plate, which can be adjusted.

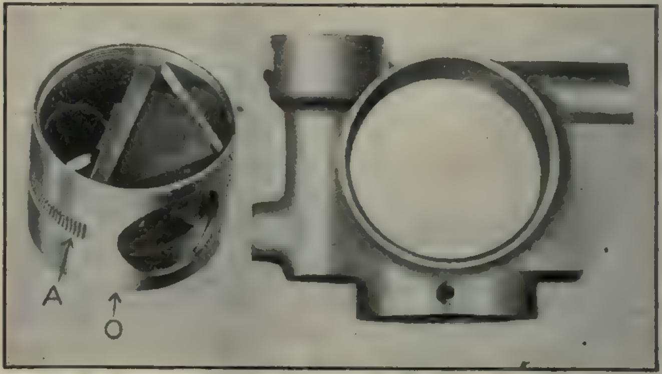


FIG. 13. ROTATING-HEAD PRISM HOLDER

The bearing surface of the plate follows along the upper surface on the lower part of the indented rim at *N*. The under side of the plate has a narrow projecting flange that is turned close to the hole and presses against the azimuth circle, holding it to position.

The azimuth circle *C*, Fig. 11, carries a threaded hub with a bearing at *N*, to which is screwed the rotating head. Upon the lower hub, as shown in the sectional drawing, Fig. 8, a circular rack is cut, which engages with the double pinion *H* as described.

The shank 21, Fig. 8, is a steel forging into the bottom end of which an internal thread is cut to fit the threaded hub of the elbow, thus joining the body and elbow groups.

The double pinion *H*, Fig. 11, is made in two parts and forced together. The geared sleeve *I* is threaded to receive the adjustable prism holder. This holder is slit with four equally spaced slots cut a short distance from each end, as shown at *F*, Fig. 11. In adjusting the revolving prism *G* in the holder *F*, the upper and lower supporting walls of the holder are slightly bent to bring the prism into proper position. The surface prepared for the base of the prism and the opposite side can be slightly filed, a few thousandths generally being sufficient to correct any error in the setting of the prism. When the prism is finally assembled in the holder, it is wrapped in one thickness of photographic black paper. The prism base is fitted with a bronze block, set in placter of paris, in which the holding screw of the prism holder *F*, Fig. 11, fits.

The elbow group with eyepiece assembled, Fig. 12, shows the method of mounting the lower reflecting prism. It is fitted directly to the immovable seats machined in the elbow. The prism is held firmly against the seats by the spring *C*, Fig. 12. The bottom of the spring has an extended bearing to accommodate the taper wedge *B* when it is entered. The amount of tension required to hold the prism in place is regulated by the wedge. Unlike the rotating-head prism, the holding parts are not assembled into a movable holder, but are mounted directly to the machined and scraped surfaces prepared in the elbow. The covers shown in Fig. 12 are screwed to each side and sealed.

As previously mentioned, the instrument must not be roughly handled during assembling operations. Emery cloth, crocus or any other abrasive should never be used. Dust and dirt are enemies of an instrument of this kind and spots of dirt, if permitted to enter, irritate and distract the user when his mind should be concentrated upon the extremely important work at hand.

Special Fixtures Used in Making Laundry Machinery

By M. E. HOAG

SYNOPSIS — *The fixtures and devices shown and described here display considerable mechanical ingenuity in design and application.*

THE special fixtures shown in the accompanying illustrations are in use in the Cincinnati shops of the American Laundry Machinery Co. and will prove of interest, as they can be applied to other lines of manufacture.

The fixture shown at *A*, Fig. 1, is a circular surface plate. It is used to true up a cast-iron wheel, previous to placing it on the vertical boring mill, to be turned and bored. There are also used in connection with this surface plate two faceplates *B*. In operation one of the faceplates is placed on the surface plate so that it rests on the row of steel balls, location being made by a central stud that enters a hole in the surface plate. This makes it very easy for the operator to turn it and thus bring all parts of the wheel under the surface gage *C*, which is attached to the edge of the plate. Suitable jackscrews and clamping screws enable the workman to locate and clamp the wheel in position, after which it is placed on the table of the boring mill, located by the central stud, and clamped down ready for the machining operations. The workman then gets another wheel ready on the second faceplate. In this way idle time on the boring mill is cut down to a minimum and works no hardship on the operator.

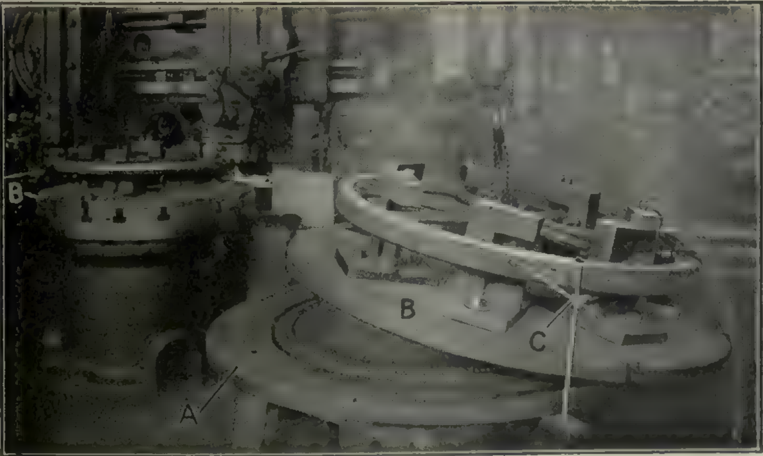


FIG. 1. SURFACE PLATE AND TWO FACEPLATES

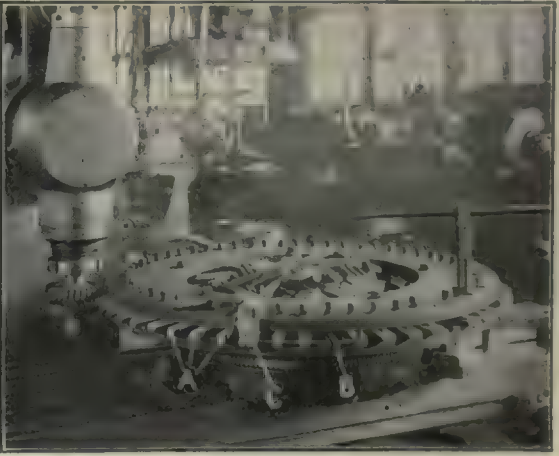
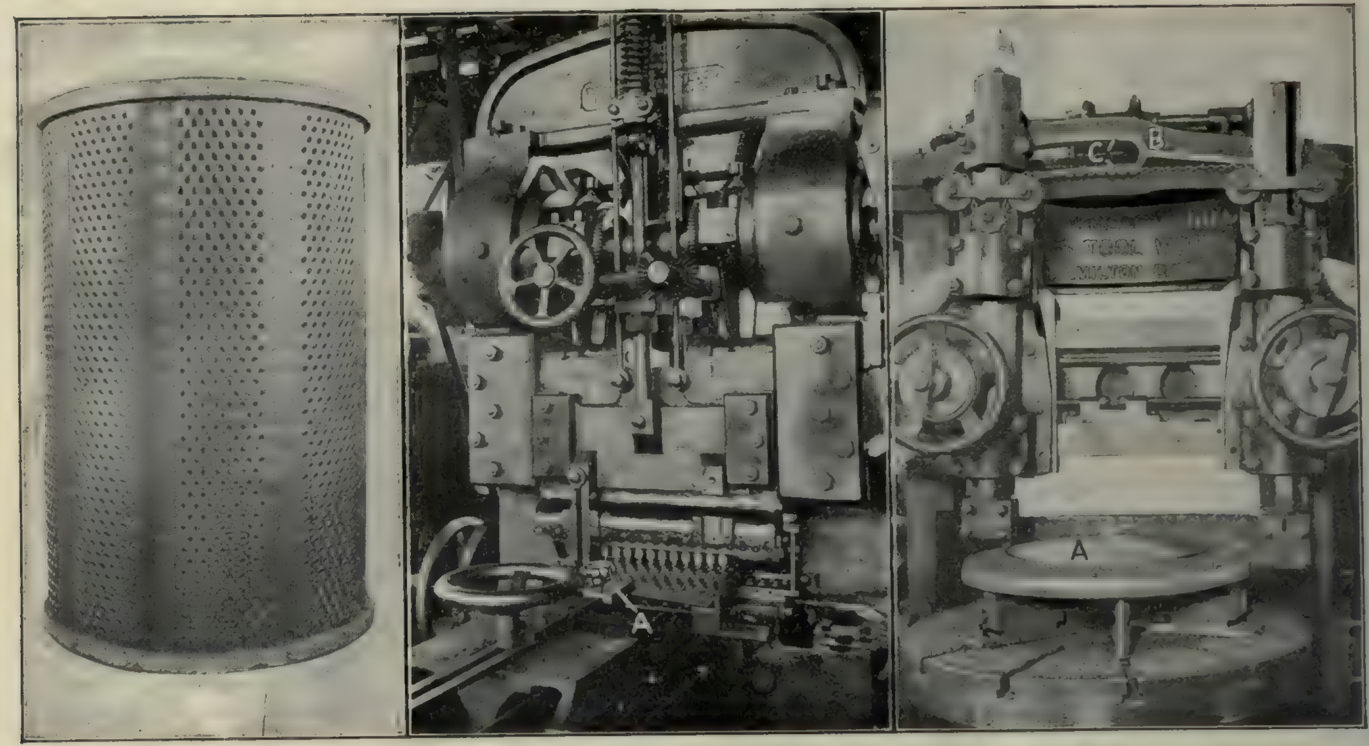


FIG. 2. CONTINUOUS STUD-MILLING FIXTURE

A simple and effective continuous milling fixture for studs is shown in Fig. 2. The studs at *A* are squared on the end after threading. Description of the fixture and cutter arrangement is hardly necessary. Attention is called, however, to the manner of holding the studs in the V-grooves *B*, and to the simple gage *C* used in setting the studs to insure squareness on the second cut. The turning of the fixture is accomplished by attaching to the universal joint drive of the miller.

In making power washers for laundry work, a large number of perforated brass plates are required, as shown in Fig. 3. As the width of these plates and the number of holes vary, it was found advisable to make a die capable of handling the maximum number of 40 holes. After punching, these holes have to be embossed, and the die for this work is shown in the press, Fig. 4, together with the feeding device, which works automatically. The clamp *A* holds the sheet in position. One of the strippers was removed from the press in order to show the general construction of the dies. When this die was first put into use, considerable trouble was experienced in getting the dies to stand up to the work required, and this trouble was overcome by using machinery steel pack hardened. The dies shown in the



FIGS. 3 TO 5. VARIOUS OPERATIONS ON LAUNDRY-MACHINE PARTS
Fig. 3—Power-washer cylinder. Fig. 4—Perforating dies and feed. Fig. 5—Radius-facing attachment

illustration have been in use for over a year and still show no signs of failing.

In making centrifugal driers and extractors, such as are used in machine shops for extracting oil from steel chips, etc., cast-iron plates, as shown at *A*, Fig. 5, are required, faced to a 60-in. radius. With the simple fixture illustrated this work is readily accomplished on the vertical boring mill. The fixture *B* is located across the ways of the mill, one tool head loosened, and engaged in the slot *C* by a roller, which does not show. The cut is started at the outside of the plate; and as the crossfeed carries the tool head forward, the roller working in the slot *C* raises the head, and a very smooth piece of work is obtained.

A number of small worm gears *A*, Fig. 6, are machined in the simple fixture shown. Proper locating and clamping means hold the blanks in proper relation to the hob, which is mounted on the miller arbor. The feed of the blank is obtained through the two gears *B*, the wormwheel *C* and a worm gear in the base of the clamping device. The pitch of the gears *B* is coarse enough so that they come into good mesh before the hob starts to cut. All that the operator has to watch is the feeding of the table forward the right distance to get the proper depth of cut to give the correct tooth shape.

Fig. 7 shows a very ingenious die for cutting, perforating and bending the brass clips *A*. For this piece brass ribbon about ¼ in. wide and $\frac{1}{32}$ in. in thickness is fed into the die, which cuts it to length, perforates, bends it at four points and ejects it from the dies at one operation. Springs hold the side bending dies away from the work, and the ejecting device, which is at the back of the die, against the work. The proper operation and timing of these parts are obtained through the three fingers shown on the upper portion of the die.

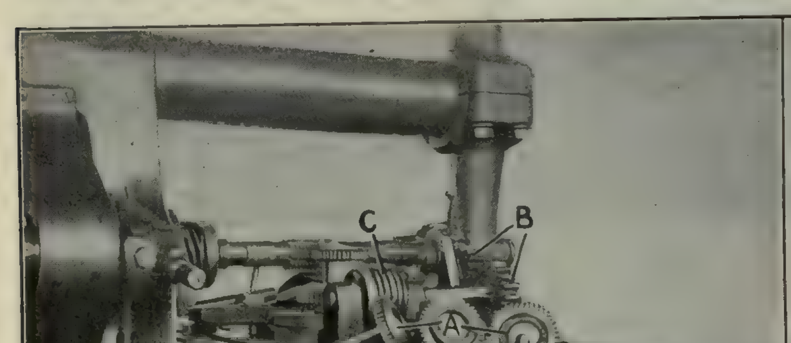


FIG. 6. WORM-GEAR HOBBING ATTACHMENT

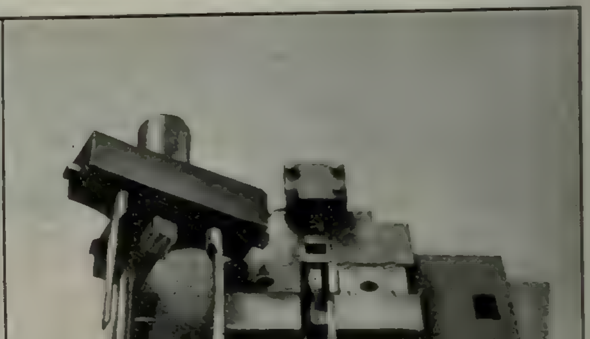


FIG. 7. DIE FOR MAKING SMALL CHIPS

Fig. 8 illustrates a simple but practical drill jig for locating and drilling the cast-iron handles shown at *A*. As these parts are not turned, it is necessary to have the hole as nearly central as possible. The cone-shaped seats in the bottom of the jig and in the removable bushing plug *B* accomplish this without much care on the part of the operator. It will also be noticed that this jig is not clamped to the drill table, but is located by two pins passing through slots on opposite sides of the jig base. This arrangement allows the jig to locate itself under the drill and also permits the operator to up-end it and drop out the finished piece and the borings.

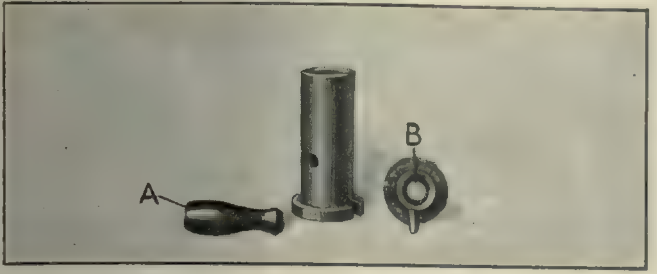


FIG. 8. SIMPLE DRILLING JIG

Templet for Marking Off Flanges

By John Gardner, Jr.

On the flanges of valves and fittings it often occurs that there is the same number of bolt or stud holes, but the pitch circle and outside diameter of the flanges vary. Tables I and II give the details of standard flanges with eight bolt or stud holes, as the case may be. The first table is for American standard low-pressure flanged valves and fittings, and the second table is for American standard extra-heavy flanged valves and fittings. A templet for marking off these flanges is shown in Figs. 1 and 2, for eight equally pitched slots. One side of the templet, shown in Fig. 1, is for marking off the low-pressure flanges, and the opposite side, shown Fig. 2, is for marking off the extra-heavy flanges. The figures on the templet carrying two parallel lines represent the outside diameters of the flanges, and the other figures the pitch-circle diameters. Suppose, for example, a standard low-pressure flanged valve is to be marked off with a 9½-in. pitch-circle diameter; the outside diameter of the flange in this case is 11 in. First, set the lines with 11 in. marked opposite until they correspond with the outside diameter of the flange at all four points. For marking off the holes, the small hardened piece, shown in Fig. 3, is used. This is checked down, as shown, to fit the slots in the templet and to be a nice sliding fit in it. With the sliding piece in place, the mark *A*, Fig. 3, is brought opposite the required pitch-circle diameter, in this case 9½ in. The hole is then marked off either with a scriber or a ring punch.

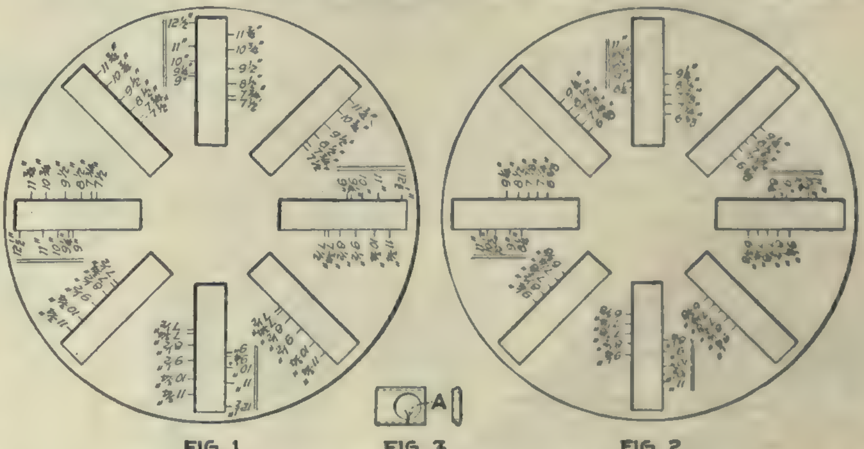


FIG. 1 FIG. 3 FIG. 2

FIGS. 1 TO 3. TEMPLET FOR MARKING FLANGES

The extended end of the sliding piece is to serve as a finger piece for moving into position in the slot. The templet may be clamped to the flange. In the case of a low-pressure flange with an 11¾-in. pitch-circle diameter, the outside diameter of the flange is represented by the outside diameter of the templet, this being 13½ in. The hole in the sliding piece is ⅞ in. in diameter, giving ⅛-in. clearance for ¾-in. bolts. A similar type of templet can be used for flanges with other numbers of holes.

TABLE I. AMERICAN STANDARD LOW-PRESSURE FITTINGS

Diameter of Flange, In.	Diameter of Bolt Circle, In.	Number of Bolts	Size of Bolts, In.
9	7½	8	[illegible]
9¼	7¾	8	[illegible]
10	8½	8	[illegible]
11	9½	8	[illegible]
12½	10¾	8	[illegible]
13½	11¾	8	[illegible]

TABLE II. AMERICAN STANDARD EXTRA-HEAVY FITTINGS

Diameter of Flange, In.	Diameter of Bolt Circle, In.	Number of Bolts	Size of Bolts, In
8¼	6⅝	8	[illegible]
9	7¼	8	[illegible]
10	7⅞	8	[illegible]
10½	8½	8	[illegible]
11	9¼	8	[illegible]

Economizing High-Speed Steel with the Electric Butt Welder

The increased cost of high-speed steel has made it necessary to economize in its use in the shop. One way to do this is to put a short tip of high-speed steel on a carbon-steel shank. Various methods of attaching this tip have been attempted, such as brazing, and also welding with the oxyacetylene torch.

The Reo Motor Car Co., Lansing, Mich., is using Winfield butt-welding machines for affixing the high-speed steel tip to carbon-steel shanks for cutting tools. The current required is 4 to 10 volts and 400 to 500 amp., depending upon the size of the tool section being welded. In Fig. 1 is shown a bent turning tool that has been made with the electric butt welder. The carbon-steel shank *A* and the high-speed steel tip *B* are first cut to length. For a bent tool this tip is made about 1¼ in. long. On a straight tool the tip is usually about 3 in. long. A piece of tin is spot welded over the joint of the two steel sections to hold them in alignment, as shown at *C*. The tool is then held in the jaws of the butt welder, and the two pieces of steel are united. The average time required to make the butt weld is approximately ½ minute.

One of the tools as it comes from the machine is illustrated at *D*. The joint is ground off, as shown, by the tool *E*. The tool may be either bent or left straight, according to requirements. A bent tool may be seen at *F*.

At this factory, reamers have been built up in a manner similar to that described for turning tools. In Fig. 2 is shown the making of a reamer from the loose shank and tip to the ground and fluted reamer. For reamers the high-speed steel tip is approximately 2 in. long.

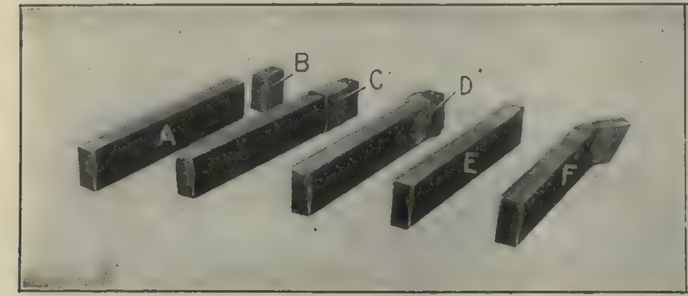


FIG. 1. BUILT-UP TURNING TOOL

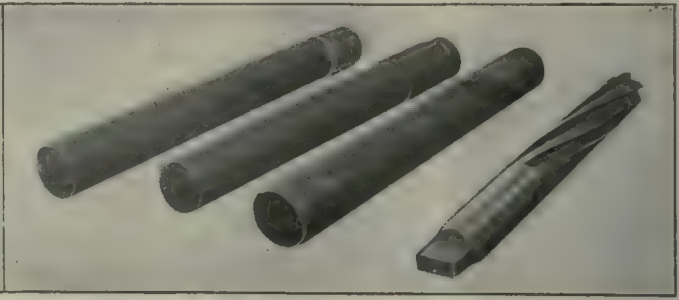


FIG. 2. BUILT-UP REAMER

For the annealing operations that follow the dressing of the joint and subsequent bending the tools are put into an oven at 1600 deg. F., where they remain for approximately 6 hours. Then they are placed in lime to cool, remaining for from 7 to 10 hours. This process is merely a preventative against crystallization and is followed by the hardening process. For this operation the tools are heated to approximately 2200 deg. F. and are then quenched in kerosene or fish oil, being left in the liquid for from 3 to 5 hours.

The tools and reamers made by this process are giving satisfaction in service.

Jig for Drilling Time-Fuse Part

By Donald A. Baker

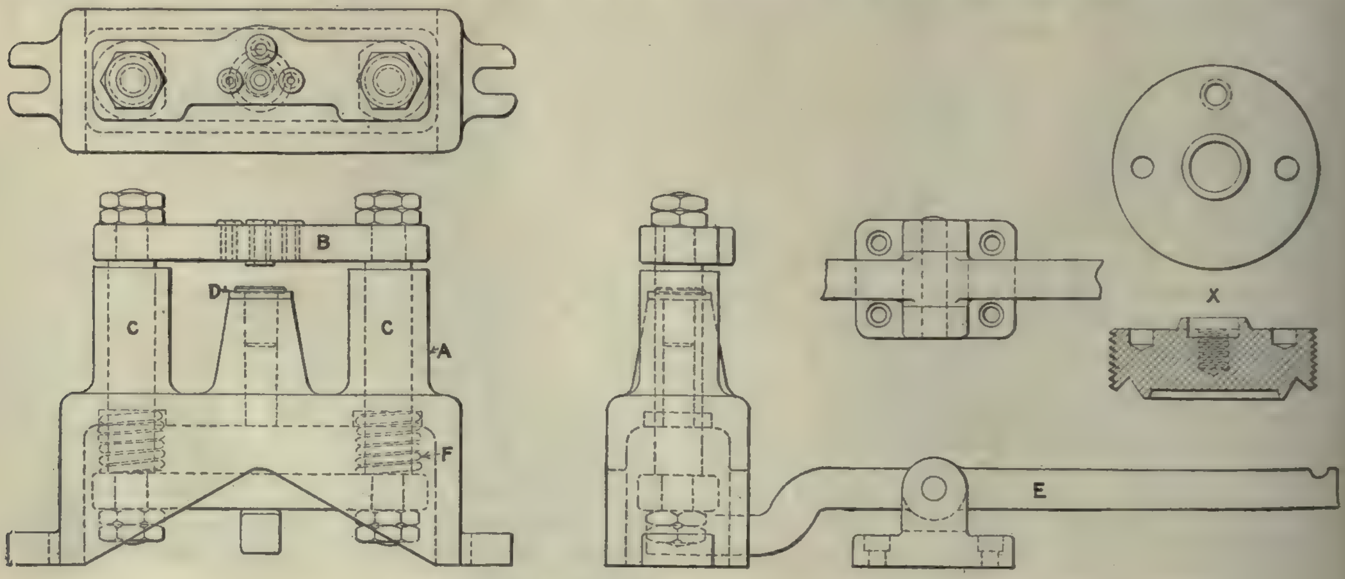
The jig illustrated was designed for use with a multiple-spindle drill head, for drilling three holes simultaneously in the time-fuse base plug shown at *X*. The base is of cast iron; *B* is a plate that carries the three drill bushings. It is carried and aligned by the two pins *C* sliding in the base casting. At *D* is shown a stud over which the work is located while being drilled as required.

The jig is operated by a foot treadle that connects with the lever *E*. Pressing down raises the plate *B*, which carries the drill bushings, and allows the base plug to be put on the stud *D* with the right hand. When the foot treadle is released, the coil springs *F* force the plate *B* down on the work and hold it solidly while it is being drilled. After the drilling, the foot treadle releases the work. The operation is very rapid, as the base plugs are put into the jig with one hand and taken out and put on boards with the other.

Molybdenite Discovery in New South Wales

The Sydney *Daily Sun* reports the discovery of a large deposit of molybdenite ore near Bathurst, New South Wales. A company with capital of $900,000 has been registered in New Zealand to exploit the mines.

The article points out that the ore has been tested by drilling and that on every part of the property the deposit has been tapped. It claims that the average molybdenum in the ore is 1.7 per cent. The company plans to put up a mill capable of treating 40 tons of ore a day, and to use electric drills, which would indicate a possible market for American manufacturers who are prepared to build and furnish the various types of machinery that will be required in carrying on the proposed work.



TIME-FUSE PART AND JIG FOR DRILLING HOLES

Blueprints from Penciled Tracings

By Wallace C. Mills

If drawings made with pencil on tracing paper are not afterward traced with india ink on tracing cloth, the blueprints made from the paper tracings are sometimes indistinct. In the drafting room of one manufacturing company considerable annoyance was experienced in this respect after the company had adopted the system of making blueprints from tracing paper, on account of being rushed for time. There was more trouble after the drawings became old and less transparent. It was considered necessary to go over the drawings with pencil and make the lines heavier, but a better method was discovered.

The back of the tracing paper was painted with cocoanut oil with an ordinary paint brush, and then wiped clean. After this the drawings were hung up to dry. No oil was put on the side of the paper which contained the pencil marks, as it was desired to leave this side so that erasures and alterations could be made. When treated in this manner the tracing paper was much more transparent and very good blueprints were produced.

The effect of the oil treatment is to not only make the paper more transparent but to make the pencil lines darker. This latter effect may be more imaginary than real, however.

Forged and Welded Copper Flowers

By B. Borden

I have noticed from time to time in the *American Machinist* articles on art blacksmithing. Almost all of these have related to the forging of flowers from iron. A great deal of the work was evidently very well done and artistic. I myself have made a number of roses and other flowers from iron, but shown herewith is a much more difficult job. Owing to the very slight difference between the welding and melting points of copper, it requires considerable knack and experience to catch the heat and prevent the copper from melting and flowing into the fire. The work shown was heated in an ordinary blacksmith's forge and was, with the exceptions noted, done with regular blacksmith's tools.

I make copper roses as follows: From a piece of copper wire which should be $\frac{5}{16}$ or $\frac{3}{8}$ in. in diameter, I forge the number of petals required. I first break down the piece as at *A*, Fig. 1, and then spread it on the anvil with an ordinary forging hammer, as at *B*. I cut off the rod and draw the end down flat, as at *C*. I next place the piece on a cup tool and with the ball peen of a hammer shape it something like a spoon, as at *D*. After this it is ready for welding. I then draw a piece like *E* from the same rod, around which I begin to build my rose, using three or four petals for small buds and increasing the number to suit the size and type of rose required, welding each set of petals separately. During the welding operation, care must be taken to have sheet asbestos, as shown at *I*, between the petals, to prevent them from welding where not wanted. After all the petals are welded, the stem is drawn out. It is then held with a pair of small tongs, and the rose petals are opened out with a scratch awl. After the petals are all loosened one from another and the asbestos is picked out, a pair of round-nose pliers that have been curved at the end are used to curl and bend the petals until the rose suits the fancy of its maker. Roses of the Madame Jules Gorlez and Lady Ashtown type require about 24 petals each for full-blown roses. In

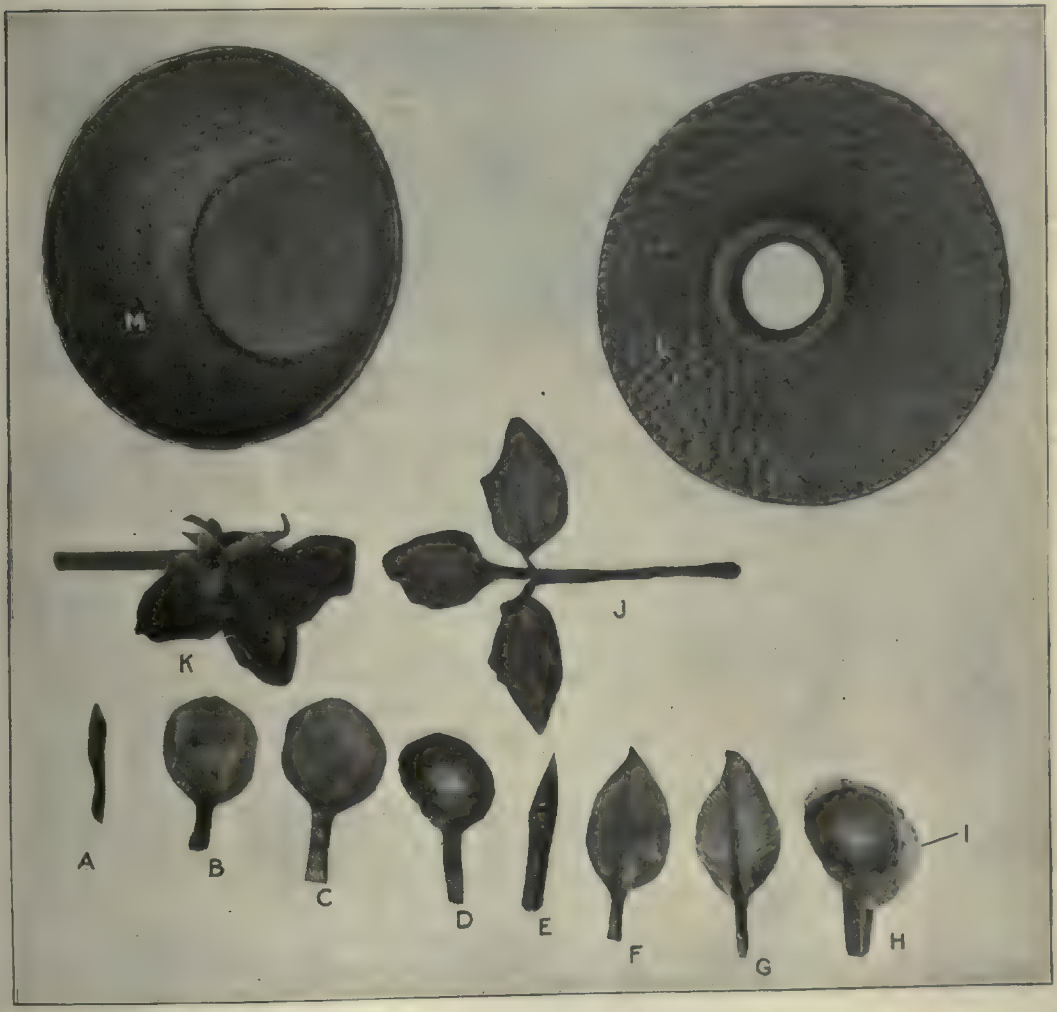
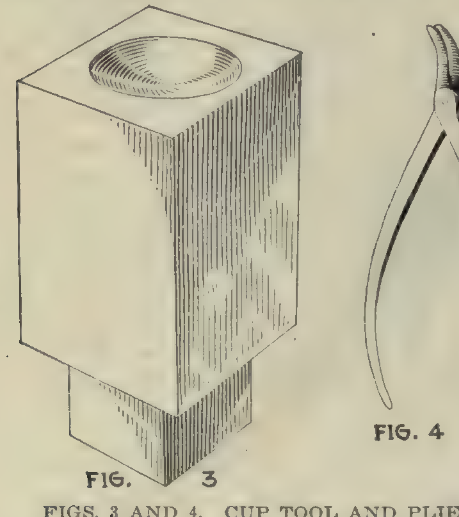


FIG. 1. COMPONENTS OF COPPER ROSE SPRAY AND VASE

shaping either of these roses much boldness may be used in their treatment, thereby adding to their beauty.

The leaves are made in about the same way as the petals, except that the metal is spread on the corner or edge of the anvil to form the rib through the center of the leaf, like *F*. The marking of the lateral veins, as at *G*, is then done with a cross-peen hammer. In welding the leaves, sheet asbestos is used between them just as in welding the petals of the rose. The leaves are then separated and formed as at *J*, with the same pliers that were used on the roses. The leaves *J* are now welded to the stem of the rose *K*, and it is ready to be arranged with as many more as may be desired. The stems are all welded together, and the whole is in condition for the vase. The vase shown is made as follows: Two copper disks are cut 6 in. in diameter and about $\frac{1}{16}$ in. thick. One of them is formed like a bowl, using a ring 4½ in. in diameter and about 2½ in. deep. The copper is placed on the ring, and with a common ball-peen hammer the metal is driven down through the ring until it is as deep as wanted. It is then taken to the anvil, and by working from the inside with the same hammer, all the dents are removed. The bowl is next filled with melted lead. When the lead is cold, the whole of the outside of the bowl is gone over with a small ball-peen hammer, striking lightly to get the beaded surface at *L* and *M*. To form the upper piece *L*, a smaller disk is used and worked from the center until it is raised about 1½ in. Then, after punching a small hole through the center of the stock, the piece is smoothed up on the horn of the anvil to get the dents out. The top of the vase is also shaped at this time, using a cross-peen hammer to draw the stock around the hole until the hole is about an inch in diameter. In this way the stock is rolled outward to form the top.



FIGS. 3 AND 4. CUP TOOL AND PLIERS

The edge of the piece to fit the bowl, which was made first, is next flanged. The bunch of roses, with the stems, is put down through the top part of the vase. After the stems are bent to fit as wanted, they are fastened with two or three rivets. The top, with the roses fastened in, is put on the bowl; and the flanged edge of the top is clinched over round it. This finishes the job, and it appears as in Fig. 2.

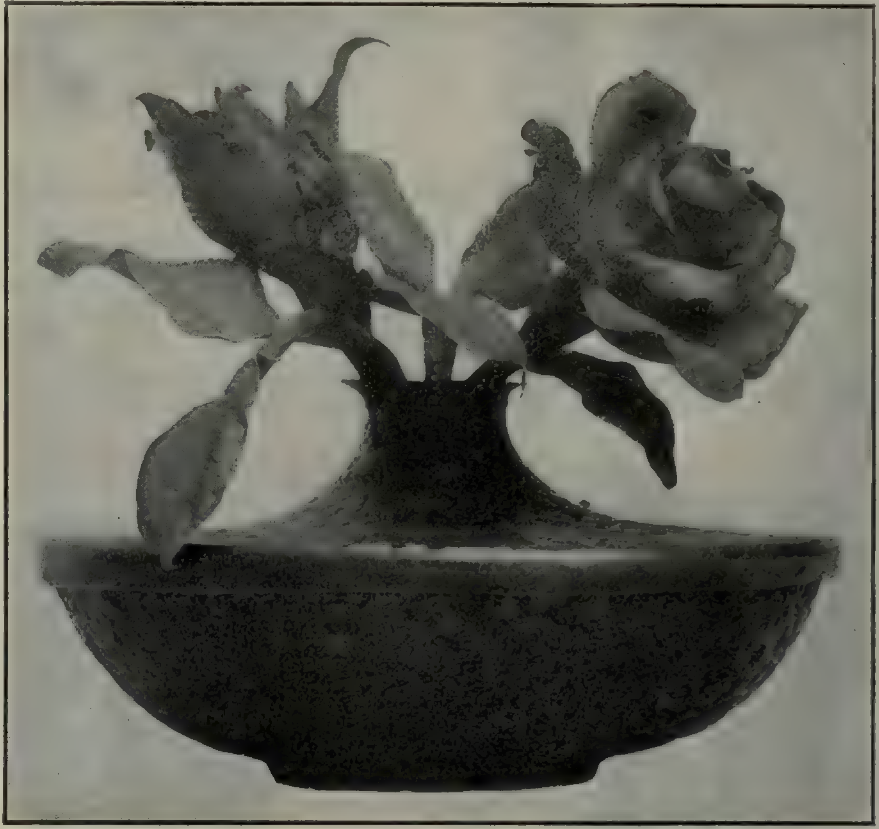


FIG. 2. FINISHED VASE AND SPRAY

The only special tools required for this work are a cup tool, shown in Fig. 3, for forming the petals, and a pair of round-nose pliers, Fig. 4. All the other tools are those used in my everyday work and are in every blacksmith shop. The cup tool is of 1½-in. square steel; the cup is about 1⅛ in. in diameter. The pliers are 8 in. long, and the points are about 1⅛ in. round.

American-Made Scythes in Russia

The announcement of the American Steel Export Co., of New York, that it is now rushing through an order of half a million scythes for the Russian Government is of interest. These scythes will be distributed without charge by the Russian Government to the peasants throughout the various *zemsky sklads*, or representatives of the *skhods* or peasant district assemblies.

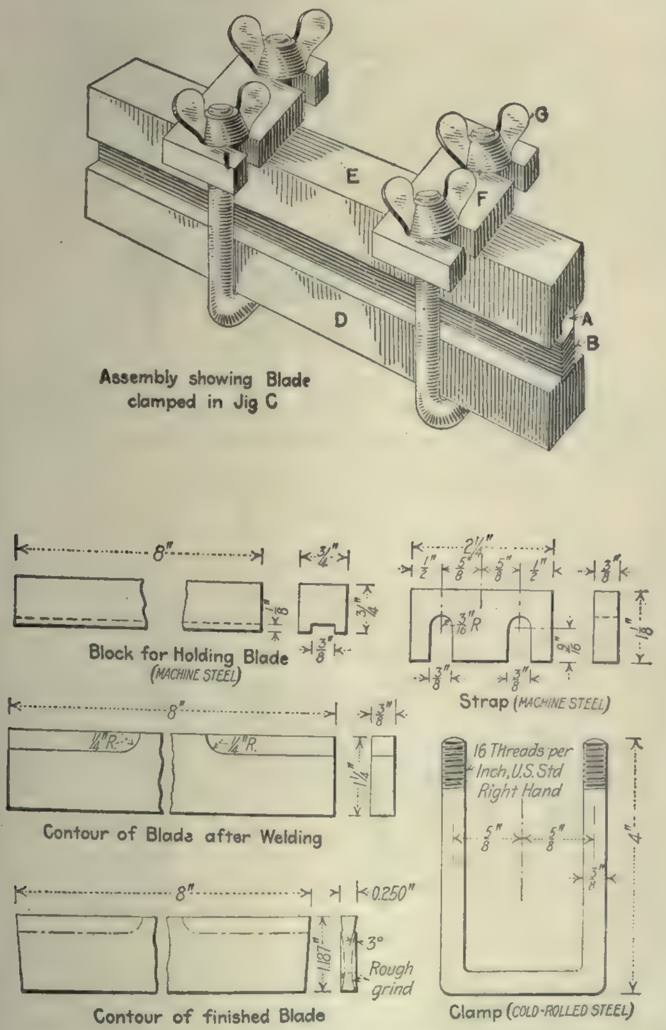
This scythe was made to the particular requirements of the Russian mower, or *kossar*, and is of special and distinctive type and manufacturing process. As the greatest strain comes on the heel, or portion that is fastened to the wooden handle, this section has been made extra heavy to stand severe usage and insure against breaking off. The blade itself is a piece of tempered steel and can be sharpened and resharpened until the metal has been used up.

IDEAS FROM PRACTICAL MEN

Oxyacetylene Welding High-Speed Steel to Machine Steel

By Herbert V. Ludwick

Owing to the high cost of high-speed steel, the practice of welding high-speed steel tips to machine-steel shanks is of interest to manufacturers. Welding a high-speed steel tip to a machine-steel body for cutting off tools for automatic machinery has been more or less a difficult problem, owing to the shock the weld has to stand from the constant chatter of the stock against the tool.


G
E
F
D
A
B
Assembly showing Blade clamped in Jig C
8"
3/4"
1/8"
3/4"
3/8"
Block for Holding Blade (MACHINE STEEL)
2 1/4"
1/2"
5/8"
5/8"
1/2"
3/8"
3/16"R
5/16"
1/8"
3/8"
3/8"
Strap (MACHINE STEEL)
8"
3/8"
1/4"R.
1/4"R.
1 1/4"
Contour of Blade after Welding
16 Threads per Inch, U.S. Std Right Hand
5/8"
5/8"
3/8"
4"
8"
0.250"
3°
1.187"
Rough grind
Contour of finished Blade
Clamp (COLD-ROLLED STEEL)

JIG FOR WELDING HIGH-SPEED STEEL TIP TO MACHINE-STEEL BODY

Take two pieces of high-speed steel *A*, ⅜ in. square by 2 in. long, and grind a ¼-in. radius on the end of each. A rough machine-steel body is milled at both ends as illustrated at *B*. The parts are assembled and put in the jig *C*, which is made from two pieces of ¾ x ¾-in. machine steel *D* and *E*. They are fastened with two clamps *F*, made of flat steel held by ½- or ⅜-in. U-bolts *G*. Wing nuts should be used if at all possible, as they are easily and quickly adjusted.

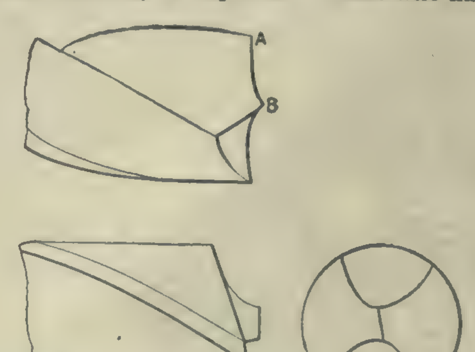
The reason for using the jig is that when the flame of the torch is directed on the places to be welded it heats the tips and the body of the blade very quickly and causes the steel in the blade to expand before the jig has time to get very hot. These two bodies, when heated until they run at the weld, are forced together by their expansion, resulting in a better weld.

The work should be removed from the jig quickly and placed in powdered lime or bar sand, to prevent chilling and the formation of hard brittle spots in the weld, which are difficult to machine even after the regular annealing process.

Drilling Thin Stock

By W. C. Winkelman

The article on page 469, Vol. 46, on the drill plate and its uses, by Mr. Pusep, is exceedingly helpful, especially for correctly locating holes in templets, models, etc., when great accuracy is required. Those who have occasion to drill thin stock, however, will find in the following paragraphs a suggestion that will certainly overcome chattering of the drill after it begins to break through the stock; moreover, a round hole is obtained. Nor is it necessary to make an expensive drill plate for drilling thin sheets.



HOW THE DRILL IS GROUND

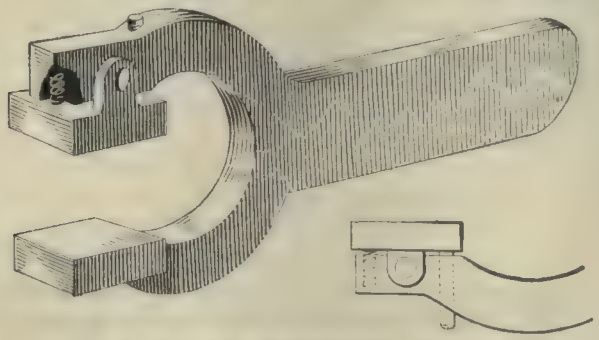
Referring to the illustration, it will be seen that the drills are ground in such a manner that the outer edge *A* comes in contact with the stock. The center *B*, which is slightly in advance of the cutting edge of the drill, acts as a pilot to locate the drill in the center punch hole and also tends to keep the drill steady while it is cutting through the stock.

Those who have had much experience in drilling thin stock with an ordinary twist drill have doubtless seen it go spinning round like a pinwheel, at the same time severely cutting their hand. They will be surprised to know that there is absolutely no need of holding the stock while it is being drilled. Again, contrary to the usual practice, it is not necessary to drill into a block or some other material in order to support the stock. It is really essential, to get the best results, to have no support whatever under the drill itself, only some means of supporting the stock; for instance, a V-block or a flat vise may be used. One of the good features of this drill is that very thin stock and even paper can be cut with equally satisfactory results and safety.

Snap Gage with Pivoted Jaw

By J. A. Raught

Difficulty is often experienced with the ordinary snap gage in gaging flat work while planing or grinding down to the proper thickness, it being hard to determine just how much more is to be taken off. To overcome this I have designed a gage with one pivoted jaw. After getting accustomed to this style of gage the operator knows by the amount of tip about how much more is to come off. It will be seen from the illustration that the spring and setscrew behind the pivoted jaw are to hold it parallel with the solid one. In case of wear it is easily readjusted.


SNAP GAGE WITH PIVOTED JAW

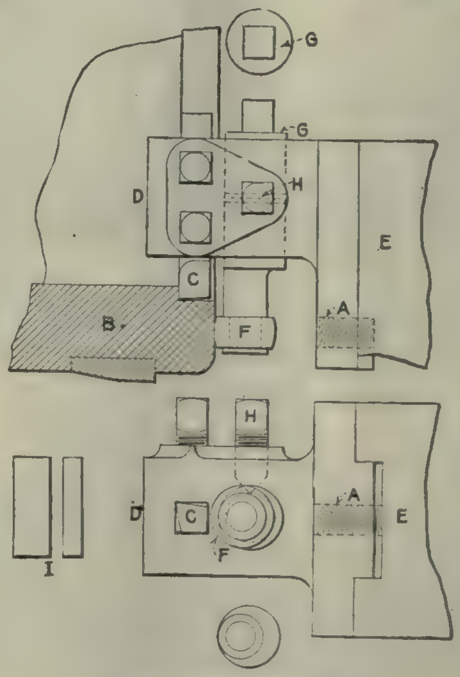
Counterboring Stop for 9.2-In. Shells

By Frank L. Johnson

Until recently a shop making 9.2-in. shells used a ½-in. machine screw in a tapped hole at *A* as a stop to get proper depth in the operation of machining the counterbore. The screw, being solid, would score and disfigure the face of the shell. I suggested the roller stop illustrated.

At *B* is shown the section of the rear end of the shell, which is being machined by a stellite tool *C*, set in the toolholder *D*, which is bolted on the turret *E*. The roller *F* is mounted eccentric on the shank *G*, which is housed in the socket *D* and locked by the pointed setscrew *H*. The eccentric feature makes the roller adjustable to allow for grinding the tool.

To set the roller, the tool is run up against the face of the shell, and the block gage *I* is placed between the roller and the shell face. The rear end of *G* is square, for applying a wrench. This idea could be used on a variety of work.

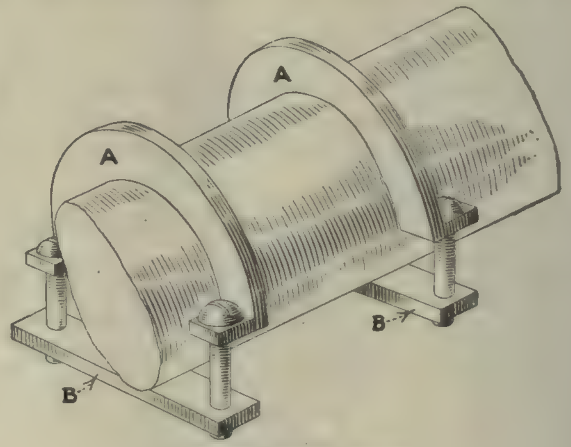


THE ROLLER STOP

A Babbitting Kink

By F. T. Schell

Not long ago I was in a shop where a considerable amount of babbitting is done. Ordinarily, cardboard was cut and fitted around the shaft and backed up with putty or fine clay. This took much time and left a lot of metal to be trimmed off after the babbitting work had been completed.



A BABBITTING KINK

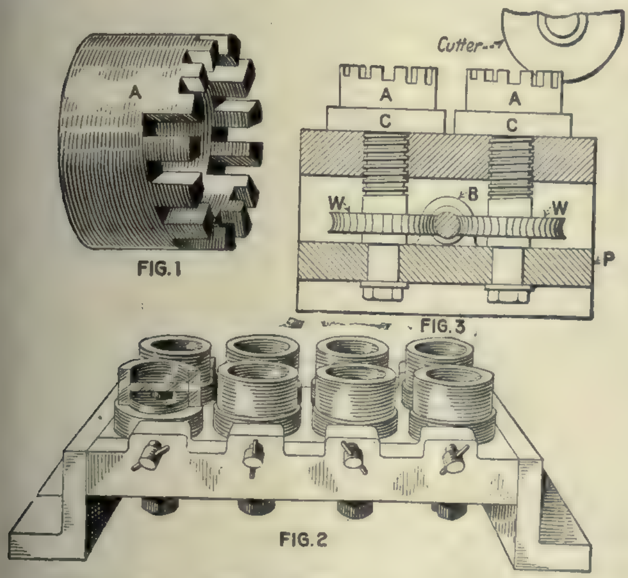
The illustration shows a clamp that proved quite a time saver. *A* is made from a washer; the legs are drilled for ⅜-in. screws; *B* is machine steel, ½ x ¾ in., tapped for ⅜-in. screws.

Machining Adjusting Collars

By Walter G. Groocock

The article on page 230, Vol. 46, by F. P. Terry, on the subject of machining adjusting collars, was interesting to me because some fourteen years ago I made a fixture for this work.

The first principle of production is to cut out all idle machine time. Mr. Terry evidently forgot this; we find eight work arbors, each of which had to be indexed separately. In operating this fixture the miller would, after having taken one cut, have to withdraw the screws, Fig. 2 (reproduced herewith from Fig. 4 of the original article), and index each arbor in turn. At the same time he must take care that the work (shown in Fig. 1) is not moved through more than one position. This would in the aggregate consume much time. Of course, if the operator was smart, he could index the first pair of collars and then start milling, doing the other indexing after cutting had begun. This would, however, be a dangerous proceeding, as half of the indexing screws are on the back side of the fixture. The probable result would be scrapping of both work and fingers if indexing was attempted during cutting time.



FIGS. 1 TO 3. THE WORK AND FIXTURES FOR PRODUCING IT

If I had this work to do, I would, in the light of previous experience, design a fixture similar to that described by Mr. Terry but with provision for indexing both lines of arbors simultaneously. A cross-section through such a fixture is shown in Fig. 3. Here *A* is the work, which is secured to the arbors *C* by means of a conical screw through the open top of the work. This is not shown, because any sort of expansion arrangement could be used. Keyed onto each threaded work arbor is a small wormwheel *W*. The bottom ends of the arbors are carried in a platform *P*, which moves up or down when indexing takes place. This platform, which moves in guides at each end, also carries two bearings *B*, in between which is one long worm of small diameter, which meshes with each of the wormwheels on the arbors. The end of the jig has a slot up which the wormshaft can move. An indexing handle on this end makes provision for indexing, by one complete turn, all the arbors. A single thread worm and fourteen teeth on the wormwheels will do for the job in question.

Another point is concerned with the advisability of stringing a lot of pieces one behind the other. While this is satisfactory for the uninitiated to look at, it is frequently not nearly so productive as operating in a different manner. For instance, with Mr. Terry's fixture turned through 90 deg., and with four cutters on the machine mandrel, the output would be increased considerably. The idea is shown in the illustration.

If Mr. Terry adopts these few suggestions he will find that his output per day will be nearer to 1000 pieces than the 200 he mentioned.

Graduations on Feed Dials

By J. F. Leigh

In reply to the inquiry on page 378, Vol. 46, regarding the graduations on the feed dials of modern machine tools, I would like to say that I have had occasion to operate lathes with the crossfeed dials graduated 0.002 in. A great advantage derived on one lathe was that for one revolution of the feed screw the cross-slide was advanced ½ in., which is something to be considered when returning the tool on production work. The dial was fairly large and the graduations close enough. To divide the dial into 0.001 in., the graduations would have to be very fine or the dial extra large. The extent of this practice may be gathered when it is known that it is found on machines made by both a well known American firm and an English builder of machine tools.

National Association of Purchasing Agents

The National Association of Purchasing Agents is composed of the membership of local branches with a present total membership, including all active local associations, of more than one thousand. Principal cities in which active associations are located include New York, Chicago, Philadelphia, Cleveland, Pittsburgh, Baltimore, Boston, Detroit, St. Louis, Columbus, Buffalo, Rochester, South Bend, San Francisco and Los Angeles.

The association is the outgrowth of the movement originated in New York about five years ago. The object of the association is to bring together on common ground purchasing agents generally, to gather and to disseminate information and knowledge of benefit to the profession, to foster and promote friendly relations among members, to secure more uniform purchasing routine method and the standardization of specifications and classifications and dissemination of data relating to the general subject of buying, and the improvement of existing methods for the diffusion of information.

The names of the present officers follow: E. L. McGrew, president, Standard Underground Cable Co.; F. W. Rowe, first vice president, H. W. Johns-Manville Co.; N. O. Aeby, second vice president, Jeffrey Manufacturing Co.; N. L. Morse, third vice president, Southern California Gas Co.; E. H. Ridgway, treasurer, Colonial Steel Co.; E. B. Hendricks, secretary, New York City.

The editorial this week is so important that we omit from this page anything to detract your attention from it.

How can our boys fight without guns?

THIS editorial is not an attack on any individual, but on a system.

⁂

Suppose, Mr. Manufacturer, with emergency orders filling your shop, you should discover that through a lack of executive decision your workmen had been forced to kill time by playing checkers and cards during working hours! What would *you* do with the man responsible for this condition? Would you accept *any* excuse from the official who exercised full authority?

⁂

Scores of skilled rifle makers in one of our best-known American plants have been for weeks and are today retained on the payroll, killing time with checkers and cards during working hours, simply because certain officials have been unable to arrive at a decision regarding details.

This work is being done on a "cost-plus" basis for our Government, so that you and I must pay these men for killing time. But this is of small moment compared to the inexcusable and dangerous loss of time in making our new army rifles.

These mechanics are not responsible for this condition. The shop management is not responsible for it. Somebody is. Who is it?

England was forced by bitter experience and delays of this kind to eliminate Bureaucratic control of all munition manufacture, and place this work in the hands of those qualified by experience to decide quickly between the essential and the nonessential.

Experienced engineers and works managers are the men who should decide upon specifications, manufacture and inspection.

We have not published these facts without due deliberation. But we believe that truth in this matter is more important than the personal feelings of well-intentioned officials whose duty it is to decide on specifications, but who are incapable of coming to a decision.

Months after war has been declared—months after the type of our rifle has been determined—it is a crime against our boys who will bear rifles at the front to permit American rifle makers at home to pass week after week playing checkers and waiting for something to do.

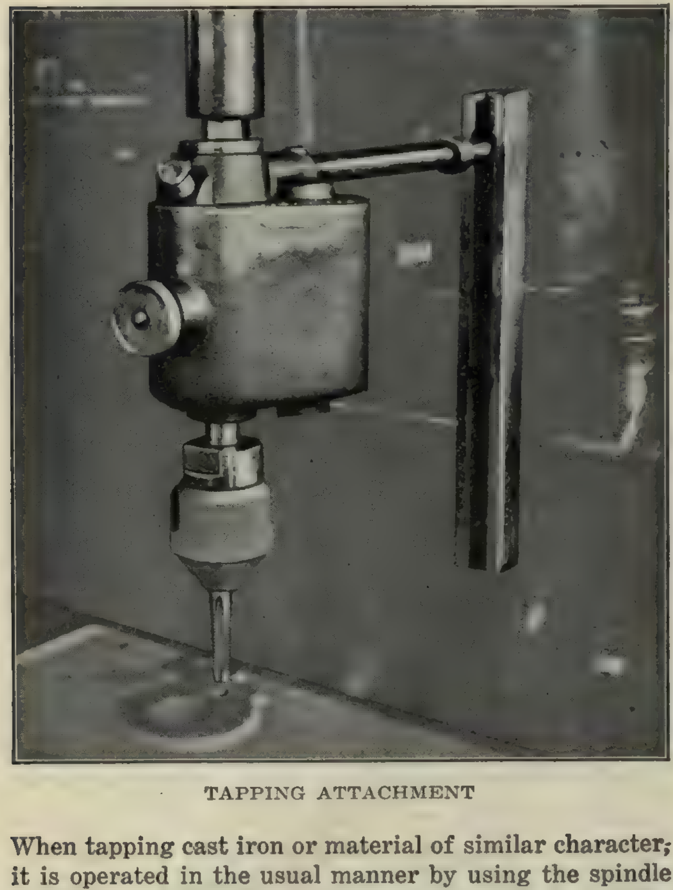
The above statement is based not simply on editorial knowledge of the facts, but on incontrovertible proof, photographic and otherwise, in the possession of the editor.

SHOP EQUIPMENT NEWS

Wahlstrom Tapping Attachment

The tapping attachment shown in the accompanying illustration is intended to reduce tap breakage in cases where holes up to ⅜ in. in diameter are to be tapped.

In operation, it is attached to the drilling machine, as illustrated. It is made with either No. 2 or No. 3 taper shank, which fits the spindle of the machine. To prevent turning, it carries a holding rod, which extends to the slide on the column of the drilling machine.



TAPPING ATTACHMENT

When tapping cast iron or material of similar character, it is operated in the usual manner by using the spindle handle on the machine. The operator relies upon the sense of touch and, if necessary, reverses the tap a revolution or two to relieve strain.

The reverse motion is simultaneous with an upward movement of the spindle and reverses at an increased speed. When tapping steel or springy metal pieces having long holes, the operator, when necessary, turns the knob half a turn, which disengages the lower and engages the upper gear mechanism controlling the oscillating feature of the attachment. This feature imparts a tapping movement similar to that used when tapping by hand. The peculiarity of the movement consists of a rapid oscillation of the tap during the continuous downward movement of the spindle.

This attachment is made by the Wahlstrom Tool Co., 5520 Second Ave., Brooklyn, New York.

White-Heat Grinding Wheels

The White Heat Products Co., Frazer, Penn., is making a grinding wheel in which the abrasive grains are welded together, the result being a very strong wheel that will cut fast and last a comparatively long time. Expensive machinery is necessary in the process, but the wheel can be finished from the raw material in 48 hours, which enables the company to make quick deliveries even on special orders.

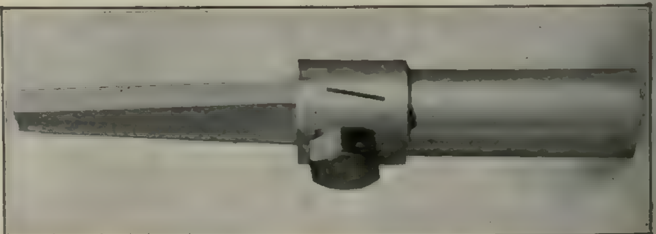
The wheels have been used by some of the big munition factories with very satisfactory results.

The abrasive grains used in these wheels are imported from France and are made by a special process from French bauxite. They are fast and free cutting. It is noticeable on cutting tool steel that the wheels generate little heat in the metal.

Skelton Taper Reamer

The reamer illustrated below is made by Charles E. Skelton, 107 N. Franklin St., Syracuse, N. Y., and is designed for reaming taper holes, using a high-speed blade and a low carbon steel holder.

The cutting edge is ground on a circle, with the heel backed off sufficiently to allow for the maximum cut and still prevent "hogging in." The flutes are ground to produce a threaded surface, which tends to force the chips out of the reamed hole.



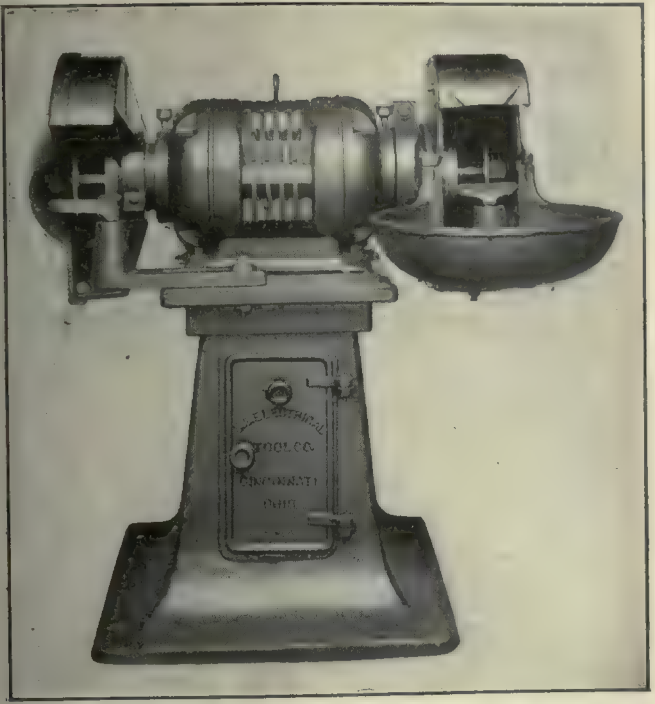
SKELTON TAPER REAMER

The method of holding the blade allows for lining up the reamer with the spindle in case the turret hole is out of line. The "bite" of the holder is offset, so that it tends to pull the blade into the bottom of the slot, thus lining it with the holder. The holding screw is of nickel steel, heat treated, and so designed that the pressure for closing comes in front of the holder.

United States Electric Grinder

The illustration shows a combination dry and wet grinder made by the United States Electrical Tool Co., Cincinnati, Ohio.

This machine is made in two sizes—of 3- and 5-hp. motor drive. The 3-hp. machine carries two 12 x 2-in. wheels, and the 5-hp. machine carries two 18 x 3-in. wheels. The bearings are of the self-aligning ball-bearing type, and Westinghouse motors are used. The speed of the 3-hp. machine is 1800 r.p.m., and it weighs 575 lb.; the 5-hp. machine runs 1120 r.p.m. and weighs 700 pounds.



UNITED STATES ELECTRIC GRINDER

These grinders are furnished for either direct or alternating current of 110, 220 or 550 volts, also alternating current of 220, 440 or 550 volts, 25 cycle or 60 cycle, two- or three-phase current.

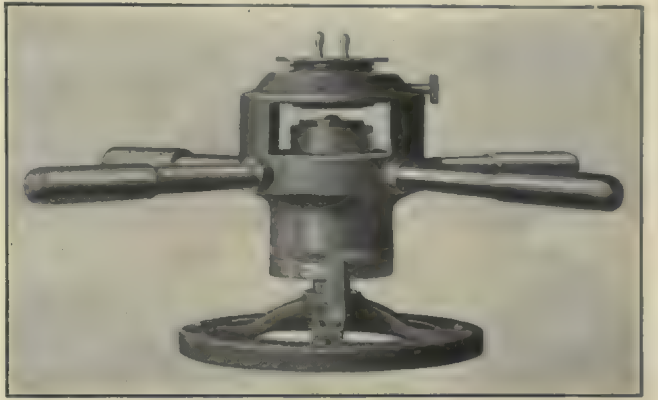
Pittsburgh Sheet-Metal Tester

A device for testing the drawing, stamping, compressive and folding qualities of sheets of iron, steel, brass, copper, gold, silver, aluminum, nickel, zinc, german silver or plated metals is made by the Pittsburgh Instrument and Machine Co., 101 Water St., Pittsburgh, Pennsylvania.

In its construction this tester may be compared to a micrometer, as the graduations permit measurements of the thickness of material and depth of impression by thousandths of an inch.

To use, measure the thickness of the sheet to be tested by setting the graduating ring to zero with the vernier. This brings the anvil in even line with the die. Clamp the press screw and open the die, which has a graduated top, and insert the test piece (about 3½ x 3½ in.). Tighten the die and read off on top the thickness of the metal sheet in thousandths of an inch. Then give the test sheet 0.002 in. play by turning the die two divisions back, and lock with the screw.

The machine is now ready for the actual test. Turn the body by means of the four handles, and the anvil or punch moves upward into the sheet, which will immediately show a bulging. Be careful when the moment of fracture is reached; then the depth of impression is read off on the scale on the lower part of the machine. The graduation lines on this scale, as well as those on the top one, represent each 0.001 in., so if one revolution of the body is made, the anvil is moved up ⅛ in. To get the readings accurate, the operation should proceed slowly when approaching the point of fracture. After the depth of the impression has been noted, loosen the die (by using the spanner, if necessary) and remove the test piece. The machine should be mounted firmly and in such a position that as much light as possible falls on the dome of the indentation.



SHEET-METAL TESTER

The threads and also the tool should be kept lubricated, as this will tend to lessen the power required to obtain fracture in testing thick sheets.

The standard anvil is a perfect semi-ball and can be used to test strips as narrow as 2 in. in width; for general tests, pieces of about 3½ x 3½ in. are recommended. For narrow strips of about $\frac{5}{16}$ and 1 in. width, special tools can be furnished.

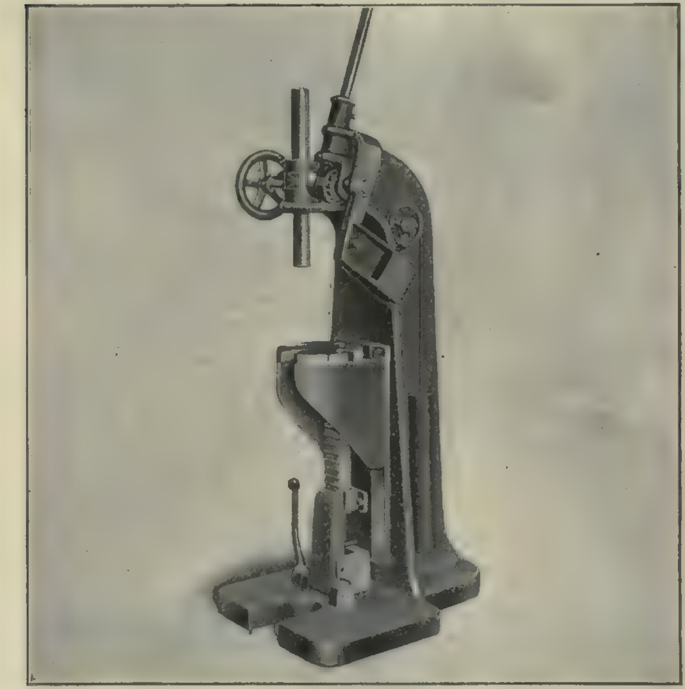
This machine can also be used for wire tests, for which a special die and holder are inserted, which permit tests of wires up to No. 4 B. & S. wire gage. These tests are for tenacity and for bending, as required for binding, telegraph, spring and airplane wires.

Fox Arbor Press

The Fox No. 4 arbor press is equipped with a special type of table elevating and lowering mechanism. A counterweight on the back of the press carries most of the weight of the table and lower rack bar. Only a slight effort on the part of the operator is required to lift and lower the table to any desired position.

To elevate the table, simply take hold of the handle on the table and lift it to the desired location. To lower the table, first disengage the pawl from the lower rack bar by means of the lever, then push the table down to the position wanted.

The frame and table are of cast iron; the rack, pinion, pawl and ratchet are made of a special alloy steel, properly treated to withstand the most severe usage to which they may be subjected in the ordinary type of machine shop practice.



QUICK-ACTING ARBOR PRESS

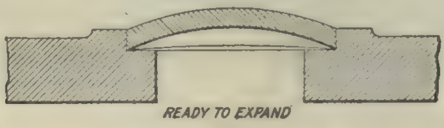
Diameter of work, 19 in.; largest arbor, 3¼ in.; capacity over table, 30 in.; size of rack or ram, $2\frac{3}{16}$ x 22 in.; movement of ram, 17½ in.; leverage, 60 to 1; height, 60 in.; floor space, 24 x 33 in.; weight, 1100 pounds

This arbor press is made by the Sunderland Machinery and Supply Co., Omaha, Nebraska.

Welch Expansion Plug

A plug for closing round cored holes of all kinds, bearings at the end of jack shafts or camshafts, or any other round hole that is to be closed permanently by a tapered, cupped or threaded plug is manufactured by the M. D. Hubbard Spring Co., Pontiac, Michigan.

To insert the plug, drill out the end of the hole just deep enough and large enough to receive the plug nicely.



EXPANSION PLUG

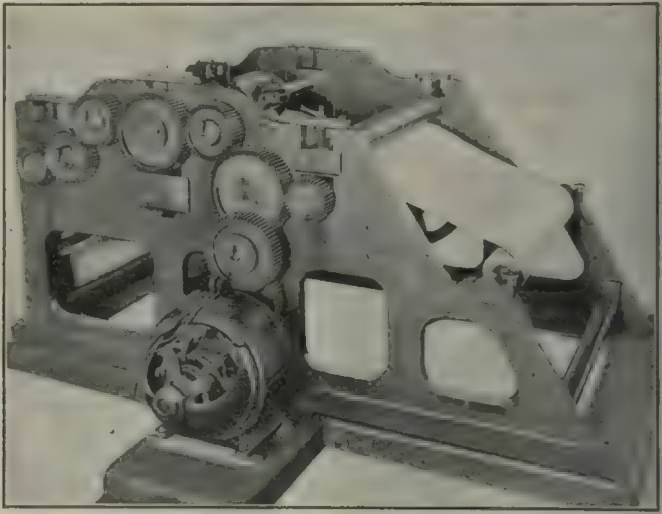
Then insert the plug and set it in place with a flat end or cupped end punch and hammer. The plug, to be tight, must be expanded in a hole that is round, smooth and free from chatter marks. The best results are usually obtained by drilling in with a fluted or core drill ground nearly straight across the end.

These plugs are made regularly in sizes from ¼ to 3¾ in. in diameter, varying by $\frac{1}{16}$ or ⅛ in., and in various metals to suit.

Malm Rotary Rubber Punch Press

The machine shown is designed for punching rubber gaskets, washers, shoe soles, heels and the like. It will take cured or uncured rubber up to 36 in. wide and 1½ in. thick. In producing work the size of an ordinary rubber heel, the output is from 2200 to 3000 per minute.

The cutters are carried on a rotary drum that contacts or meshes with a punch shaft, the material being fed in between. The machine has steel motor pinion, phosphor-bronze bearings and cast-iron gears. It also is equipped with a hand flywheel and a counting and stacking attachment.



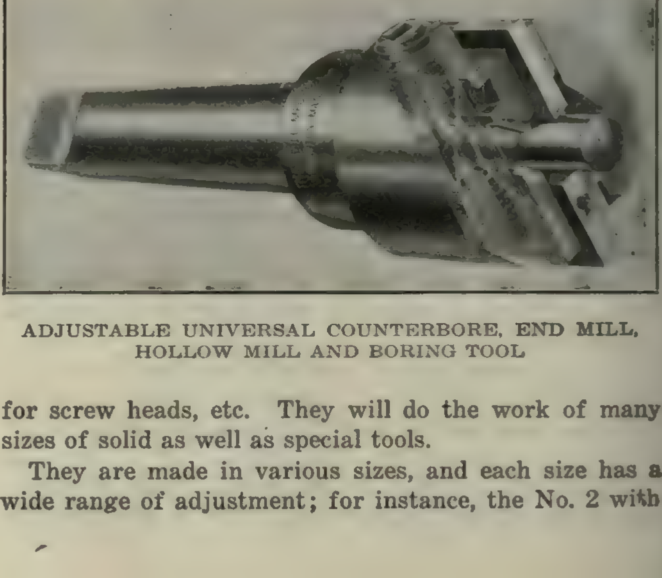
RUBBER PUNCHING MACHINE

Capacity, sheets up to 36 in. wide by 1½ in. thick; motor, 5 hp., floor space, 7½ x 10 ft.; weight, 8000 pounds

This machine is made by the Malm Machine Co., Dayton, Ohio.

Hall Adjustable Counterbore, End Mill, Hollow Mill and Boring Tool

The tools illustrated are adjustable and universal and can be used for counterboring, end milling, hollow milling, boring, facing off bosses, spot facing, counterboring for screw heads, etc. They will do the work of many sizes of solid as well as special tools.



ADJUSTABLE UNIVERSAL COUNTERBORE, END MILL, HOLLOW MILL AND BORING TOOL

They are made in various sizes, and each size has a wide range of adjustment; for instance, the No. 2 with one set of cutter blades and different-sized pilots will do work up to 2½ in. in diameter.

The blades are ground on all four edges, so that the same set of blades serves for counterboring, end milling, hollow milling or boring.

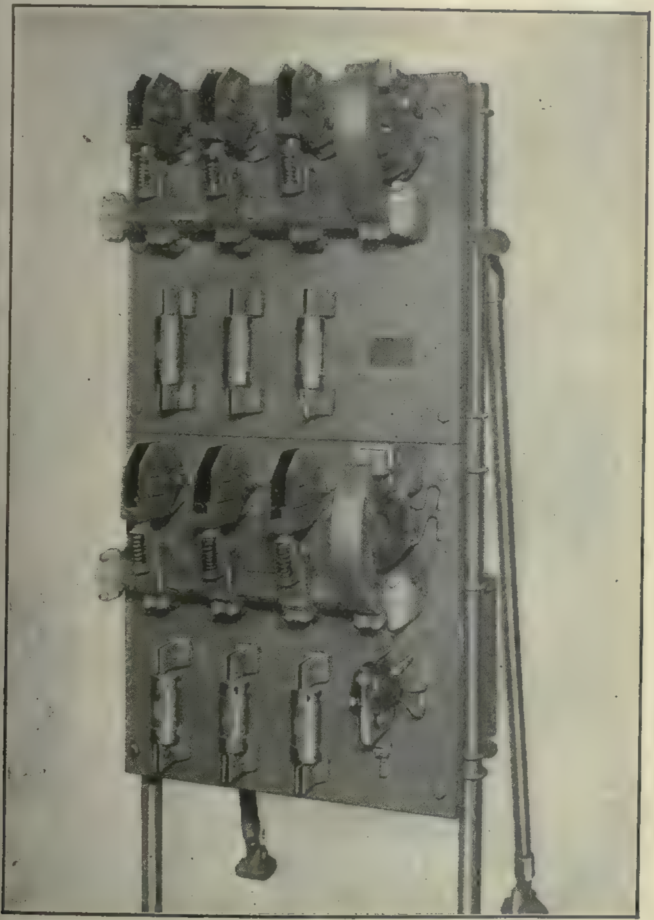
The blades are clamped into movable jaws operated and set by means of a right- and left-hand screw. Any shape of cutter blade and any size of pilot can be used.

This tool is made by the Hall Manufacturing Co., Abington, Massachusetts.

Westinghouse Oven-Heat Controller

The illustrated electric control apparatus for enameling and japanning ovens and kindred work consists of magnet switches or contactors mounted on slate bases, which in turn are mounted on a pipe frame. They are grouped in any number for the control of any size of oven.

The magnet switches can be operated only by opening and closing the magnet circuit. This is accomplished in two general ways—hand control by push buttons, or automatically by means of a thermostat. The push-button station consists of a two-button station with "on" and "off" buttons. The thermostat control is accomplished by means of a control instrument designed to maintain the temperature of the oven automatically within certain limits.



OVEN-HEAT CONTROLLER

This instrument is of the pressure-gage type, the pressure being produced by the expansion and contraction of mercury or a gas in a steel capillary when subjected to heat. Instead of the gage reading pounds pressure, it is calibrated to read temperature. It may be set so as to maintain the temperature practically constant, continuously and entirely automatically throughout the operating period. With an increase in temperature to a predetermined value, the thermostat actuates a relay which in turn operates the magnet switches, causing them to open. As soon as the temperature decreases to a predetermined value, the thermostat again actuates the relay to cause the magnet switches to close.

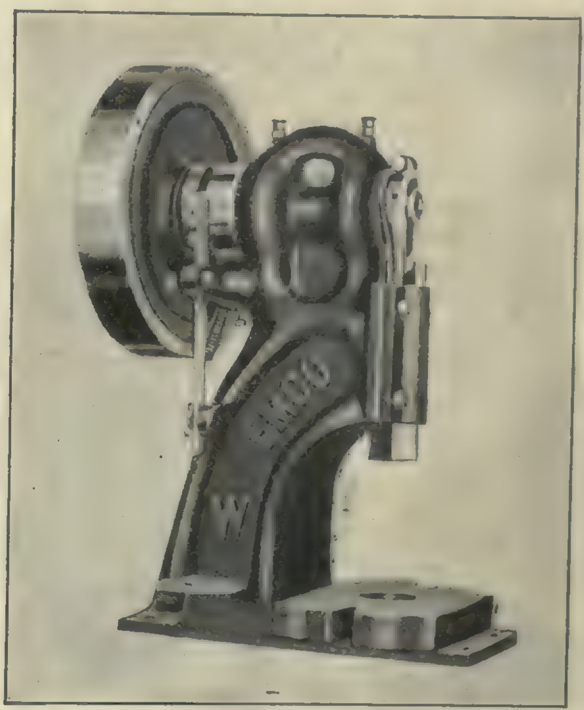
This control equipment is made by the Westinghouse Electric and Manufacturing Co., of East Pittsburgh, Pennsylvania.

Enterprise Bench Punch Press

The press known as the Emco W bench punch press is made by the Enterprise Machinery Co., 32 South Clinton St., Chicago, Ill. It is especially adapted for jewelers, electrical or brass workers, clock and watch makers.

The clutchpin and knife are of hardened steel, the knife taking the thrust lengthwise; the clutch is simple, compact in construction and easy of access.

The press stops automatically at one stroke or runs continuously, if desired, when the pedal is pressed down. A safety lock, adjusted in an instant, locks the press so that the die can be set without throwing the belt.



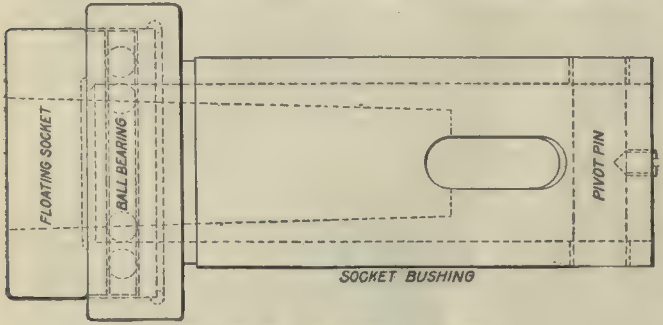
BENCH PUNCH PRESS

Total weight of press, 120 lb.; weight of flywheel, 30 lb.; size of flywheel, 11 x 2 in.; stroke, ¾ in.; adjustment of stroke, ¼ in.; hole in bed, round, 2 in.; slide to bed, stroke up, adjustment down, 5 in.; distance center of ram to frame (throat), 3½ in.; size bottom of ram, 1⅝ in.; size of bed, front to back, 6½ in.; size of bed, right to left, 8½ in.; bench space required, 11 x 16 in.; height over all, 21 in.; speed, 300 r.p.m.; hole in ram for punch, ⅜ in.; capacity, maximum, soft iron, ⅜ x 1/16 inch

Bolted down and inclined laterally, the press will discharge by gravity. A brake, two striking pins, adjustment by cam, round clutchpin and heavy crankshaft are other features of the press.

Sherman Floating Reamer Holder

As the name implies, the tool illustrated is a floating holder for reamers used in turret or automatic lathes and on vertical or horizontal boring mills. It will be seen that there are only a few parts that go to make up the tool. The shank of the socket being of less diameter than the bore of the socket bushing allows freedom of movement. The shoulder of this socket takes its bearing on a thrust ball bearing, which permits the reamer to adjust itself to a perfect alignment with the spindle of the machine, thus permitting it always to ream to its actual size and perfectly straight. A pin at the rear serves to keep the socket from turning in the bushing.

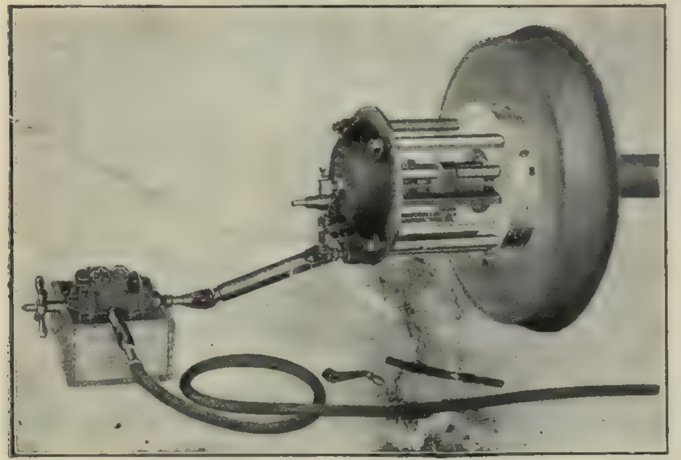


FLOATING REAMER HOLDER

These holders are made in standard sizes, with either taper or straight shanks, but special sizes are made on order. They are made by the Victor Tool Co., Waynesboro, Pennsylvania.

Pearce Journal-Truing Machine

The machine shown herewith is made primarily for truing car journals, but is convenient for numerous other jobs. It will true journals from 3¾ x 7 in. up to 6 x 11 in. Of the two spools that make up this machine, the inner one rotates and the outer one is stationary. The inner spool carries the toolpost, the tool being fed forward by the feed screw, which is automatic in its working, the same as on any lathe.



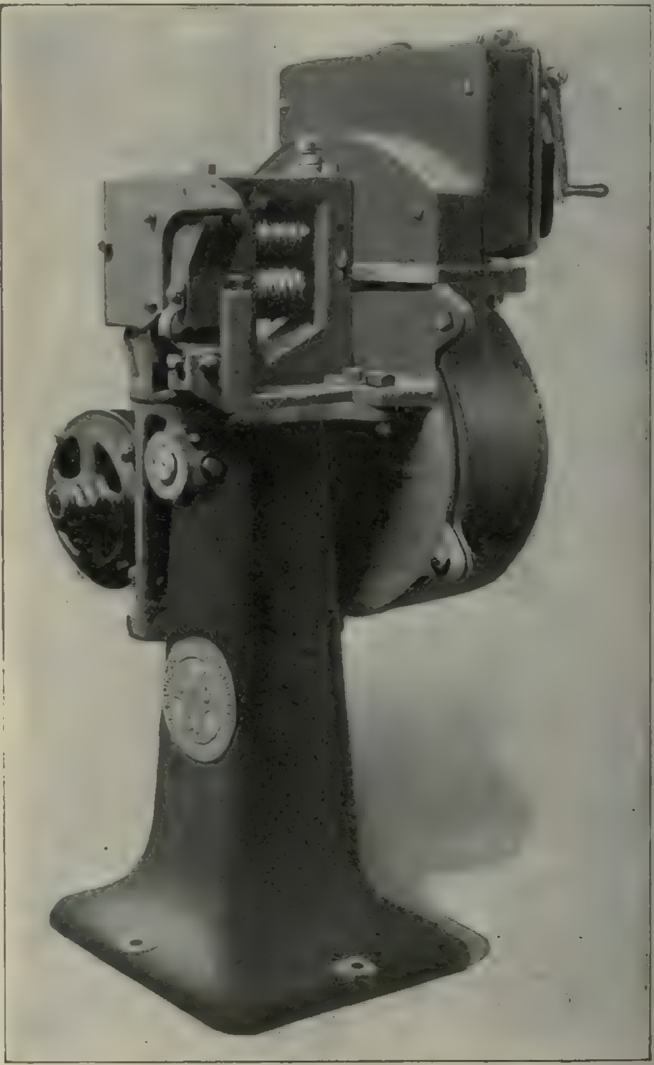
JOURNAL-TRUING MACHINE

In a case at the front of the machine are the necessary gears. At the back end there are scroll chuck jaws to grip the axle, the machine being placed on the axle as far as it will go. The back end is centralized at the dust guard, and the jaws are brought down on the axle, centering the back end. In the case end of the machine is found the customary centering screw. This screw centers the point of the axle; thus an accurate, perfect centering, perfectly rigid machine is obtained. The actual time consumed in attaching the machine and completing the work is 20 to 40 min., depending entirely upon the condition of the journal.

A standard electric or air drill is used as motive power; but in the absence of either, the machine can be operated by hand. It is made by W. C. Dunn, 26 Hulbert Block, Cincinnati, Ohio.

Morgan Motor-Driven Wire Pointer

For those wire-drawing shops which prefer individual motor drive, the Morgan Construction Co., Worcester, Mass., has equipped its wire-pointing rolls with a motor mounted on the frame. This makes the unit very compact, since it is free from external apparatus and overhead connections. It is also easy to start and stop by means of the conveniently located starting-box handle.



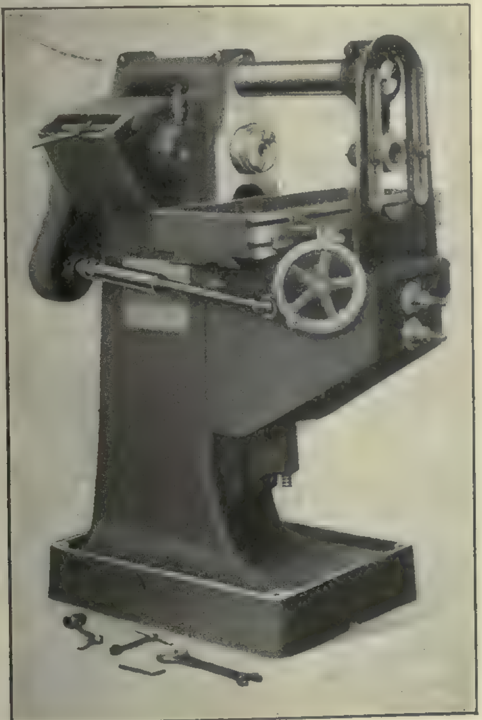
MOTOR-DRIVEN WIRE POINTER

The wire pointer consists simply of a pair of rolls revolving so as to feed material toward the operator. There are a number of grooves to care for various sizes of wire. The cross-section of these grooves diminishes around the circumference, so that the end of a wire placed in the open part of a groove is pushed back by the rolls and reduced into a tapering end. This pointed end is then threaded through the die in which the wire is to be drawn down. These machines can also be used for other pointing jobs. The motor provided is a Westinghouse Type CS induction motor of 3 hp., running at 1700 revolutions per minute.

Cincinnati 12-Inch Plain Miller

The Cincinnati Milling Machine Co., Cincinnati, Ohio, is now marketing the 12-in. plain manufacturing miller shown in the accompanying illustration. It has been built for the rapid production of small machine parts such as are used in the construction of rifles, typewriters, sewing machines, adding machines, etc. The drive is through tight and loose pulleys on the machine direct from the lineshaft, no countershaft being required.

Twelve speeds, arranged in geometric progression from 30 to 600 r.p.m., are obtained by means of three pairs of change gears, which when reversed provide six speeds. A pair of sliding gears increases this number to 12. All driving gears are of hardened steel. The belt shifter automatically operates a brake that brings the spindle to a quick stop. The feeds are driven from the rear end of the spindle through four spur gears that allow four changes. The wormwheel shaft carries a spiral gear meshing with a rack under the table, giving a table movement similar to that of a screw feed machine. A trip mechanism for the feed is provided, which may be set to limit the hand movement anywhere within its travel and automatically to engage and disengage the power feed.



CINCINNATI 12-IN. PLAIN MANUFACTURING MILLER

Working surface of table, 8 x 20 in.; longitudinal power feed, 12 in.; cross-adjustment with braces, 3½ in.; without braces, 6 in.; vertical adjustment, 10½ in.; maximum distance center of spindle to table, 12¾ in.; diameter overhanging arm, 3¼ in.; diameter front spindle bearing, 2$\frac{15}{16}$ in.; hole through spindle, $\frac{13}{16}$ in.; spindle speeds, twelve, 30 to 600 r.p.m.; feeds, four, 0.011 to 0.032 in. per revolution; rapid table movement, 2¾ in. per turn of handwheel; floor space, 40 x 48 in.; weight, 1650 pounds

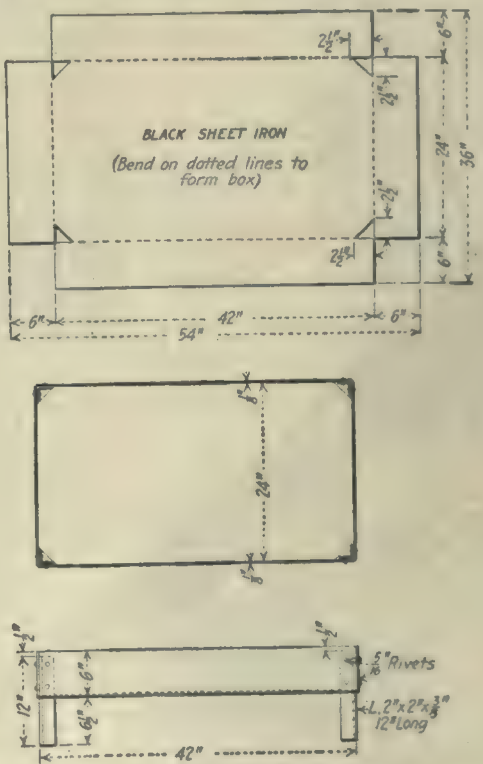
The machine has been arranged in such a manner that the workman may operate all control levers without leaving his position at the front of the machine, the right hand controlling the feed movements while the brake and belt shifter are operated by the left hand. After a piece of work has been placed in position, the table may be moved rapidly forward to the cutter without danger, as a trip automatically disengages the feed just before the cutter is reached. All sliding bearings are equipped with taper gibs, adjustable lengthwise. It is claimed that the very massive construction used enables cuts to be taken about three times as heavy as can be carried with the usual column and knee type miller. The weight of the machine is 1650 pounds.

The table edge is cast in the form of an oil pan with a rim extending 1⅝ in. above the surface, which is provided with one ⅝-in. T-slot. The over-all dimensions are 28 x 12 in. The spindle is of chrome-nickel steel with an adjustable front bearing and No. 10 B. & S. taper hole. An adjustable sleeve bearing is used for the arbor support. An oil pump can be furnished as an extra, being driven from the machine pulley shaft, the lubricant tank being located in the base.

Handy Tote Box

By V. E. Stevens

The illustration shows a tote box that I designed for the Kerr Turbine Co. These boxes, used in conjunction with an elevating truck, have proved very satisfactory, as they can be stacked three or four high. They take but little floor space as compared with stacking rough or semi-finished parts on the floor.



HANDY TOTE BOX

New Publications

Steam Boilers. Revised by Robert H. Kuss. Published by the American Technical Society, Chicago, Ill. Cloth; 138 pages; 8½ x 5½ in.; 74 illustrations; indexed. Price $1.

In the introduction it is stated that "the aim of this little volume is to cover in a very practical manner, and yet with sufficient detail, the methods of construction of the different types of boilers, the proper testing of the materials used, the methods of riveting and staying, and finally a careful discussion of the difficult [different] types of stationary and marine boilers on the market." The book is divided into two parts, Part 1 dealing with the construction of boilers and taking up 56 pages, and Part 2 dealing with types of boilers and taking up 82 pages. Rules are given for testing boiler steel as contained in the Boiler Code of the American Society of Mechanical Engineers. The reviewer is puzzled to know for just what class of engineers the book is intended. Part 1, dealing with construction, is too incomplete to meet the needs of the designer or the constructor, and Part 2 seems to be too much a catalog to command the attention of the designer, although it will, of course, be found useful by the operator.

There is nothing new in the book or nothing that has not been covered by the several books now on the market and dealing with boilers, many of which in new editions have appeared recently. Considering that the volume costs but a dollar, there is everything in it that should be expected for the money.

Business Finance. By William H. Lough. Six hundred and sixteen 6 x 8½-in. pages; cloth bound. Published by the Ronald Press, New York City. Price, $3.

Reviewed by Dexter S. Kimball

One, naturally, would expect that any book by the author of "Corporation Finance," so long and so well known as to rank it as a classic in its field, would be clear, readable and interesting; and this writer's latest work, "Business Finance," well fulfills this expectation. As its name indicates, it deals with the everyday financial problems of the private business concern as viewed by the owner, organizer or manager of such an enterprise. The author divides the work into five parts, each part consisting of several chapters as follows:

Part 1, entitled "Finance and Business," which treats of the fundamentals of finance and of business organization, contains the following chapters: (1) Principles of Financing; (2) Forms of Business Enterprise; (3) The Corporation; (4) The Corporate Form.

Part 2, entitled "Capital," which discusses the several forms of security issues and the manner in which they may be combined and organized, consists of the following chapters: (5) Owned Capital: (6) Borrowed Capital Long-term; (7) Borrowed Capital Short-term; (8) Basis of Capitalization.

Part 3, entitled "Securing Capital," deals with the methods of raising capital and consists of the following chapters: (9) Sources of Capital Funds; (10) Promotion; (11) The Promoter; (12) Promoting Combinations; (13) Selling Securities Direct; (14) Selling Securities Through Dealers; (15) Underwriting.

Part 4, entitled "Financial Management," deals with efficient methods of financial management and consists of the following chapters: (16) Investment of Capital Funds; (17) Calculating Requirements for Working Capital; (18) Determination of Net Income; (19) Dividends; (20) Surplus; (21) Budgets; (22) Financial Standards.

Part 5, entitled "Financial Abuses and Involvements," deals with financial mismanagement and methods of reorganization and contains the following chapters: (23) Exploitation by Officers; (24) Exploitation by Directors and Majority Shareholders; (25) Insolvency and Receivership; (26) Reorganization.

It is obvious that the largest group to which the book will appeal will be composed of business men, organizers, financiers, bankers, bond dealers and other financial men who are operating or investigating commercial enterprises. The author states, however, that the book is intended to be of use to engineers, lawyers, accountants and other professional men who are frequently drawn into close contact with the financial side of industry, although they may not necessarily be well informed on such matters.

In this expectation the author should not be disappointed. There is a great need for a book of this kind for the professional man, such as the engineer, who, whether he wills it or not, is frequently called upon to help in the decision of important matters the intelligent disposition of which requires some knowledge of elementary financing. This book should be very valuable for this purpose. It contains a clear and simple account of the methods that are used in financing and operating industrial enterprises. It is free from technicalities, contains no abstruse discussions of accounting methods and can be understood readily by the layman. Indeed, any man interested in business of any kind may read the book with profit, and it should be of particular value to engineers and managers. To the young engineer who wishes to obtain a general insight into financial methods it should be both interesting and useful.

There are two chapters that are worthy of special notice—Chapter 21, called Budgets, and Chapter 22, entitled Financial Standards—not so much for the actual information that they contain as for the ideas put forward. In Chapter 21 the author discusses the desirability and possibility of making up budgets in advance of operation in manufacturing and similar enterprises. This method, so little known and little practiced, contains powerful possibilities as the author points out, and will doubtless be more used as time goes on. Chapter 22 contains a brief discussion of the need of establishing financial standards that will serve as barometers, so to speak, of the fluctuations in business. This method, so well known and so much used by engineers, is rapidly becoming an integral part of good business management. It is impossible for any manager, be he ever so able or ever so well informed regarding his business, to actually see the relative values of the movements of material and labor if his enterprise is at all complex. By establishing proper standards and ratios, this matter is almost as much simplified as is the reading of a steam gage or a thermometer, but the selection of the particular standard and the segregation of its elements may be a difficult matter. The entire volume, and these chapters in particular, should be of help in such work. In fact, the book should be of great use to a wide range of readers.

Business Items

The Reynolds Pattern & Machine Co. announces the discontinuance of operations at Moline, Illinois, to occur about August 1, 1917, and the removal of the business entire, together with the management to Massillon, Ohio, where the business will be continued under the name of The Reynolds Machine Manufacturing Company. Geo. D. Reynolds will continue as President and General Manager.

Personals

Henry M. Wood has resigned from the Lodge & Shipley Machine Tool Co., Cincinnati, to become associated with Axel Malm in the Malm & Wood Machine Co., Dayton, Ohio, manufacturing rotary punch presses and dies. Mr. Malm is president and mechanical engineer, Mr. Wood vice president and general manager of the new organization.

Trade Catalogs

"Holyoke" Transfer Truck. Holyoke Truck Co., Holyoke, Mass. Circular. Illustrated.

"Stanley" Cotton Belting. Stanley Belting Corp., 32-40 S. Clinton St., Chicago, Ill. Booklet. Pp. 8; 3½ x 6 in.; illustrated.

Electric Hoists, Type W. Sprague Electric Works, 527-531 W. 34th St., New York. Bulletin No. 48923. Pp. 32; 8 x 10½ in.; illustrated.

Oil Storage Systems. Gilbert & Barker Manufacturing Co., 42 Union St., Springfield, Mass. Catalog No. 42. Pp. 28; 6 x 9 in.; illustrated.

"A Few Words on Dynamic Balance." This is a title of a pamphlet issued by N. W. Akimoff, Philadelphia, Penn., describing the Akimoff dynamic balancing machine. Pp. 12; 5 x 7 in.; illustrated.

Oakite Platers' Cleaner. Oakley Chemical Co., 22 Thames St., New York. Information Sheet No. 860. Pp. 16; 4½ x 6½ in.; illustrated. This contains data on cleaning articles for plating, lacquering, etc., which ought to be useful to those interested.

Hoisting Machinery for Industrial Works. Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Hand Book. Pp. 116; 5 x 8 in.; illustrated. This contains data describing the various types of hoists and cranes together with tables of dimensions.

Forthcoming Meetings

The twelfth annual exhibit of foundry and machine-shop equipment and supplies will be held under the auspices of the American Foundrymen's Association in the Mechanics Building, Boston, Mass., from Sept. 25 to 28, 1917. The officers of the exhibit committee are: President, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; vice president, Benjamin D. Fuller, Westinghouse Electric and Manufacturing Co., Cleveland, Ohio; secretary and treasurer, A. O. Backert, 12th and Chestnut Sts., Cleveland, Ohio; manager of the department of exhibits, C. E. Hoyt, 123 West Madison St., Chicago, Illinois.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

The American and Canadian engineers and architects of Norwegian birth and descent will hold an informal congress and reunion at the Chicago Norske Klub, Logan Square, Chicago, Ill., Sept. 27 to 29, 1917.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

The annual congress of purchasing agents, under the auspices of the national association, will be held at Pittsburgh, Oct. 9 to 11. The program includes business sessions for the mornings and visitation and inspection of industrial works during the afternoons. Special features are: Tour of Pittsburgh's principal business districts by automobile during the late afternoon of the first day, and cabaret dinner in the evening, to be held at one of the country clubs. The banquet will be held at the Convention Hotel the evening of the second day, Oct. 10, with speakers of national prominence in attendance.

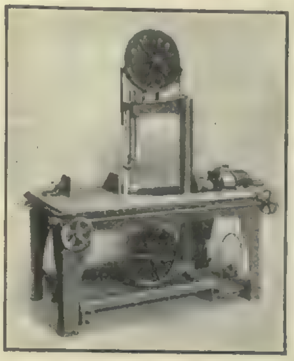
All purchasing agents as well as others interested are welcome and expected to attend and participate in the activities of the convention. Special arrangements are planned for the entertainment of the ladies.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 6-in. cards and file as desired

SAW, METAL BAND (MARVEL NO. 8)

Armstrong-Blum Manufacturing Co., 333-357 North San Francisco Ave., Chicago, Ill.

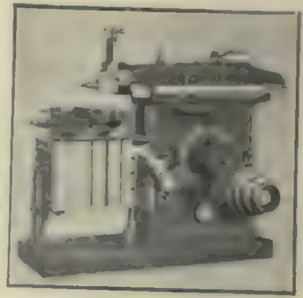


"American Machinist," Aug. 9, 1917

Capacity of throat, 18 x 20 in.; takes saw blade 14 ft. 8 in. long by $\frac{5}{8}$ in. wide by 0.032 in. thick; speed of tight and loose pulleys, 400 r.p.m.; diameter of pulleys, 10 in.; takes 2-in. belt; floor space, 36 in. by $6\frac{1}{2}$ ft.; height over all, 7 ft.; net weight, 1500 lb.; weight crated, 1760 pounds

SHAPER, 20-IN. CRANK

Columbia Machine Tool Co., Hamilton, Ohio

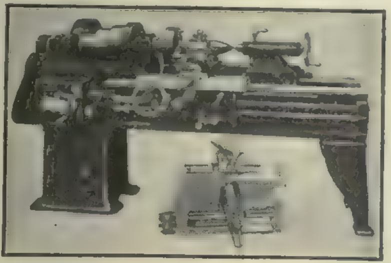


"American Machinist," Aug. 9, 1917

Length of stroke, $20\frac{3}{4}$ in.; vertical traverse of table, 15 in.; horizontal traverse of table, 26 in.; maximum distance ram to table, 17 in.; length of downfeed, 8 in.; feeds, $\frac{1}{64}$ to $\frac{1}{4}$ in.; strokes of ram permitted, 8 to 113; gear ratios, 4.7 and 21.5 to 1; weight skidded, 4000 pounds

LATHE, 18-IN. SHELL

Cincinnati Lathe and Tool Co., Cincinnati, Ohio



"American Machinist," Aug. 9, 1917

Swing over bed, $18\frac{1}{2}$ in.; swing over carriage, $11\frac{3}{8}$ in.; front bearing, $3\frac{1}{8} \times 5\frac{5}{16}$ in.; rear bearing, $2\frac{7}{16} \times 4\frac{1}{2}$ in.; hole through spindle, $1\frac{9}{16}$ in.; lengths of bed, 6 to 16 ft.; distance between centers, 8-ft. bed, 56 in.; weight, 6-ft. lathe, 2730 lb.; extra weight per foot of bed, 145 pounds

GRINDER, UNIVERSAL

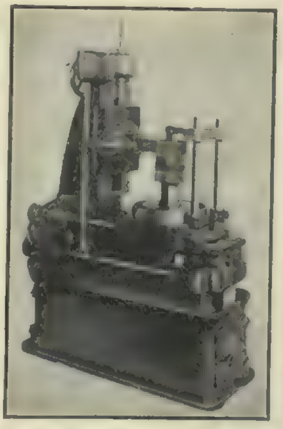
Ott Grinder Co., Indianapolis, Ind.

"American Machinist," Aug. 9, 1917

Incorporates a number of improvements on the No. 2 machine formerly made by this concern, the principal one of which is the improved crossfeed of mechanism. Feed may be varied from 0.00025 to 0.003 in. The grinding wheel is fed under power, while the spring is relied upon only to give the feed adjustment. An automatic throw-out and a positive stop are used

GEAR HOBBER

Bilton Machine Tool Co., Bridgeport, Conn.



"American Machinist," Aug. 9, 1917

Capacity: Diametral pitch, 10; outside diameter, 10 in.; width of face, 10 in.; countershaft speed, 250 r.p.m.; range of hob speeds, 50 to 250 r.p.m.; range of feed hob per revolution of work, 0.010 to 0.125 in.; countershaft, four-step cone pulley, 2-in. belt; driving pulley, $8\frac{1}{2} \times 4$ in.; net weight, 1100 pounds

PYROMETER, OPTICAL

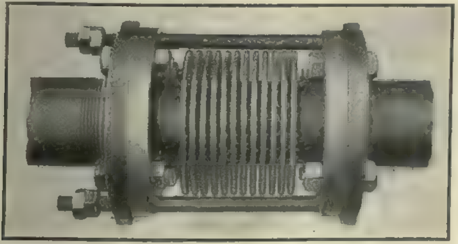
Leeds & Northrup Co., Philadelphia, Penn.

"American Machinist," Aug. 2, 1917

Used for determining the temperature of bodies heated above a dull red heat. Rays from the hot body are brought to a focus on a tungsten-lamp filament which appears to the observer to lie upon the surface of the image. The filament is brought to the same color by means of an electric current, passing through a rheostat and a milliammeter. Temperature is calculated from the current used

JOINT, ONE-PIECE EXPANSION

R. D. Nuttall Co., Pittsburgh, Penn.

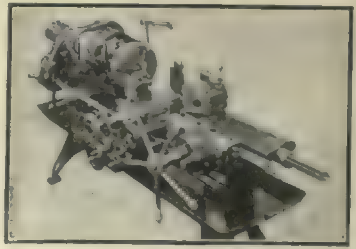


"American Machinist," Aug. 9, 1917

An expansion joint machined inside and out from a solid hammer-forged steel blank and tempered in oil. The joint is intended to be bolted between standard pipe flanges and is made for either high- or low-pressure work. The joints for high-pressure work allow a total movement of 2-in., while those for low pressure allow a total movement of $\frac{5}{8}$ in. Various sizes are made

LATHE, UNIVERSAL TURRET

Millholland Machine Co., Indianapolis, Ind.



"American Machinist," Aug. 9, 1917

Chuck capacity, $1\frac{3}{8}$ in.; diameter of turret across faces, 9 in.; length of work turned, 10 in.; maximum distance spindle to turret, $23\frac{3}{4}$ in.; swing over bed, $18\frac{3}{4}$ in.; diameter front spindle bearing, $3\frac{1}{2}$ in.; rear bearing, 4 in.; weight, 2665 pounds

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Qutations were current as follows at the points and dates indicated:

	Aug. 10, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$47.00	$40.00	$14.00
No. 2X Northern Foundry, Buffalo.....	53.00	46.00	19.75
No. 2 Northern Foundry, Chicago......	55.00	47.00	19.00
*Bessemer, Pittsburgh	55.00	50.95	21.95
*Basic, Pittsburgh	52.00	45.00	18.95
No. 2X, Philadelphia	54.50	45.50	19.75
*No. 2, Valley......................	53.00	45.00	18.25
No. 2, Southern Cincinnati...........	49.90	42.90	16.90
Basic, Eastern Pennsylvania..........	50.00	42.50	19.00

*Delivered Pittsburgh; f.o.b. Valley, 95% less.

STEEL SHAPES—The following base prices in cents per pound are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Aug. 10, 1917	One Month Ago	One Year Ago	Aug. 10, 1917	One Year Ago	Aug. 10, 1917	One Year Ago
Structural shapes ...	5.25	5.00	3.25	4.50	3.25	5.00	3.10
Soft steel bars......	5.00	4.75	3.30	5.00	3.25	4.50	3.10
Soft steel bar shapes.	5.00	4.75	3.25	4.50	3.25	4.50	3.10
Plates, ¼ to 1 in. thick.	10.00	8.00	4.00	8.00	3.65	10.00	3.50

BAR IRON—Prices in cents per pound at the places named are as follows:

	Aug. 10, 1917	One Year Ago
Pittsburgh, mill	5.25	2.50
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Aug. 10, 1917	One Month Ago	One Year Ago	Aug. 10, 1917	One Year Ago	Aug. 10, 1917	One Year Ago
*No. 28 black......	8.50	10.50	10.00	3.65	9.00	3.20	10.00	3.20
*No. 26 black......	8.45	10.40	9.90	3.55	8.90	3.10	9.90	3.10
*Nos. 22 and 24 black	8.40	10.35	9.85	3.50	8.85	3.05	9.85	3.05
Nos 18 and 20 black	8.35	10.30	9.80	4.45	9.20	3.70	9.80	3.00
No. 16 blue annealed.	8.70	10.20	9.70	4.45	9.20	3.70	10.20	3.60
No. 14 blue annealed.	8.60	10.10	9.60	4.35	9.10	3.60	10.10	3.50
No. 12 blue annealed.	8.55	10.05	9.55	4.30	9.05	3.55	10.05	3.45
No. 10 blue annealed.	8.50	10.00	9.50	4.25	9.00	3.50	10.00	3.40
*No. 28 galvanized..	10.00	12.50	13.00	5.40	10.75	5.20	11.50	5.10
*No. 26 galvanized..	9.70	12.20	12.70	5.10	19.45	4.90	11.20	4.80
*No. 24 galvanized..	9.55	12.05	12.55	4.95	10.30	4.75	11.05	4.65

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring fair-sized lots, the following quotations hold:

	Aug. 10, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	40%	45%
Cleveland	40%	45%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—This material per 100 lb. sells as follows:

	Aug. 10, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	13.30	6.30
Chicago	12.50	5.25

In coils an advance of 50c. usually is charged.
Note—Stock scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16 No. 8, 5/32 and No. 10 ⅛ .... No. 12 .... 3/32, No. 14 and 1/16 .. No. 18 .... No. 20	21.00@30.00

*Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

***Special Welding Wire**

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Aug. 10, 1917	Cleveland Aug. 10, 1917	Chicago Aug. 10, 1917
Tire	5.00	5.00	4.50
Toe calk	5.00	5.50	4.75
Openhearth spring steel...	7.00	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Ordinary carbon tool steel, base price	14.00	13.00	15.00
Special best cast steel.....	18.00	20.00	....

*In bars.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

BUTT WELD					
	Steel			Iron	
Inches	Black	Galvanized	Inches	Black	Galvanized
⅛, ¼ and ⅜..	42%	15½%	¾ to 1½.....	33%	17%
½	46%	31½%			
LAP WELD					
2	42%	15½%	2	26%	12%
2½ to 6.....	45%	31½%	2½ to 6.....	28%	15%
BUTT WELD. EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	38%	20½%	¾ to 1½.....	33%	18%
½	43%	30½%			
¾ to 1½......	47%	34½%			
LAP WELD. EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4.....	43%	31½%	2¼ to 4......	29%	17%
4½ to 6......	42%	30½%	4½ to 6......	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	29%	15%	38.8%	24.8%
3½ to 6 in. steel lap welded	28%	10%	36%	21%	42.8%	27.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound:

	Aug. 10, 1917	One Month Ago	One Year Ago
Copper, electrolytic (carload lots).....	28.50*	30.00	27.00
Tin	63.75	62.00	38.00
Lead	11.00	11.50	6.00
Spelter	8.75	9.25	9.75

*Fourth-quarter copper; for spot copper the market price is 29c.

ST. LOUIS

Lead	10.75	11.25	5.87½
Spelter	8.25	9.00	9.50

At the places named, the following prices in cents per pound prevail:

	New York			Cleveland		Chicago	
	Aug. 10, 1917	One Month Ago	One Year Ago	Aug. 10, 1917	One Year Ago	Aug. 10, 1917	One Year Ago
Copper sheets, base.	38.40–40.00	42.00	35.50	40.00	35.50	39.50	37.50
Copper wire (carload lots)	38.50	39.50	30.00	39.00	33.00	38.50	35.00
Brass pipe, base...	42.00–44.00	47.50	46.50	46.00	45.00	46.00	45.00
Brass sheets	40.00	45.00	44.50	36.00	42.00	42.00	39.00
Solder ½ and ½ (case lots)	39.25	39.50	24.12½	39.50	24.50	39.25	24.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Aug. 10, 1917	One Year Ago
Mill	$34.00–36.00	$42.00
New York	38.00	45.50
Cleveland	38.00	38.00
Chicago	42.50	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

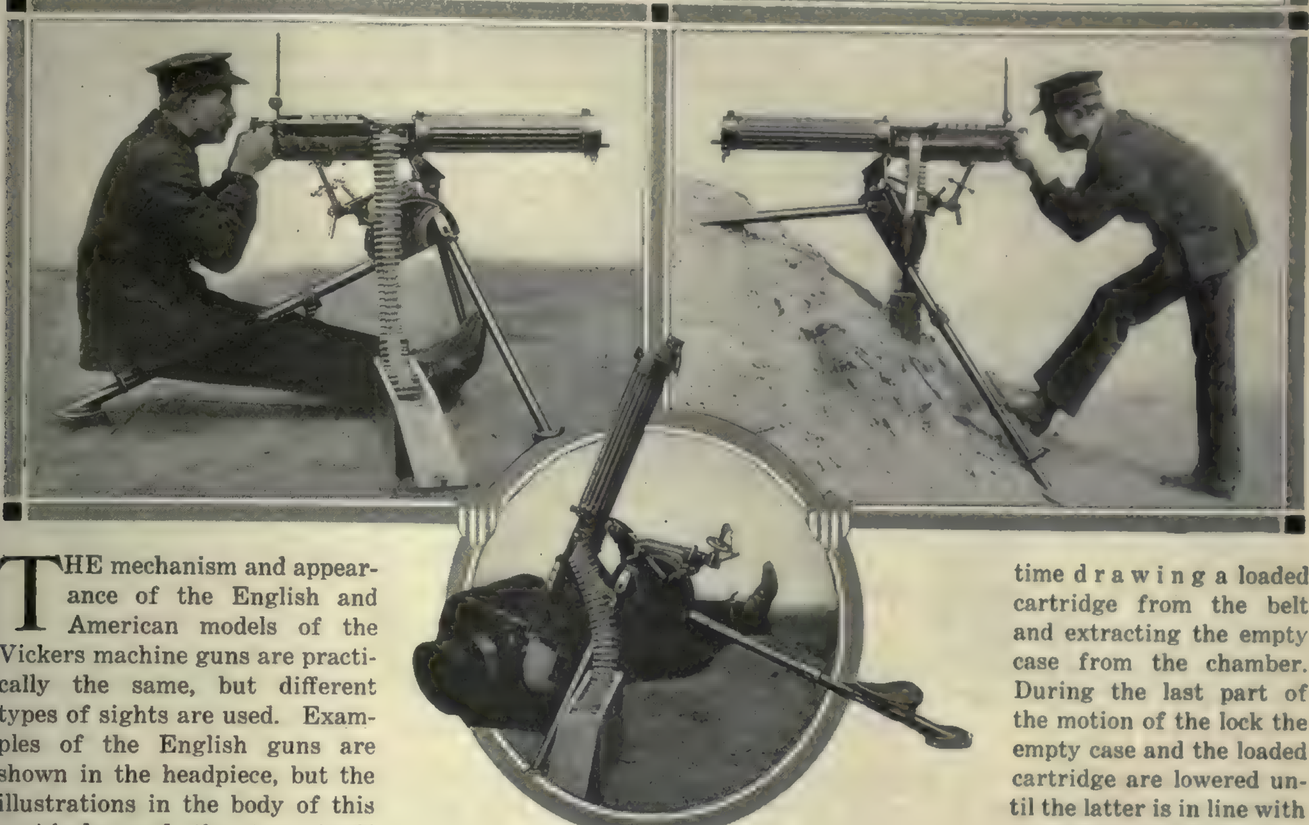
Carload lots f.o.b. mill.............................. 19.00

	In Casks		Broken Lots	
	Aug. 10, 1917	One Year Ago	Aug. 10, 1917	One Year Ago
New York	21.00	17.00	21.50	18.00
Cleveland	23.00	16.50	23.25	17.50
Chicago	22.50	17.00	23.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound for spot delivery, duty paid:

	Aug. 3, 1917	One Year Ago
New York	15.00	13.00
Cleveland	17.00	16.00
Chicago	16.50	15.25

The Vickers Machine Gun Model of 1915



THE mechanism and appearance of the English and American models of the Vickers machine guns are practically the same, but different types of sights are used. Examples of the English guns are shown in the headpiece, but the illustrations in the body of this article and the text itself apply directly to the American model. The machine gun, model of 1915, opposite views of which are shown in Figs. 1 and 2, belongs to that class of automatic guns in which the force of recoil is utilized for operation. After the first shot the gun is self-operative, until the ammunition in the cartridge belt is exhausted or until the trigger is released. The force of recoil opens the breech, extracts the empty case, and inserts and fires the next cartridge. The gun, without water in the jacket, weighs 32½ lb., with water in the jacket, 42 lb.; weight of tripod, 36 lb. The gun is adjusted to fire 500 shots per minute.

The ammunition used in this gun is the same as that provided for the United States rifle, caliber 0.30, model of 1903. It is fed into the gun by means of cartridge belts, holding 250 cartridges each. The cartridges are loaded in the belts by means of a belt-filling machine.

The belt is formed of two pieces of flax webbing connected by brass strips and eyelets between adjacent cartridges, every third strip projecting 0.95 in. beyond the bullet edge of the belt to guide the latter through the feed box and belt-filling machine and to prevent side motion of the belt in the ammunition box. The webbing is made double thick along the bullet edge by turning ½ in. over a cotton cord, which regulates the distance which the cartridges may be inserted in the belt. A brass handle 4 in. long is attached to each end of the belt.

In firing, the action of the mechanism is as follows: The barrel and lock move to the rear a short distance. At the end of this recoil the lock is drawn back from the chamber, thus opening the breech and at the same time drawing a loaded cartridge from the belt and extracting the empty case from the chamber. During the last part of the motion of the lock the empty case and the loaded cartridge are lowered until the latter is in line with the chamber and the former drops to the ground. Under the influence of a spring, which the movement of recoil has extended, the lock is then pressed forward, the fresh cartridge is pushed into the chamber, the belt is fed forward one round, and the carrier and barrel finally returned to the firing position. During the recoil the firing pin is cocked, and unless the trigger has been released the sear is struck at the conclusion of the movement described above, and the gun is again fired. Continuous fire is obtained, therefore, simply by keeping the trigger pressed down after firing the first round.

DETAILED DESCRIPTION OF THE GUN

The gun consists of the following principal parts: The barrel, trunnion block, water jacket, condensing apparatus, water-jacket cap, steam tube, filling and drain plugs, casing, handle block, recoil mechanism, lock mechanism, firing mechanism, feed box, muzzle attachment and sights. Details of the mechanism are shown in Fig. 3, and of the action in Figs. 4 and 5.

THE BARREL

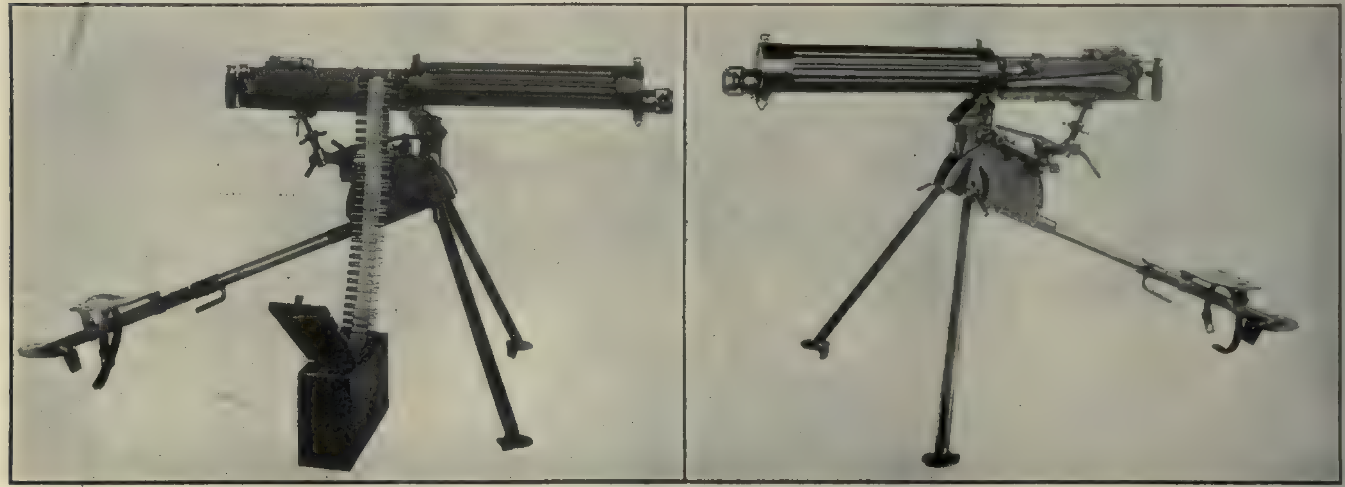
The barrel is chambered and rifled the same as the United States magazine rifle. On its exterior, near the muzzle and breech ends, are turned two cylindrical bearings which rest in corresponding supports in the trunnion block and water-jacket cap, and on these bearings the barrel slides back and forth in action. Both bearings are packed with asbestos to prevent water leaking from the water jacket. On the breech end of the barrel are formed two trunnions, by which the two recoil plates are attached to the barrel. The muzzle end is threaded for the barrel disk. To prevent rusting from the water in the water jacket, the exterior of the barrel is copper plated.

The trunnion block is a steel casting, carrying at its lower end a lug, through which passes the trunnion pin of the tripod. The trunnion pin secures the gun to its mount and forms the axis about which the gun is moved in elevation. The front end of the casting is cylindrical and is threaded to receive the rear end of the water jacket. Under the circular section a drilled hole furnishes a seat for the rear plug of the inside tube and directly in rear of this circular section the block is rectangular in shape and serves as the front support of the casing inclosing the lock and recoil mechanisms. A horizontal hole is drilled through the rectangular part of the trunnion block and serves as the rear support for the barrel, and back of this in the bottom plate is the opening through which the cartridge cases fall.

THE WATER JACKET

The water jacket consists of a piece of drawn-steel tubing threaded on the exterior at each end. The rear end screws in the trunnion block and the front end in the water-jacket cap. Near the rear end and on the upper right-hand side is a drilled and tapped hole for the filling plug, and near the front on the bottom a second hole is drilled and tapped for the water plug, through which the water in the jacket may be drawn off.

The adjustment of water jacket and trunnion block brings the barrel, when in position, below the center of the water jacket. By this arrangement a sufficient space above the barrel is obtained for the insertion of a steam exhaust consisting of an inside tube and an outside slide. The inside tube has two holes cut in its upper side, one near each end. A steam vent running down through the water-jacket cap is connected with the inside tube by means of a hole in the front plug. By this arrangement, no matter whether the piece be horizontal or in maximum depression or elevation, steam can always escape, as the outside slide will automatically cover the lower opening in the tube, preventing water from entering it and will leave the other hole open for the passage of steam from the jacket through the tube and water-jacket cap hole to the condensing apparatus. From the arrangement of this tube and slide, if the piece be left horizontal in filling and the stopper closing the steam-escape hole in the water-jacket cap be removed, water will issue from the water-jacket cap hole as soon as the water jacket has been filled above the level of the tube. This is an indication that the jacket is sufficiently full of water. Should the stopper not be removed, the jacket may of course be filled up to the level of the filling hole. This will do no harm, but will result, after firing a number of rounds sufficiently to develop steam pressure, in the blowing off of hot water through the water-jacket cap hole which will continue until the level of the water in the jacket has been reduced sufficiently to allow the free escape of steam to the condensing apparatus or to the open air, depending on the conditions under which it is operating.



FIGS. 1 AND 2. OPPOSITE VIEWS OF VICKERS MACHINE GUN AND TRIPOD

THE CONDENSING APPARATUS

The condensing apparatus consists of a hose and a water box nearly full of water. In place of a water box, a pail, can, or a hole in the ground that will hold water, may be used. The hose leads from the steam outlet of the water jacket into the water, thereby condensing the steam as it comes in contact with the water.

When a container is used, the condensed steam and water may be returned to the water jacket of the gun and used over again.

THE WATER-JACKET CAP

The water-jacket cap is a steel casting which screws on the front end of the water jacket. It contains a threaded seat for the stuffing-box follower, which forms the front support for the barrel and also a threaded seat for the front plug on the inside tube. On the front of the cap is screwed the follower and on top is screwed the front sight. The water-jacket cap tube for the escape of steam, mentioned above, is screwed into the cap and runs from the front plug hole of the inside tube diagonally down to its opening at the underside of the cap. On the top of the cap are stamped the name, model and serial number of the gun for identification purposes.

THE FILLING PLUG

The filling plug consists of a tapped hole in the trunnion block, a water plug, and a chain, hook and eyebolt for securing the plug to the trunnion block. The construction is such as to allow the easy unscrewing of the plug for insertion of the nozzle of the filling cup. When the nozzle is withdrawn the plug is screwed again into place.

THE CASING

The casing consists of the right and left outside plates, the bottom plate, slide and two covers, which are all made of steel. The outside plates are slotted to permit the free movement of the projecting parts of the recoil mechanism and to guide them in recoil. They are drilled for the pins and rivets by which they are attached to the handle block, trunnion block, covers and bottom plate. The bottom plate is of channel cross-section, the side flanges providing a support for the outside plates. The space beneath the flanges serves as a sliding seat for the slide. On the underside are the lugs to which the head of the elevating screw is pinned. The covers are hinged to each other and to the side plates, and are held closed by a spring catch at the rear end and a rotating bolt at the front end. On the underside of the rear cover the cover guides are riveted for guiding the carrier in recoil. On top of the front cover is riveted the rear sight. On the underside of the rear cover the trigger bar is guided in a groove.

THE HANDLE BLOCK

The handle block is a steel casting which closes the rear end of the casing and carries the handles by which the gun is held during firing. Between these handles is pivoted the trigger, which consists of a straight lever, on the upper end of which a thumbpiece is riveted. The trigger is pointed to engage the safety catch. The upper end of the trigger engages a projection on a catch which is pivoted between the handles and prevents accidental movement of the trigger. The handle block is pivoted about a bolt passing through its lower end and the two side plates. The upper end is held in place by a T-headed pin passing through it from the left side plate and screwing into the right side plate.

On the inside of the handle block the trigger lever is pivoted, the lower end of which engages a pawl which in turn is pivoted to the trigger. Between the upper end of the trigger lever and the safety catch is a compression spring which keeps these parts in constant contact. The upper end of the trigger lever engages the rear end of the trigger bar between two projections on its lower side.

THE RECOIL MECHANISM

The recoil mechanism consists of the recoil plates, crank, roller handle, fusee, crosshead, dead stop, crank-slot filler pieces, recoil spring, recoil-spring tension screw and spring box.

The recoil plates are two parallel steel plates which embrace the trunnions of the barrel at their front ends, and at their rear ends include and furnish bearings for the crank. On their inner surfaces are formed guides in which the lock frame slides back and forth in action.

The crank consists of a shaft which extends through the side plates on both sides and carries at its center, between the recoil plates, a slotted arm to which the crosshead is pinned and about which pin the crosshead rotates. Its right end is hexagonal in shape and carries the roller handle secured to it by a pin. On the left end is a short arm called the fusee, to which is pinned the link chain for connecting the recoil spring with the fusee. The crosshead is a short piece pivoted at the rear end to the arm on the crank and secured at its front end to the side levers of the locking mechanism by a bayonet joint. It serves simply as a link to connect the crank arm with the side levers. On its shank near the center is screwed the crank-adjusting nut. By inserting thin washers between the shoulder on the shank and the nut the position of the side levers with reference to the crosshead can be varied. This causes a change in the location of the lock frame, and by this means an accurate adjustment of the head space required by the cartridges can be obtained. The dead stop is a steel cam pivoted on the right side plate and serves to limit the movement of the roller handle in counter recoil. The recoil-spring is a helical tension spring inclosed in the spring box attached to the left side plate by means of two small studs in front and one in the rear. The rear end of the spring is held by two short links to the fusee and the front end is secured to the box by means of the tension screw threaded to the recoil-spring nut and passing through a hole in the spring box. The tension of the recoil spring is regulated with the tension screw which is turned by a sliding pin handle.

THE LOCK MECHANISM

The lock mechanism is contained between the recoil plates and consists of the lock frame, filler piece, carrier, gib, gib spring, gib-spring plate, side levers and pins, lifting levers, firing pin and striker point, mainspring, tumbler and pin, safety sear and pin, and hand sear and pin. All these parts are contained in or assembled to the lock frame. The latter is a steel forging having at its front a narrow vertical face about 3.25 in. long in which are cut the guide ribs which mount the carrier. The filler piece is located in the center of the narrow vertical face. On the bottom part of the lock frame are formed two horizontal ribs on each side that support the lock in the recoil plates and are the bearings on which it moves during recoil. Above these ribs the frame is slotted out horizontally to form a seat for the firing pin. The top of these ribs forms a seat for the lifting levers.

The carrier has a vertical sliding motion on the front face of the lock frame. Its face is provided with flanges which, with the gib projecting through from the rear, embrace the base of the cartridge case in the operations of withdrawing it from the belt, inserting it in the chamber and extracting it after firing. Near the bottom a conical hole is drilled to permit the passage of the point of the firing pin.

The side levers consist of a fork-shaped shank, the solid end of which is bored out to fit the crosshead, while each arm of the forked end terminates in a lever extending upward and to the rear. The fork embraces the lock frame, and the piece is pinned to the latter at the front end of the fork.

The lifting levers consist of two plates pivoted near one end on a pin. This pin passes through the rear part of the lock frame, the levers lying outside the frame.

The firing pin is a rectangular-shaped forging, whose front end has the case-hardened striker point secured to it by a screw. On the sides are formed parallel shoulders, by which the pin is supported in the lock frame. The top edge is cut away irregularly, forming a shoulder, against which the mainspring abuts, and also a bearing for the tumbler. The latter, an L-shaped piece, is pivoted to the lock frame at the angle. The shorter arm fits the notch in the upper edge of the firing pin and serves to retract and hold the firing pin in the cocked position. The longer arm is pushed up by the side lever shank as the latter is raised in recoiling, thus forcing the shorter arm to retract and cock the firing pin.

The mainspring is a leaf spring placed vertically in the upper part of the lock frame, the longer end engaging a boss on the firing pin and the shorter abutting against the hand sear. The latter is a straight lever secured near the lower end by a pin passing through the sides of the lock frame, and about which it rotates. The lower end engages a notch on the tumbler, and the upper end fits into the long slot of the trigger bar and is engaged by the front end or shoulder of the slot. In the firing position the side-lever shank is horizontal in prolongation of the crosshead. The carrier is therefore dropped to its lowest position by the lifting levers, so that the firing-pin hole is opposite the corresponding hole in the lock frame. Upon firing, the carrier first receives the shock of recoil, distributes it along its bearing surfaces to the lock frame, which in turn transmits it to the side levers, side-lever shank, crosshead, crank, recoil plates, fusee, and finally through the recoil spring to the casing and mount.

The Firing Mechanism

The firing mechanism consists of the trigger, trigger spring, trigger-lever safety catch and trigger bar. As described above, the trigger is a straight lever secured near its lower end to the handle block by a pin, about which it rotates. The upper end engages the safety catch, which holds it to the rear until it is released by lifting the catch and is pressed in. The trigger bar is a long, narrow plate lying in the channel of the rear cover plate. It contains one long slot. The trigger spring is a small helical spring mounted on a stud in the front face of the safety catch and tends to separate the trigger and trigger lever. It presses the upper part of the trigger to the rear, so that the trigger bar can move forward under the action of the mainspring transmitted through the hand sear and permit the latter to engage the shoulder on the tumbler when the piece is cocked. In continuous firing, as the trigger bar is held back by the trigger, the hand sear will never be able to engage the shoulder on the tumbler, but, being kept out of engagement, will allow the firing pin to move forward again as soon as the cycle of movement which ends with its cocking or retraction is completed.

The Feed Box

The feed box is a hollow steel casting extending transversely through the casing near its forward end. On the right side it projects beyond the casing, and its lower edge is curved to facilitate the feeding of the cartridge belt. On the front edge of the feed box a vertical bearing is provided in which is seated the arbor of the feed-box lever. This lever is held in place by the feed-box bearing cap, which slides into place after inserting the lever. At the end of the lower arm of the lever is a stud which engages in a slot near the front end of the left recoil plate. In the end of the upper arm of the lever is a stud which takes a slot on the top of the feed-box slide. The feed-box slide is a flat steel plate seated in grooves in the feed-box casting, which permit it to have a transverse movement. At its right-hand end, on the underside, are formed two lugs. These

SERIAL LIST OF COMPONENT PARTS

(Numbers before components refer to numbers shown in Figs. 3 and 4.)

4A	Trunnion block
5A	Outside plate, right
5B	Outside plate, left
6A	Bottom plate
6B	Bottom plate slide
6C	Bottom plate slide stop
6D	Slide catch head
6E	Bottom plate slide catch
6F	Roller bracket
6G	Outside plate filling piece
6H	Front cover stop
7A	Water-jacket cap
7B	Steam outlet tube
7C	Trunnion block distance piece
7D	Stuffing box
8A	Water jacket
8B	Outer steam tube
8C	Steam tube plug
8D	Inner steam tube
8E	Steam tube socket
8F	Water-jacket trough
9A	Barrel
10A	Recoil plate, left hand
10B	Recoil plate, right hand
11A	Crank
11B	Crosshead
11C	Fusee link (rear)
11D	Fusee link (front)
12A	Roller handle
12B	Dead stop plunger
12C	Roller handle knob
12D	Dead stop
12E	Dead-stop bracket
12F	Roller
13A	Lock frame
13B	Filling piece
13C	Hand sear
13D	Tumbler
13E	Firing pin
13F	Safety sear
13G	Distance piece for lock frame
13H	Striker point
14A	Side lever
14B	Lifting lever, right hand
14C	Lifting lever, left hand
14D	Carrier
14E	Gib
14F	Gib spring plate
15A	Handle block
15B	Handle grip
15C	Oil reservoir cap
15D	Reservoir cap washer
15E	Handle block oil reservoir
15F	Brush holder
15G	Brush
16A	Trigger lever
16B	Trigger pawl
16C	Safety catch
16D	Thumb piece
16E	Handle block pin
16F	Trigger
17A	Rear cover
17B	Trigger bar
17C	Rear cover catch
17D	Rear guide stud
18A	Front cover
18B	Front cover catch cap
18C	Front cover catch snib
18D	Cover guide, right hand
18E	Cover guide, left hand
18F	Front cover catch bracket
18G	Front cover catch
19A	Feed box
20A	Bottom pawl, left hand
20B	Bottom pawl, right hand
20C	Bottom pawl connecting plate
20D	Feed-box lever
20E	Feed-box slide
20F	Cartridge guide and stop
20G	Feed-box bearing cap
20H	Upper pawl, left hand
20J	Upper pawl, right hand
21A	Front sight
21C	Deflection leaf
21E	Front-sight carrier
22A	Sight cam
22B	Rear sight bracket
22C	Rear sight stem
22D	Catch button
22E	Slide
23A	Water plug
23B	Water-plug top piece
23C	Stem covering
23D	Water-plug fastening link
23E	Water-plug fastening ring
23F	Water-jacket cap hose connection
23G	Stem
23H	Eyebolt
23J	Securing S hook
23K	Securing chain (6 links)
23L	Securing chain (12 links)
24A	Spring box
24B	Spring-box fixing (front)
24C	Spring-box fixing (rear)
24D	Fusee
24E	Recoil-spring hook
24F	Recoil-spring nut
25A	Sleeve
25B	Front disk
25C	Muzzle attachment securing chain
25D	Securing chain ring
25E	Muzzle gland
25F	Front disk cap
25G	Barrel disk
25H	Barrel-disk clamping screw
25K	Follower
26B	Locking pin
26C	Side-lever pin
26D	Trigger pin
26E	Bottom pawl rivet
26F	Rivet
26G	Rivet
26H	Bottom and outside plate rivet
26J	Bottom and outside plate rivet
26K	Dead-stop bracket and outside plate rivet
26L	Carrier supporting spring rivet
26M	Fusee rivet
26N	Chain-link rivet
26P	Lock-frame rivet
26Q	Adjusting washer (thick)
26R	Adjusting washer (thin)
26S	Stem washer
26T	Tension screw handle washer
26U	Water plug washer
26V	Belleville washer
26W	Deflection-screw washer
26X	Roller washer
26Y	Side lever-pin bushing
27A	Deflection-screw washer pin
27B	Rear-sight stem pin
27C	Dead-stop pin
27D	Slide-catch pin
27E	Trigger-pawl pin
27F	End-link pin
27G	Crank pin
27H	Crank-pin fastening link
27J	Upper-pawl pin
27K	Filling-piece pin
27L	Safety-sear pin
27M	Trunnion block and outside plate pin
27N	Rear rivet for rear sight
27P	Front rivet for rear sight
27Q	Cartridge guide and stop rivet
27R	Cartridge guide rivet
27S	Spring box rear stud
27T	Spring box front stud
27U	Tumbler pin
27V	Hand-sear pin
27W	Muzzle attachment stop pin
27X	Bottom pawl pin
27Y	Trunnion block and outside plate rivet
27Z	Tension-screw handle
28A	Handle block hinge pin
28B	Cover-hinge pin
28C	Rear-cover catch hinge pin
28D	Front-plug screw
28E	Steam tube front plug
28F	Front-sight carrier screw
28G	Hose-connection screw
28H	Safety-catch pin
28J	Recoil spring tension screw
28K	Screw-securing crank handle
28L	Deflection screw
28M	Trunnion block and outside plate screw
28N	Cover-hinge pin nut
28P	Sight-cam securing screw
28Q	Dead-stop plunger stop
28R	Adjusting nut
28S	Trigger-bar spring plunger
29A	Carrier supporting spring, left hand
29B	Carrier supporting spring, right hand
29C	Gib spring
29E	Rear cover catch spring
29F	Bottom-pawl spring
29G	Bullet-guide spring
29H	Upper-pawl spring
29J	Mainspring
29K	Safety-sear spring
29L	Recoil spring
29M	Dead-stop plunger spring
29N	Trigger-lever spring
29P	Trigger-bar spring
29Q	Front-cover catch snib spring
29R	Catch-button spring
29S	Slide-catch spring
B1A	Trunnion pin
B1B	Trunnion pin collar
B1C	Trunnion pin adjusting nut

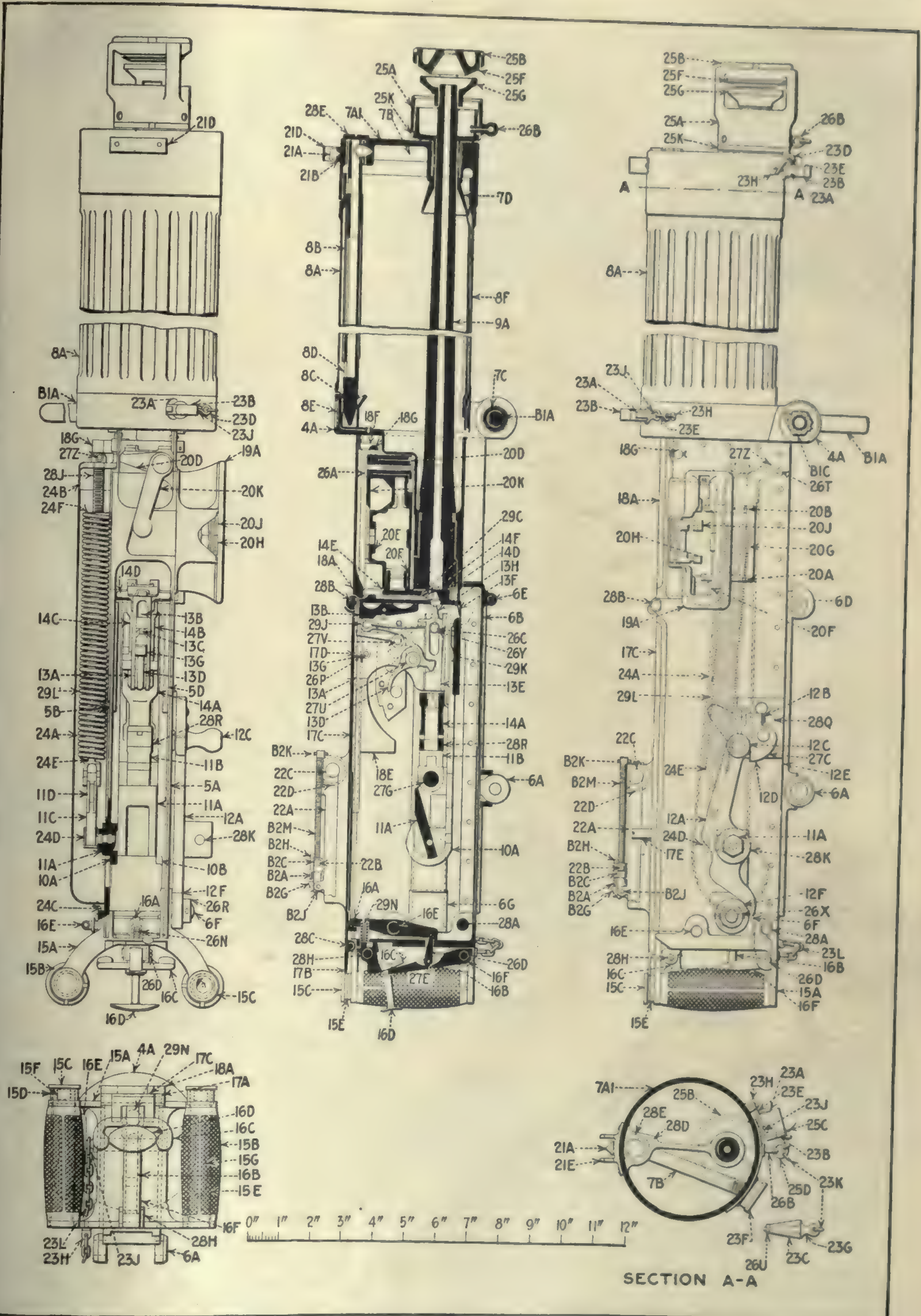


FIG. 3. GENERAL ARRANGEMENTS AND SECTIONAL VIEW OF GUN

lugs are drilled for the upper pawl pin, which serves as an arbor for the upper pawls. The long arms of the pawls are pressed downward by a double leaf spring consisting of two parallel leaves joined at the base and secured to the underside of the slide by an undercut lip.

Beneath the curved lower edge of the right-hand end of the feed box are formed two lugs drilled to take the bottom pawl pin. The bottom pawls are mounted on this pin as an arbor, their long arms projecting through slots in the bottom of the feed box. The shorter arms are slotted at the end in which a finger plate connecting the two arms is riveted for easy manipulation by the fingers. The pawls are kept in position by a peculiar shaped double leaf spring mounted at the center of the pawl pin.

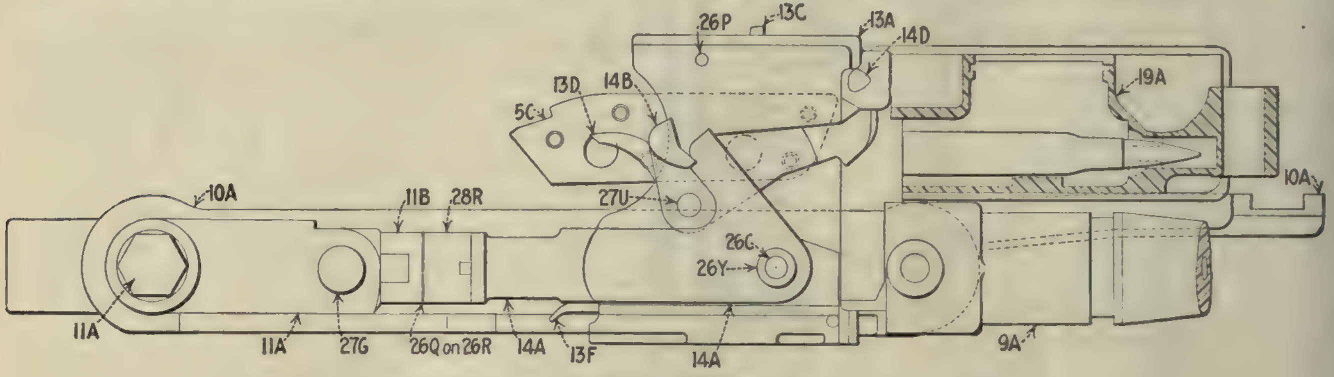
The action of the feed box is as follows: During the recoil of the parts the slot near the front end of the left recoil plate pulls the stud on the end of the lower arm of the lever to the rear. This causes a counterclockwise revolution of the vertical arbor of the lever, resulting in throwing of the feed-box slide plate from left to right by the upper arm, so that the pawls on the underside of the slide plate are pushed back and engage in rear of the next cartridge in the belt. During the counter recoil the movement is reversed, resulting in the feeding of the next round in the belt to the position for engagement with the carrier grooves. The under pawls prevent the movement of the belt from left to right unless depressed from beneath by hand.

The muzzle attachment consists of the follower, barrel disk, front disk, disk cap and sleeve, which are steel forgings whose functions are to regulate the effect of recoil on the system. The barrel disk consists of a hub which screws on the muzzle of the barrel and carries a disk concaved to the front. The follower is secured to the water-jacket cap by a screw thread. Through the front disk a hole is drilled just large enough to permit passage of the bullet, while the sides of the sleeve are cut away as much as possible to allow free escape of the powder gas. The front disk cap can easily be removed when heavily coated with the products of combustion by unscrewing the front disk and prying it out, after which a new cap may be inserted.

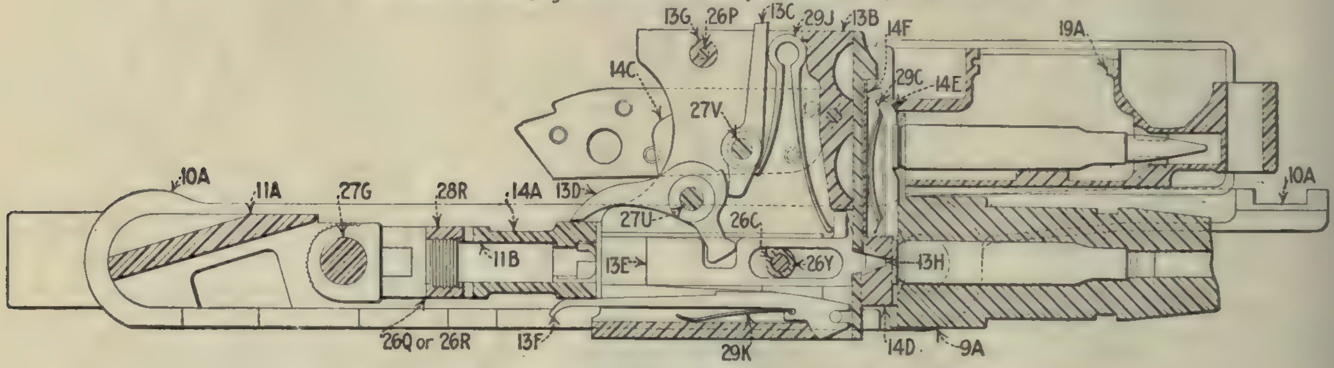
SIGHTS

The front sight, complete, is composed of the front sight, front-sight carrier and front-sight carrier screw.

The front sight is a forged-steel piece dovetailed into the front-sight carrier, thus allowing lateral adjustment of the sight. It is shaded by the front-sight cover.



Firing Position
Lock, barrel and recoil plates fully home. Firing pin cocked on to handsear and carrier engaging with two live cartridges, one in barrel, one in feed box.



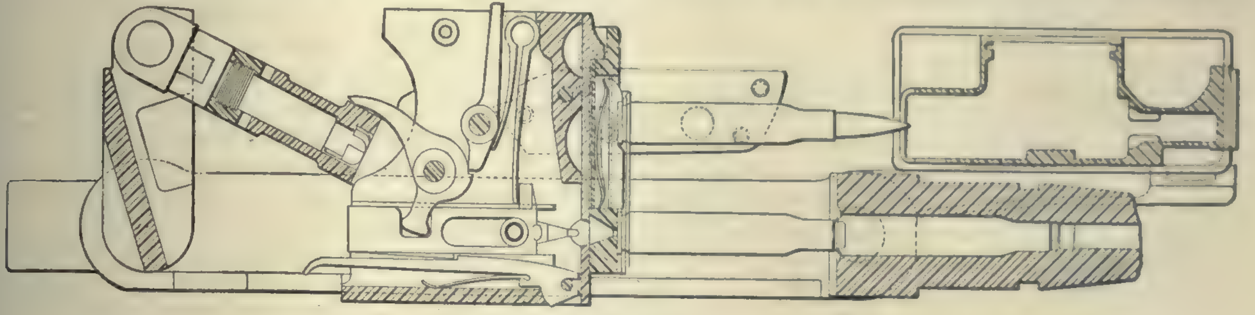
Fired Position
Lock, barrel and recoil plates fully home. Firing pin released and the carrier engaging with a live cartridge in the feed box, and with the empty case in the barrel

FIG. 4. THE ACTION IN FIRING AND FIRED POSITIONS

The rear-sight group is made up of the following principal parts: The movable base, the base spring, the leaf, the elevating screw, the slide, the half nut, the slide cap, the drift slide, the aperture disk and the windage screw.

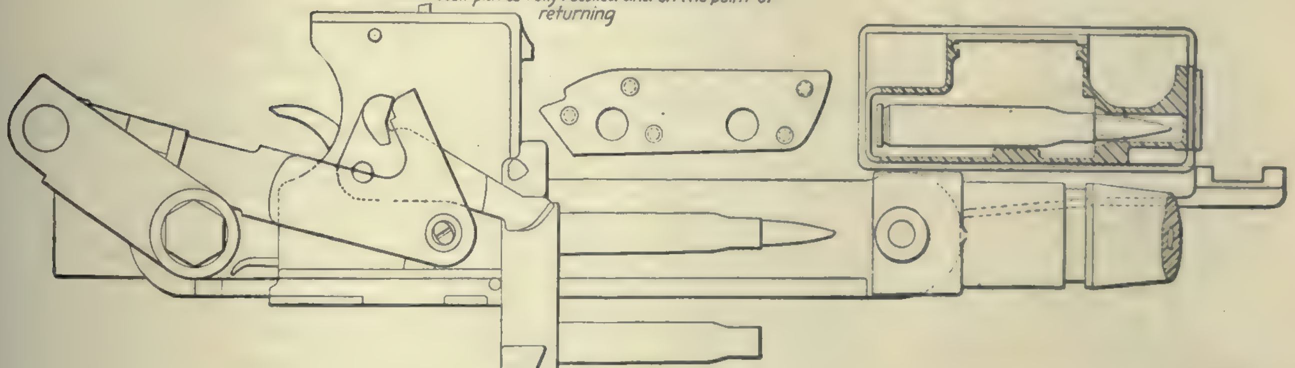
The movable base has on its upper surface two ears, in which are the holes for the joint pin which serves as a hinge for the leaf. On the rear end of the movable base are the wind-gage graduations, each point of which corresponds to a lateral deviation of 4 in. for each 100 yd. Both ends have lips which fit the undercuts of the fixed base, the front lip having also a worm gear for engaging the thread of the windage screw. The base spring fits in the spring seat of the movable base.

The rear face of the leaf is graduated from 0 to 2600 yd. and its right edge is graduated in mils. On the right side of the sighting opening in the leaf is the groove and seat for the elevating screw, which is a long, thin screw, extending from the bottom of the sighting opening to the top of the leaf, where it is secured in the elevating screw head by the elevating screw pin. This elevating screw allows minute corrections for elevation and also holds the slide in position on the leaf by means of a half nut which is seated in the slide and the half-nut spring, the latter forcing the half nut against the thread on the elevating screw. The pitch of the screw is such that one complete turn corresponds to a change of one mil. The outer end of this half nut is knurled, and by pressing in on the knurled head the half nut can be released from the elevating screw and the slide quickly raised or lowered.



Recoiling Position

Lock partly recoiled cocking the firing pin and extracting the live cartridge from the feed box and the empty case from the barrel. Barrel and recoil plates fully recoiled and on the point of returning



Returning Position

Lock fully recoiled and on the point of returning. Firing pin cocked on to safety sear. Extractor in dropped position bringing live cartridge in line with the chamber of the barrel. Barrel and recoil plates fully returned and new cartridge brought into feed box

FIG. 5. THE ACTION IN RECOILING AND RETURNING POSITIONS

The rear face of the slide is cut out for the leaf, and the drift slide and the right half are made with a seat for the half-nut spring and the half nut. The right and left ends are drilled and tapped for the small slide-cap screw and the large slide-cap screw, which secure the slide cap to the slide. The front face of the slide is slotted and recessed for the pivot.

The slide cap has a circular cut in its upper surface which forms a recess for rotating the aperture disk, and also apertures for sighting and for reading the graduation on the leaf. The center is slotted for the pivot. On the right and left sides are drilled the holes for the small and large slide-cap screws. On the rear face at the bottom of the slide cap is the open or battle sight.

The drift slide moves in the drift slots in the leaf. At the top is a small open sight, while just below are two openings, the upper for the pivot and circular lug on the aperture disk and the lower for a sighting aperture. The drift slide is held in place by a lug on its front face, which bears against the slide and by the lug which contains the open sight. This latter lug extends to the rear and bears against the top of the slide cap. On the lower edge of the open sight lug is another small lug, which engages in the notches on the perimeter of the aperture disk, locking the latter in the desired position.

The aperture disk is a circular piece containing five sight openings, namely: Four peepholes, 0.04, 0.06, 0.08, and 0.10 in. in diameter, and one large aperture which contains an open sight. A circular lug on the front face engages in the central opening of the drift slide, thus causing the aperture disk to conform to the movement of the former. This lug is drilled and tapped for the pivot spring and the pivot. The purpose of the pivot spring is to force the aperture disk to the rear, so that one of the notches, which are cut on its perimeter, will engage in the small lug on the drift slide and prevent rotation. By pressing inward, the aperture disk can be released and rotated until the desired aperture is opposite the sighting openings, located in the drift slide.

The windage screw consists of the windage screw, the windage screw knob, the windage screw collar, the windage screw spring and the windage screw pin. It is seated in the front part of the fixed base.

DESCRIPTION OF THE TRIPOD

The tripod consists of the following principal parts: Front legs, trail, seat and seat bracket, pintle and pivot, top carriage, body, traversing mechanism and elevating mechanism.

THE FRONT LEGS

The front legs consist each of a short length of drawn steel tubing carrying at the upper end the link by which it is attached to the adjusting arc and at the lower end a flattened shoe. One end of the link is turned to fit snugly in the bore of the tubing and riveted thereto in two places. The upper end of the link terminates in three teeth which fit into a circular rack when adjusted for firing. When it is desired to fold the tripod for transportation or to extend the front legs forward in carrying by hand, the slot in the link permits the clamp to be loosened from its seat on the drum and the teeth to be disengaged from the adjusting arc, swung around, reëngaged, and clamped.

THE TRAIL

The trail consists of two lengths of steel tubing, called the outer and inner trail tubes. The inner tube fits into and is riveted to a socket, which is also riveted between two semicircular side plates, and at its front end carries two adjusting arcs for the front legs. The outer trail tube forms the trail clamp and holds the attachment for the seat.

The inner tube is turned to fit closely the bore of the outer tube, in which it has a sliding motion. This motion may be stopped and the inner tube clamped in any position by means of the trail sleeve clamp which is riveted to the top end of the outer tube. The sleeve is split for a short distance back from the end, so that by tightening the clamp the lugs are brought nearer together and the inner tube firmly gripped.

The key inserted in the trail sleeve works in a longitudinal slot cut in the surface of the inner tube on the underside and prevents the tube from turning. To the rear end of the outer tube is attached a shoe similar to those on the front legs. This construction of the trail permits adjustment of its length to uneven surfaces and shortening to a minimum length for transportation. A pair of leg clips fastened to the outer tube serves to bind securely to the trail the front legs when the tripod is folded.

THE SEAT

The seat is of sheet steel pressed to shape. Its front end is pivoted to fit the seat sliding collar which slides on the trail tube. The rear end is pivoted to the seat link, which in turn is pivoted to the seat link collar attached to the outer trail tube.

The seat link collar is of steel and riveted near the end of the outer tube. On the underside of the seat are two lugs of the hinge drilled and riveted to it, the action of which is described below. For transportation the seat slides forward by means of the seat sliding collar to which it is pivoted. The rear of the seat folds down close to the trail and the top of the seat link rests on the trail. In action the seat is slid backward and automatically stops by the contact of the seat link with the seat link collar.

THE PINTLE

The pintle is a hollow steel forging which furnishes the points of attachment for the legs and trail, the pivot for transverse movement of the gun and top carriage, and the seat for the traversing arc.

In the rear of this casting are machined two surfaces inclining outward to which the traversing arm is riveted. The upper end is turned to form a bearing for the top carriage, traversing pivot and yoke. The rear end of the traversing arm furnishes pivot bearings for the elevating nut, while on the underside is the clamp for the traversing arc, the rear edge of which is turned to an arc struck from the center of the pintle axis and fits into a corresponding groove in the rear of the traversing arm, thus preventing the latter from jumping. The top surface of this seat is machined to form a flat bearing surface for the rear ends of both the top carriage and the traversing arm.

The top and front of the pintle is turned to form a vertical bearing for the top carriage and traversing arm. In the upper part of this bearing is pivoted the yoke.

THE TOP CARRIAGE

The top carriage is a steel forging consisting of a hub bored out to fit over the pintle and an arm projecting downward and to the rear, to which the traversing arc is riveted. This arm is also gibbed to the top carriage guide by means of the groove engaging the circular lip on the latter. On top of the hub is the pivot yoke drilled and slotted transversely for the trunnion pin. The gun rests between the cheeks of this yoke supported by and rotating on the trunnion pin. One end of this pin is bent to a sharp angle to form a handle, while the other is threaded to receive the adjusting nut. The cheeks of the pivot yoke are reamed out and slotted to the size of the ends of the pin. On mounting the gun the pin is dropped through the slots of the pivot yoke and secured by rotating the handle, thereby tightening the cam.

The web at the rear of the top carriage is cut away just in rear of the hub for the top carriage clamp link, and a hole is drilled through the horizontal web for the top carriage clamp bolt, the head of which is fitted with a lever handle. The eccentric portion of the clamp bolt is fitted with a bushing into a link connecting to a hinged plate. By rotating the clamp bolt this plate is raised to engage the notches under the top carriage guide, thereby locking the top carriage to the body.

THE BODY

The body consists of the side plates, top carriage guides, trail socket, distance pieces and adjusting arcs of the front legs.

THE TRAVERSING MECHANISM

The traversing pivot is drilled for the passage of the pivot stud and counterbored slightly as a seat for the shoulder on it.

The traversing arm is a steel casting to one end of which is riveted the pintle and rests upon the shoulder formed at the base of the latter. Slightly in rear of this bearing a curved slot is cut, through which the traversing arc passes, and in rear of this slot the arm is bent downward. At the rear end is formed a yoke in which is pivoted the elevating nut.

In front of the elevating nut is fitted the traversing clamp, which consists of a claw, a bushing and clamp handle. By swinging the handle one way or the other the claw engages the under surface of the traversing arc thereby clamping the arm stationary with the traversing arc.

On each side of the traversing arm a traversing stop is fitted to the traversing arc. This stop is fitted with a plunger, a spring and a screw and hooks over the rear of the traversing arc. On the plunger are found teeth to engage the teeth formed under the edge of the traversing arc. By pinching this stop between the thumb and forefinger of either hand it may be disengaged and set at any desired position on the traversing arc. When these stops are placed on the extreme ends of the traversing arc, the traversing arm may be swung 22½ deg. either side of center. By releasing the elevating gear an all round training may be obtained but without any clamp.

THE ELEVATING MECHANISM

The elevating mechanism consists principally of the outer elevating screw, the inner elevating screw, the elevating nut, hand wheel, the elevating clamp, the elevating nut pin and the elevating pin.

The outer elevating screw is a steel cylinder, on which is screwed at the upper end the handwheel, with six knobs, with which the screw can be turned by hand. A right-hand screw thread is cut on the exterior of the body and a left-hand thread is cut for a short distance on the interior of the body. The remainder of the bore is reamed out to a diameter large enough to clear the inner screw when in place.

The inner elevating screw is a steel forging, at the upper end of which a T-shaped head is formed, which is drilled transversely. This head fits between lugs on the bottom plate of the gun and is secured to them by the elevating pin. The pin has a spring at one end which is held in place by riveting.

On the body of the screw is cut a left-hand thread corresponding to that on the interior of the outer screw. The lower end is drilled and tapped axially for a stop screw, which, by closing the end of the thread, limits the upward movement of the inner screw when it comes in contact with the bottom of the interior thread in the outer. The elevating nut is a long nut, carrying at its lower end a lug drilled to take the elevating-nut pin by which it is hinged to the top carriage and at its upper end a second lug for the elevating clamp. The bore of the nut is threaded for the outer elevating screw for its whole length. The threaded part is slotted longitudinally through the center of the clamp lug. One side of the latter is reamed to take the body of the clamp and the other is threaded. The clamp itself consists of a bent handle and a body partly smooth and partly threaded. It is inserted through the reamed portion of the lug on the nut and screws through the threaded portion, being kept in place by a collar and pin on the projecting end. By screwing in the clamp still farther the two portions of the lug are brought closer together, thus causing the nut to grip the outer elevating screw tightly and prevent any movement of the latter.

As the inner elevating screw is prevented from turning by its attachment to the gun and the elevating nut likewise by its attachment to the carriage, it follows that rotation of the outer screw will cause it to move either up or down in the nut and at the same time force the inner screw in the same direction. The elevating mechanism gives a range in elevation of 16 degrees.

By disengaging the T-head of the elevating screw from the bottom cover plate the gun may be swung around a complete circle. By swinging it around 180 deg. the gun may be elevated to 75 deg., but without any elevating clamp.

Proposed S. A. E. Standards for Airplane Parts

Column Control—Fig. 1 illustrates the general arrangements and movements of the type of control generally used for airplanes of the heavier and slower types. It is not intended to standardize the exact arrangement or connections, rather the directions of the movements required to produce given results.

Stick Control—The control movements for the type of control used in the lighter and faster machines are illustrated in Fig. 2.

Loops for Hard Wires—The method of fastening ends of hard wires, shown in Fig. 3, is recommended for standardization. This is the present British standard, consisting of an oval coil of wire, through which the hard wire is slipped, bent in the form of a loop, inserted again and the end bent over against the coil. The whole is then soldered.

Galvanized Nonflexible Cable Ends—The splices for galvanized nonflexible cable ends, shown in Fig. 4 and Table I, are recommended for standardization. The total length of splice is indicated by *L*. Soft steel wire of 0.041-in. diameter is to be used for wrapping. Two spaces are to be left between convolutions of the wrapping wire, the width of the spaces being indicated in Table II, which also gives the sizes and strength.

TABLE I. PROPOSED SPLICES FOR GALVANIZED NONFLEXIBLE CABLE ENDS*

Diameter of Cable		*L*	Space	Wind	Full Strength of Cable
1/16	1 x 19	1½	⅛	1	500
3/32	1 x 19	2	⅛	1¼	1,100
⅛	1 x 19	2¼	⅛	1½	2,100
5/32	1 x 19	2½	⅛	2	3,200
3/16	1 x 19	3	3/16	2¼	4,600
7/32	1 x 19	3½	3/16	2¼	6,100
¼	1 x 19	4	¼	2½	8,000

* Solder without drawing temper of wire.

Splices for Flexible Cable Ends—Flexible cable splices, as shown in Fig. 5 and Table II, are proposed for standardization. The length of splice from the pointed end of the opening in the thimble is represented by "splice plus or minus ⅛ in." The end of the splice

TABLE II. PROPOSED SPLICES FOR FLEXIBLE CABLE ENDS

Diameter of Cable		Length of Splice	Number of Tucks	Length of Serving	*A*	Full Strength of Cable
3/32	7 x 14	1¼	3 over core buried 4 under	1	⅛	800
⅛	7 x 19	1½		1	⅛	2,000
5/32	7 x 19	1¾		1¼	¼	2,800
3/16	7 x 19	1⅞		1¼	¼	4,200
7/32	7 x 19	2⅛		1½	¼	5,600

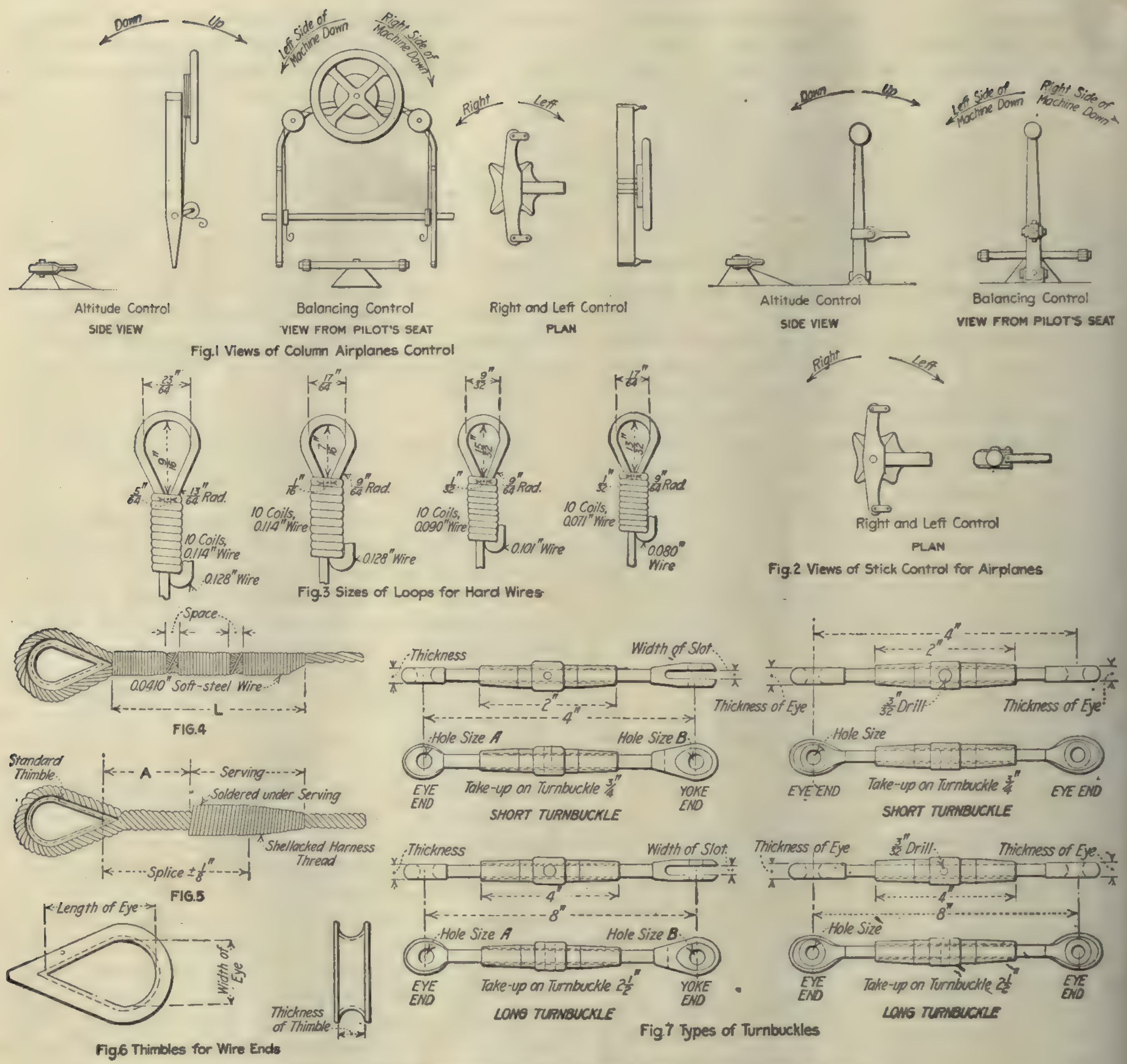


Fig.1 Views of Column Airplanes Control

Fig.2 Views of Stick Control for Airplanes

Fig.3 Sizes of Loops for Hard Wires

FIG.4

FIG.5

Fig.6 Thimbles for Wire Ends

Fig.7 Types of Turnbuckles

FIGS. 1 TO 7. PROPOSED STANDARDS FOR AIRPLANE PARTS

Fig. 1—Views of column airplane control. Fig. 2—Views of stick control. Fig. 3—Sizes of loops for hard wires. Fig. 4—Galvanized nonflexible cable end. Fig. 5—Flexible cable end. Fig. 6—Thimbles for wire ends. Fig. 7—Types of turnbuckles

is wrapped with a "serving" of shellacked harness thread. Dimension *A* represents the distance from the end of the opening in the thimble to the end of the "serving."

Thimbles for Wire Ends—Thimbles, as shown in Fig. 6, in sizes indicated in Table III, are submitted for standardization.

TABLE III. PROPOSED DIMENSIONS FOR THIMBLES FOR WIRE ENDS

Size of Rope	Thickness of Thimble	Width of Eye	Length of Eye
1/16-3/32	0.09	0.35	0.70
1/8	0.13	0.35	0.70
5/32	0.17	0.40	0.80
3/16	0.21	0.50	1.00
7/32	0.24	0.60	1.20
1/4	0.25	0.70	1.40
9/32	0.30	0.80	1.60
5/16	0.33	0.90	1.80
3/8	0.39	1.00	2.00

Turnbuckles—The turnbuckles shown in Fig. 7 and Tables IV and V are recommended for standardization. The dimensions given are for short and long turnbuckles, each length having either two eye ends or one eye end and one yoke end, depending upon the exact use to which they are to be put when in use on the airplane.

TABLE IV. PROPOSED DIMENSIONS FOR TURNBUCKLES*

Item	Short	Long
Length of barrel	2	4
Lengths between eyes:		
With threads flush with ends of barrel	4	8
With maximum extension	4 1/16	8 1/16
With minimum extension	3 1/4	5 1/2

* With either two eye ends or one eye and one yoke end.

TABLE V. STRENGTH (IN POUNDS) OF PROPOSED TURNBUCKLES

No.	Short	Long
1	500	500
2	1,000	1,000
3	1,500	1,500
4	2,000	2,000
5	2,500	2,500
6	3,000	3,000
7	3,500	3,500
8	.....	4,000
9	.....	4,500
10	.....	5,000
11	.....	6,000
12	.....	7,000
13	.....	8,000
14	.....	9,000
15	.....	10,000

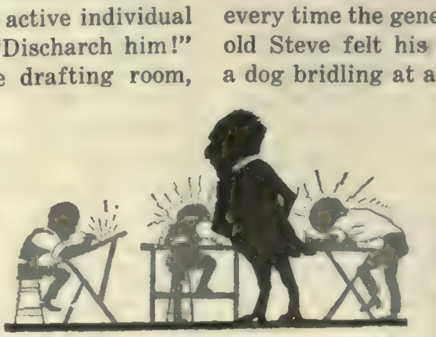
Series for Draftsmen and Designers

Value of Detail on Drawings*

BY CHARLES M. HORTON

TRAVELING about the country, Steve Winthrop often struck queer jobs. Sometimes he found the work interesting, but his associates not quite so much so. Sometimes he found himself with a good crowd of draftsmen, but the work itself petty and slack and anything but absorbing, which might have accounted for the other fact—men *will* be interested. And sometimes he discovered the combination of interesting work and interesting associates in a single job. But for the most part he found both the work and the men around him enervatingly pleasing. Yet there was one job he struck, which for queer slants beat anything.

The company was known as the American This-and-That Co. It did a nation-wide business and frequently was in the courts for alleged infractions of the Sherman anti-trust law. But that is beside the point. Though it called itself American, and probably had a right to call itself American, the other members of the department in which Steve worked, from the general manager down to and including the office boy, were either German or German-American. For instance: The general manager's name was Hoffmeyer, his assistant's name was Schlosser, the chief draftsman's name was Schwartz, and the office boy's name was Heinie. In between, there were seven draftsmen, whose names respectively were Kriecker, Hochstrasser, Weschler, Reckendorfer, Specht, Meisel and Helmstaedter—all fine, soft, mellifluous, *Latin* names. Steve was the only man on the department payroll with an Anglo-Saxon name; and he figured it out afterward that his name never would have got there but for the fact that the company heads were in a hurry for their drawings—to beat out some law, I suppose. The general manager was a tall, active individual whose favorite phrase seemed to be, "Discharch him!" He spent a good deal of time in the drafting room, in fact seemed to love the place. He would come into the room with great, long strides, take up a towering stand centrally among the drafting boards and sweep a merciless eye around and over and at the trembling draftsmen, giving for all the world the impression of a rooster on a dunghill, surveying with a more or less disdainful gaze his flock of hens and chickens. He was lord of that domain, unquestionably. And he knew it; that, too, was evident. Hands in his pockets, head and shoulders and body high above the surrounding grovelings, he would stand motionless for a long time. Then suddenly and without warning he would step toward one of the men and proceed to discuss, with the chief draftsman, the machine or part of machine being laid out on that particular board. Altogether it was nothing if not dramatic. Now these visitations, naturally, got Steve's goat.



Steve was an old-line American, whose ancestors had come over in the first boat; and consequently his blood was riotous with corpuscles that, combined, spelled Liberty, Equality, Justice. Also, Steve himself had taken three degrees Somewhere, and deep within him was the conviction that all men were created equal. Perhaps the general manager, too, had taken these degrees—Steve could not say. He could say, though, that in his own case the thing had "took." In the case of the general manager, in certain directions at least, there was but scant evidence of it, however. So when the man stalked in upon him in that fashion about three times a week, Steve in time found himself getting more and more peeved. Indeed, after a month or two of this, though he could not see these dramatic entrances, owing to the fact that he sat with his back toward the door, every time the general manager stepped over the threshold Steve felt his hair slowly bristle, like the hair on a dog bridling at an enemy. One day came Steve's turn to feel the hand of the general manager. Steve was laying out an arrangement of a machine. As I have said frequently in these columns, Steve was a good draftsman. A good draftsman is one who will take any amount of pains to forestall an error in the shop. This means the showing of detail on the drawing, as well as other things. A drawing is only a form of language anyway, with certain rules and signs supposed to be well understood by those whose duty it is to read them, and the picture, when finished, ought to tell its own complete story. Steve well understood this, of course, and always tried to tell the story to the shop in as clear and simple language as he had at his command. When a tap bolt was required, Steve drew in a tap bolt; when it was a stud, he drew in a stud; when it was a through bolt, Steve carefully drew in a through bolt. You can't get away from it, Steve knew his business. Nevertheless, though his skill usually was never questioned on a job, it was doomed to be brought under vigorous questioning now. The general manager, after his haughty survey of the room, as usual, strode across to Steve's board, followed by the meek and servile chief draftsman. Whereupon the following conversation ensued:

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"Ho-ho! You must not do that, Mister Windcoop! That iss too fancy! Shust make a center line! That iss sufficiend! Too much time—too much time! We cannod afford that, Mister Windcoop!"

Steve looked up.

"Winthrop is my name," he calmly corrected the general manager. Then he looked at the drawing. "I know that takes time, but not very much time, because I work fairly speedy. And don't you think the man in the shop ought to know? Somebody will have to inform him sometime, if my drawing fails to state the thing!"

The general manager dismissed this with a wave of his hand—superciliously.

"That iss a trivial matter! You are too fancy, Mister Bimthrop! Ve never show things like that. Too much time—too much time!"

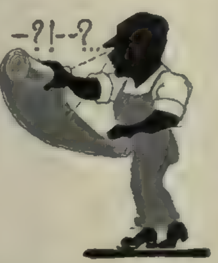
"Winthrop," said Steve quietly. "I've always showed things like that wherever I've worked, and my training and experience lead me to believe that it pays. I—"

"Und anyway," interrupted the general manager, "that is incorrect! It should be the opposite—a casting. That is incorrect!" Then to the chief: "Otto, you know that. Vy did you—" etc., etc., *ad infinitum.*

Steve laid down on the argument in disgust. In his last criticism the general manager had taken the prop out from under his own argument. Had Steve neglected to draw in that detail, the general manager would not have discovered the error. Yet he was finding fault for Steve's having shown intricate detail. It was all beyond Steve. He rubbed out the detail, following the chief draftsman's advice, and thereby expended some more valuable time, in addition to the time taken to draw it in. He grinned to himself as he rubbed, and asked himself, as he had asked himself frequently on some jobs, What is the use of being a general manager if you can't be thick whenever you want to be?

Consulting engineers hate to show detail on their drawings. Personally, I do not understand why. Their compensation for the job is usually a certain per cent. of the cost, and so it cannot be for want of time—desire to save time—in getting out the drawings. Nor have they any reasons for wanting to bring doubt as to their meaning in the shop. Maybe they aim to set up confusion in the shop and thereby stretch out the cost of the plant—maybe, I say. I do not know. All I know is that the average consulting engineer will get out nothing more than a sort of glorified sketch of the kettle or pan or oven that he wants installed and pass the buck along to the manufacturer, who himself, judging from some of the drawings I have seen put out by consulting engineers, must put a draftsman to work deciphering the drawing as submitted in order to get the thing made properly. "Ours"—as draftsmen—"not to reason why, ours but to do and die—onward the six hundred!"

There were other things about that job that got Steve's nanny, besides the one of nationality, which in itself made him feel daily that he had taken a somnolent trip across the ocean; and in due course of time he got fired. He wanted to get fired, and just naturally he got what he was after. He hated to quit, because the times at that time were hard. So he continued to draw in sharp detail on his drawings, sticking to his original convictions, and one day the hand of the general manager revealed itself, via the voice of the chief draftsman—woeful mixture of metaphor, is this—and he was given the gate. I am not sure, but I think that Steve thanked everybody, from the general manager down to Heinie, and sped for the gate and the glorious U. S. A., which left the department all-German.



Detail on drawings is necessary. I say that in a loud, bold, clear tone of voice; that is, it is necessary provided the organization wants to save money in the shop. An hour of a draftsman's time is worth two in the shop, or my figures are mixed. Taking the average draftsman's time at $30 a week (yes, times have changed; the average now in New York for a skilled man is $35), and taking the average machinist's time, to say nothing of the patternmaker's and the molder's, at 40c. per hour—well, figure it out for yourself. It certainly pays the establishment to show detail on its drawings—to make the story, clear, in a word; for thus is saved a lot of running around in circles on the part of mechanics at 40c. an hour. And running around in circles, as any executive will admit, of itself does not pay, since it contributes nothing toward getting out the machine. All it does is develop the muscles of the machinist's legs, when what is wanted is girth of chest and arms. Detail on drawings sure does pay, of itself.

Incidentally, I wish to say a word here relative to sticking to one's early training, if this training in later years proves to have been thorough. As a general rule, when you see a draftsman who turns out poor drawings, it is because he was started wrong, caught his first job of drafting under a man who himself made a poorly executed drawing, because he himself started in the game under a man who made a faulty drawing. It is something that goes on and on, like the water under a bridge. There is no need for a man's turning out a slipshod drawing, and certainly no excuse for it.

Steve had been brought up in a Government shop—a shop doing much Government work, that is—and in consequence he had been trained early in standards that are high. One of these standards was the showing of complete details, and therefore Steve really did not know how to make any other kind of drawing. That is to say, he knew how, but he refused to lower his standard for any general manager or chief draftsman, because it was clear to him that, if he once lowered his standard, he would continue to lower it—it is much easier to do hasty work lacking detail than the other kind—until eventually he would wake up to find himself the kind of draftsman he did not like around him, and getting paid their rate. So he stuck to his early methods and training, in the belief that if he failed to give satisfaction in a job because of these methods and training, it was the company's loss and that somewhere he would find the job where the kind of skilled work he was capable of was just the kind of drafting they were looking for and would pay for at commensurate rates per hour or day or week. Go and do thou, my brothers, likewise—stick to your guns, though the heavens fall.

Men capable of showing detail in fine, hard lines are scarce. Indeed, you can judge a draftsman by just that—the character that he gives to his lines. The man who does heavy black work, with a pencil that looks as if it had been sharpened with a pair of scissors by a lady or a school kid, reflects his ability as a draftsman the very first drawing he undertakes. So I say, if you have a high standard, stick to it; and if your style is a little coarse, develop it along fine lines. Use a HHHHH pencil for construction lines and a HHH or a HHHH for "penciling in." Also, keep your drawing paper clean.

All these things help in showing detail. Sharp lines are necessary when one is drawing a large machine on a small sheet of paper, where the scale required is a small one and where the work demands that nuts of bolts be shown. Further, keep a trigger point on the lead of your bow compass. Circles, especially in machine drawing, are more than half the drawing. Structural guys have little use for a compass, except for rivet holes, and these can be chased in freehand. I shall endeavor to talk about these alleged draftsmen some day, when the weather gets a little cooler and my ire can be held down to a comfortable temperature. For of all the kinds of draftsmen easing through life under assumed credits—

Another thing, it helps to make a drawing presentable if you will show fillets. Some there are who push fillets in freehand. Time pressing, this, of course, is forgivable. But freehand work on any drawing detracts from the appearance of the drawing; and five years from the date upon which the drawing was made, those looking at it—and perhaps admiring of it—will not know whether you consumed three hours or three weeks in getting the drawing out. You, as the draftsman who made that drawing, will be judged by what lies before the eyes of the critics. The element of time, once a drawing is cold, rarely comes into the consideration, when your work is judged by what it shows. So do not hesitate to take pains with your compass in tracing fillets, as in showing bolts and nuts.

There was once a draftsman in a large organization in western Pennsylvania whose work invariably was good—clear, bold lines, where clear bold lines were effective; fine, light lines, such as center lines and dotted lines, where these should have been. This man knew the value of contrast in his work. Indeed, though it was a large organization and there were many draftsmen employed, his drawings always were shown to newcomers as a sample of what the company wanted in the shape of drawings. Newcomers examining these sheets admired and copied, or else, being of another type of draftsman, produced their own good work and let it go at that. But the company had samples of the other kind of drafting also. These now and again would come under the eyes of the newcomers, and the lessons which this taught, showing both kinds of work, is obvious. Yet never was the element of time given toward the making of these two kinds of drawings mentioned. Nor was it thought of, in fact. One man evidently was a good man and the other was a slob, so thought the newcomers, probably.

As a matter of fact, however, the one draftsman was slow and the other was speedy, and each in his way had his values at the time of employment. And they always will have. But with neatness once cultivated, speed is only a matter of practice, and the combination of neatness and speed is worth attaining. It may not be generally known, but the desirable qualities in a draftsman are three, and in the order here given. I hope I have your attention. Accuracy, neatness, speed. There they are! You who lack them, or lack them in the order as set down, would do well to get after them, provided you want to shine in this brainiest of trades and dullest of professions.

Says Steve—Steve had just stepped in to see how I am making out with these articles—says Steve, falling into my easiest chair, after reading what I have written on this particular subject:

"You're a little rambling toward the last. Were you out last night or what? I know; you said all there was to say—and it's enough—when you cleared up about that general manager finding fault with detail on my drawing and then making the appalling discovery that the particular bit of detail as shown was not in accordance, as a piece of design, with that organization's shop procedure. When you say that you say all on this matter of showing detail on drawings. All other points—if there are any—are without import or value. What that general manager did, stumbling as he did over his own feet, as it were, is sufficient reason for any draftsman to show all the detail he knows about the thing on the drawing. Certainly he cannot do more, and surely he ought not to do less. The rest of your article is all right. Pull it to a close and come on out. I know a place where they are still selling German brew—and there hasn't been a keg of it brought into this country in three years! But, come on!"

Needless to say, I am reaching for my hat.

Truing Miller, Dividing-Head and Tail Centers

By William T. Slider

Our experience has always been similar to that of the editor, as on page 384, Vol. 46; that is, the tail center is always hard, and oftentimes the dividing-head center is also hard. But I believe we know a better way of truing these centers.

Our experience is that when a tempered or hardened piece of steel is turned with a tool it never turns true. The cutting tool will almost always ride over some spots of the hard piece being turned. We can cut tempered steel, but not so effectively as is required for a lathe or miller center.

For the dividing-head center we use just a soft sleeve, of either cast iron or steel, bored to fit the center to be ground. We chuck this sleeve in the universal grinder, truing it to within 0.002 or 0.003, or a little closer if it hapens to come that way readily. Then we just skim-grind the die inside and, while it is still chucked, insert the dividing-head center and grind in the usual way. The sleeve we can use many times; for as it becomes ground out too large, we simply turn off the mouth end. This change was in mind at the time of making the sleeve, so that we made allowances.

If on testing the center in the dividing head with an indicator, we find it shows out a little, we turn it to several different positions in the head until we find a place where it does run dead true. But if by this method we fail to get a true running center, we then scrape out the hole in the dividing head until the center when inserted runs true, the same as we would if we were lining up the centers in a lathe being built. It should not be necessary to scrape out the holes unless the machine has been roughly handled or the hole upset by using misfit centers or handling stock through it while using the die chuck.

Our procedure with a soft tailstock center in a miller is as follows: Take a small angle plate, and in one face of it plane a groove or keyway about midway between the two ends, so that when the angle plate is attached to the faceplate of a lathe the groove will lie to the faceplate. A hole should be drilled in the angle to the faceplate. A hole should be drilled in the angle plate in a position that will allow the adjusting lug of the tail center to protrude out of the way. The groove in the plate should be tested for parallelism and so made that the flat bottom of the tail center will fit closely into it, thus bringing the center square, but not central, both laterally and vertically in its relation to the miller.

The arc of the point of the tail center being only a little more than the half of a circle, there are but three points from which to indicate the point for setting it for grinding. Now move the angle plate on the faceplate until the tapered point of the center runs true, using the indicator on the largest available part of the taper and being sure to indicate it exactly laterally.

The vertical alignment is well provided for within the tailstock itself by the manner of its construction. In placing the tail center in position in the stock, using a test arbor to get the vertical alignment, it will be found that the centers are now in line.

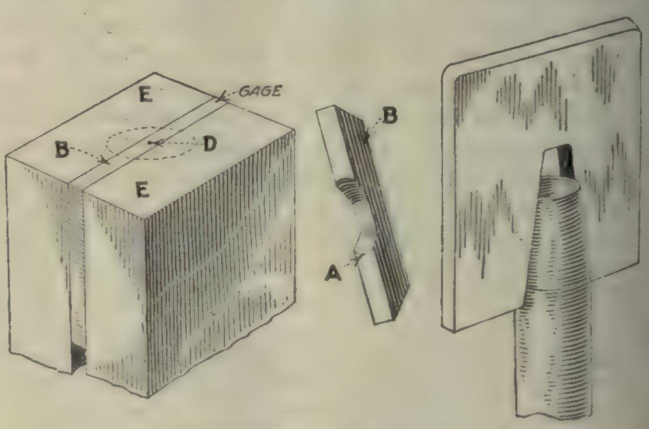
Unless the slots in the table are in a more nearly perfect condition than the general average and the keys on the bottom of the tailstock fit more closely than usual, the tailstock may still be bumped with a babbitt block a few thousandths either way, thereby permitting a perfect alignment. By perfect we mean practically perfect, not absolutely.

Cartridge-Punch Templet

By A. R. Whittle

The special micrometer for measuring cartridge tools shown on page 651, Vol. 46, is hardly necessary for the work for which it is intended. A simple and accurate gage for testing the formed ends of the punches is made as follows:

A piece of sheet steel about No. 14 B. & S. gage is cut to size, and the outline of the punch is scribed on it. The portion inside the lines is then cut out and the opening filed to size. In use, the gage is placed over the end of the punch to be formed and held to the light.



CARTRIDGE-PUNCH TEMPLET

If the punch has not been reduced enough, there will be a space between the end of the punch and the bottom of the gage. The punch is reduced until it touches the bottom of the gage, which should fit on without pressure. A more accurate method of making the gage is shown.

A reamer is made, the cutting end having the same form as the tapered end of the punch. A piece of sheet steel *B* is cut to a convenient size; one side is squared up, and a punch mark *D* is made in the center of the side. It is then clamped between two blocks of steel *E* and centered in a lathe chuck by means of the punch mark. A hole is drilled and bored out to nearly the finished size and finished with the reamer. The plate is then taken out of the chuck, and the radius *A* is just filed out.

Devices Used for Testing Typewriter Type—I

By FRANK A. STANLEY

SYNOPSIS—*The gages and special testing fixtures used in the inspection of typewriter type assure correct alignment of the type, correct position on the type bar, accurate fitting in the center guide of the typewriter and uniformity of line in the printing upon the typewritten sheet. The gaging devices are all of most ingenious design, and they are operated with facility to enable a large number of parts to be tested per day in each fixture.*

IN recent articles in these columns the methods of the Noiseless Typewriter Co., Middletown, Conn., in making its type were illustrated quite fully, up to the point of testing the type and assembling it on the type bars. The present article shows some of the equipment and high-grade methods utilized in the various testing processes in the inspection department and type-making shop by means of which accuracy in the type is assured.

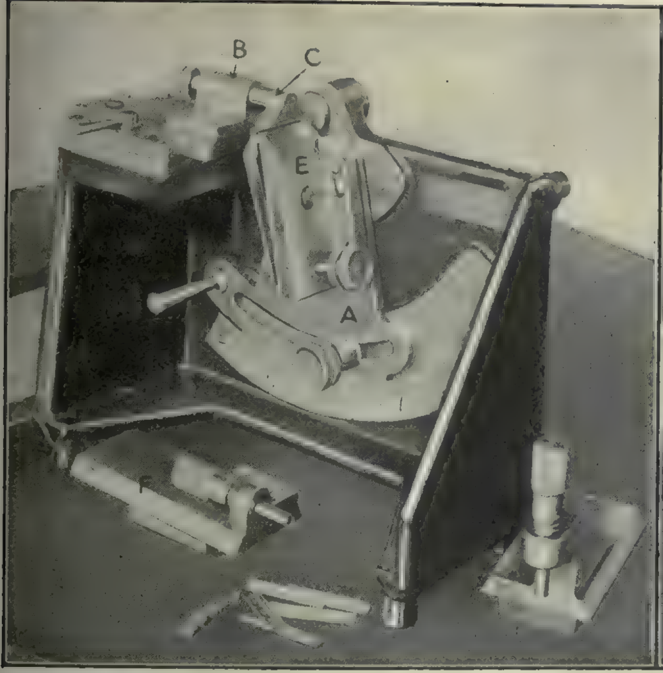


FIG. 1. TESTING FOR ACCURACY IN MILLING

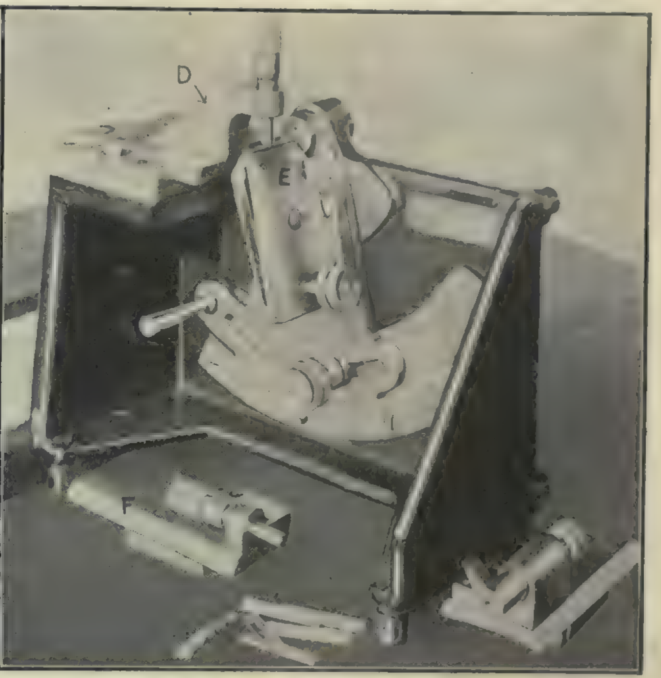


FIG. 2. METHOD OF USING THE MICROMETER

In the production of type of this character there are a number of requirements to be kept ever in mind, and the accuracy can be checked only by most precise inspection methods. For example, it is essential that the center of the type characters be on the exact center line of the type bar. It is equally important that each of the three characters on the type be correctly spaced, one above the other and an exact distance above the bottom of the type bar The body of the type must have a definite thickness or a definite offset from the edge; the top and bottom shoulders on the type body must be to exact thickness in order to fill the center guide on the machine and assure alignment at the point of printing. Then, too, the faces of the type must be dead flat—that is, in the same vertical plane—to assure uniformity in printing. These are some of the important points that must be kept in mind in passing the type through the shop preparatory to assembling in the machines.

The processes and tools used in milling the sides of the type bodies, in finishing the shoulder to definite distance from the face of the type, in grinding the type body accurately to assure its proper fitting in the center guide on the typewriter and in certain other machining operations have been fully described, so that the use of the various gaging devices for checking up the accuracy of these shop operations will be of special interest in this connection.

Figs. 1, 2 and 3 illustrate clearly an ingeniously designed device for testing the accuracy of the type from three different points. The first test—that in Fig. 1—is to determine if the milling of the shoulder and body has been accurately performed and if the sides are central with the center line of the type bar, to which it is later to be attached. The test here is made by swinging the holding plate *A* to the desired angle, as indicated by graduations and letters on the arc, which is shown more clearly in Fig. 3. Then the gaging head *B* is moved into certain positions in the guide at the left-hand side of the fixture and swung down the gage blade *C*, to determine if the locating mark (the cross-lines on the face of the type) coincide exactly with a setting line scribed on the sloping face of the blade *C*.

This assures absolute alignment when the vertical cross-line on the locating cross on the type coincides with the inspection line on the blade *C*. To determine that this is in true alignment, the inspector works with an eyeglass, as the slightest deviation here from the center means that there will be improper spacing of the letters when printed on the paper in the typewriter. That is, the character will be too far to the right or too far to the left, and it is surprising what a slight inaccuracy in this spacing will produce results unsatisfactory to the eye when the typewritten characters appear on the printed sheet. Any deviation in this respect is only slightly less objectionable to the eye than irregularity in alignment up and down, where even a thousandth of an inch is quite conspicuous to the keen observer studying the printing characters for inaccuracies of alignment. The next step is to apply a test of the accuracy of the milling of the shoulder at the bottom of the type. This shoulder must be an exact thickness measured from the face of the printing character. In the gaging device illustrated the testing process is performed by sliding the micrometer block *D*, Figs. 2 and 3, into place. The first view, Fig. 2, shows the application of the micrometer clearly. In this test, as in the others, the type rests with its shoulder against the body of the holding fixture *E*, where it is clamped securely by operation of the knurled-head screw, which, pressing against the under side of the clamp at the left, throws the jaw of this clamp tight against the outer side of the type body. The micrometer spindle is then run down in contact with the type characters and the measurements noted. In this test a limit of 0.002 in. either high or low is permissible, as there is fully $\frac{1}{32}$-in. adjustment in the brackets that carry the type-bar operating mechanism. Consequently, the type bar may be moved forward or back in the assembling process to compensate for any slight difference from standard in the height of the printing face of the type from the back of the shoulders. It is of interest to point out, however, that in the process of manufacture of the type, particularly in the finishing up of the shoulder,

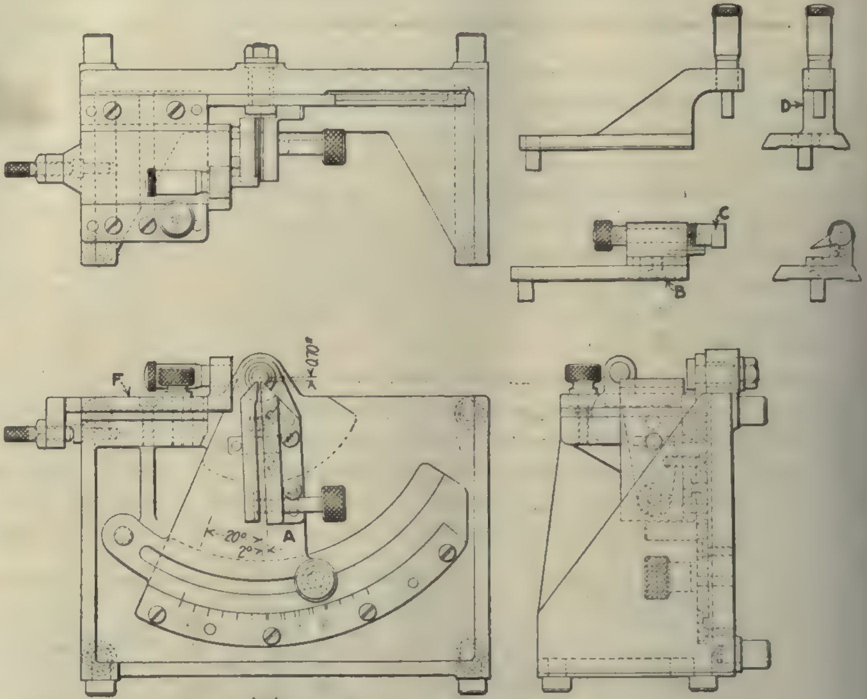


FIG. 3. DETAILS OF THE TESTING FIXTURE

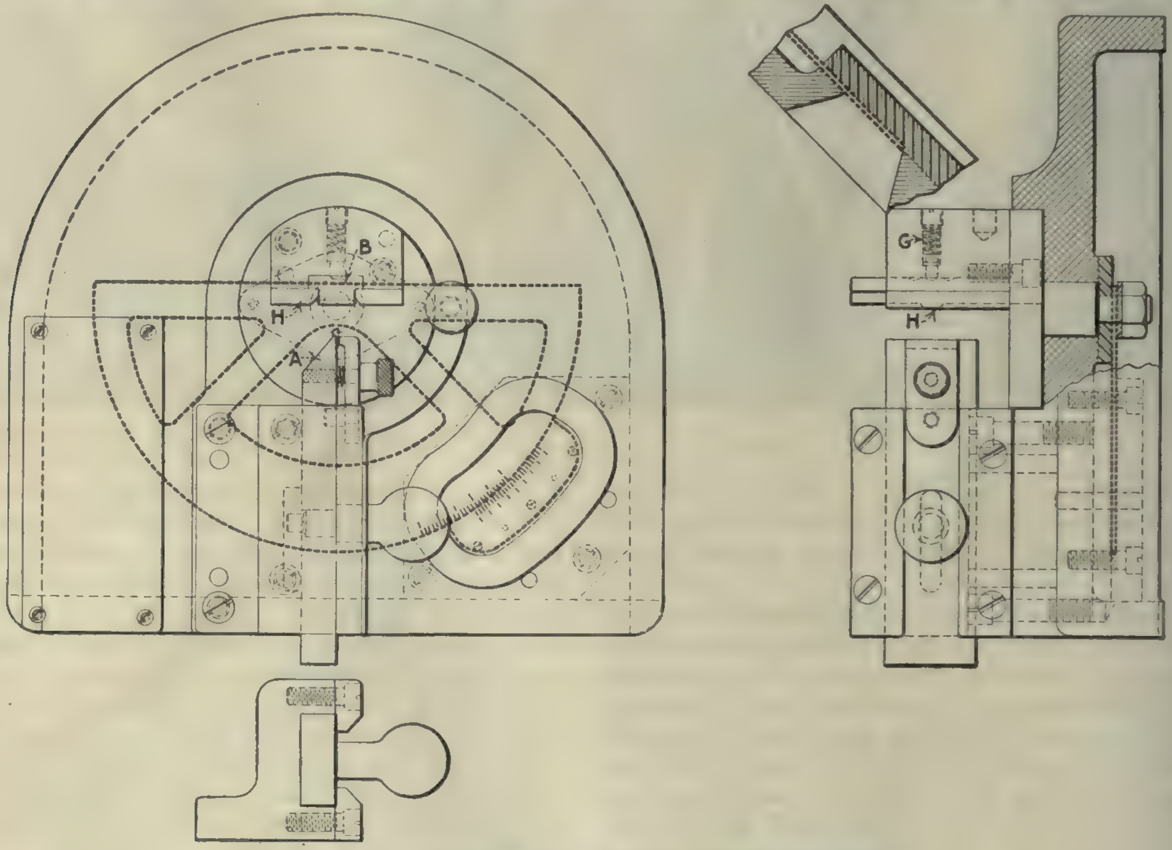


FIG. 5. DETAILS OF THE PRINTING-TEST FIXTURE

such accuracy is maintained with the aid of the fixtures utilized that in the testing process under this micrometer spindle little deviation from normal thickness is ever discovered. And in the assembling process not more than a 0.002-in. adjustment is ever required to position the brackets and the type-carrying mechanism properly for uniformity of printing, as compared with the rest of the type in the machine. While, as previously stated, fully $\frac{1}{32}$-in. leeway could be permitted in this dimension, only a small portion of this is ever made use of.

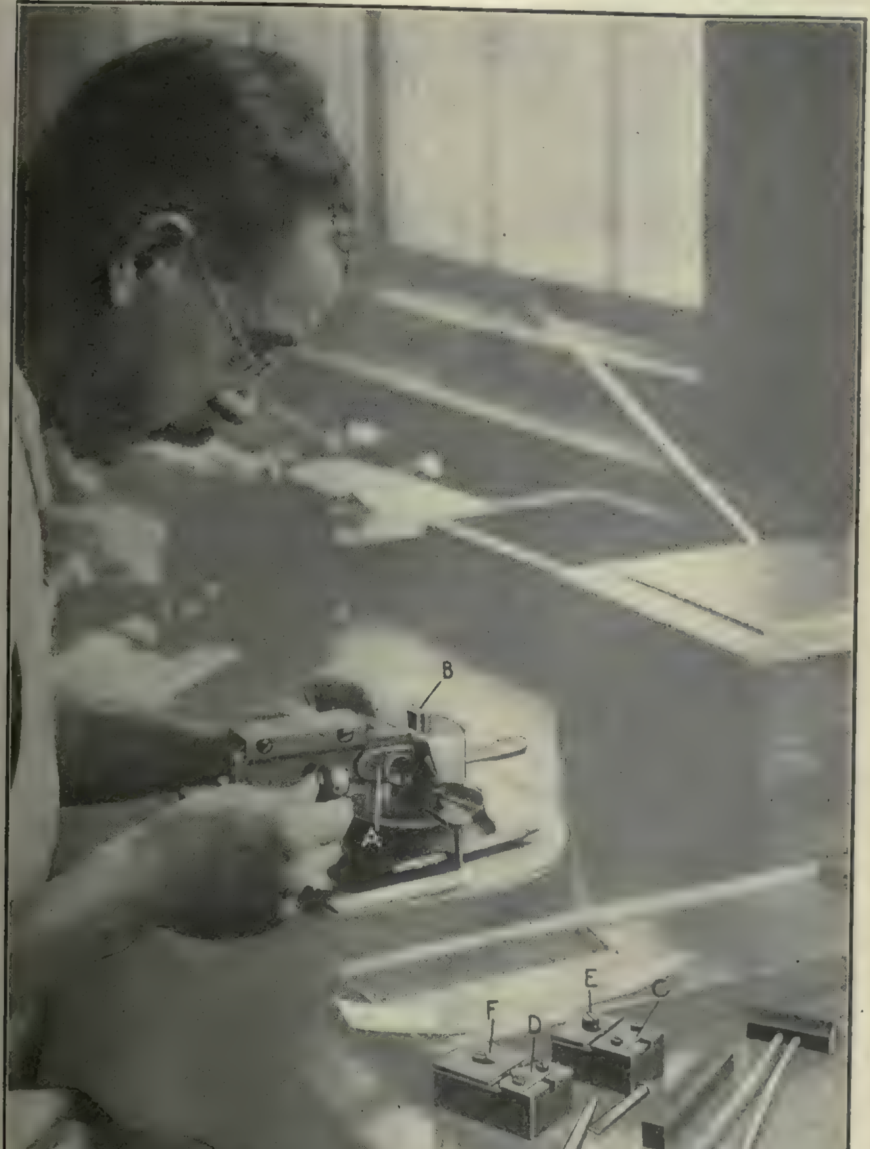


FIG. 4. TESTING TYPE FOR PRINTING QUALITY

This degree of accuracy as maintained in the production of type is also the feature of the type bar itself, so that accurate results in type-making processes are not nullified by inaccuracies of the bar that carries the type. Reference to the testing of the bars themselves will be made a little later on.

The third test of the type and the fixture in Figs. 1, 2 and 3 is made, as shown in the latter view, with the micrometer block *F*. This tests the thickness of type on the center line. The micrometer gage is fitted into the fixture against a hardened stop, and the reading of the micrometer determines the distance from the center line to the face of the body in accordance with the table laid out, which gives the thickness of every type used in this machine.

As already pointed out, owing to the fact that the type slide into the printing guide at various angles (due to the radial disposition on the typewriter), there is a corresponding difference in the thickness in the type bodies in order that each and every one of them shall fit in the printing guide. Therefore each type is measured by the micrometer reading to determine if the distance from center line to working face is in accordance with the schedule of dimensions. Fig. 3 shows the general features of this gage very clearly, particularly with respect to the graduated arc by which the holding attachment is adjusted to the desired angle for each of the letters in the alphabet. These graduations, it will be noticed, are not designated in degrees, but opposite each is stamped the character to which the gage must be set when the type for that particular character is suggested. The making of this gage with the three special testing devices that slide into the top block is a work which any tool maker may appreciate. Like many other devices of similar character, photographic reproductions can do little more than suggest the accuracy employed in the making of the tool itself. One little feature in detail is shown in Fig. 3, in the knurled-head clamping screw by which the micrometer blocks are secured in place when slid against the stock. This clamp, as will be seen, consists of a shoe with sloping face corresponding to the guide surface of the micrometer slide, and underneath this is a sensitive compression spring which, when the knurled-head screw is released, lifts the clamping screw sufficiently to clear the edge of the micrometer body. The clamp jaws themselves for holding the type can be easily operated in that the forward end of the clamp is thrown up by a spiral compression spring when the knurled-head screw is turned back to open the jaws, and thus the placing and removal of the work are accomplished with ease.

An interesting little detail on the lining gage *B* is the spring and stop pin. The former, wound around the body of the gage wing *C*, throws this wing upward to clear the type face normally when the type is slipped into the jaws of the work-holding fixture. The spring is sensitive and presents resistance to the fingers when the knurled end of the spindle is grasped to turn the gaging wing down upon the face of the type to see if the locating crossmarks coincide with the gaging line on *C*. At the same time this spring tension is just sufficient to return the wing to normal position, where it clears the type which is to be removed and the next type to be put in place.

Reference has been made in an earlier article on this type work to the hardening process, in which several hundreds of the type are treated at once in a cyanide bath. After the type have been hardened, they are tested to see if the body requires straightening and to check the accuracy of the printing of the three characters upon the face of each type. Two methods of handling this operation are shown in Figs. 4 and 5.

Using the gaging device here illustrated, the inspector picks up one of the hardened type, places it in the clamped jaw *A* and presses it against a piece of carbon copying paper resting on a slip of white paper that backs up against the block *B*. This shows at once if the face of the type is hollow or convex, or if one side of any character is high or low enough to cause the printing to show lack of uniformity and inequality of pressure all around the type line. The inspector has at his right two blocks, *C* and *D*, Fig. 4, which he uses for straightening purposes. If he finds the type slightly convex, or if it should be bent the other way, he puts it in one of the blocks, according to whether concave or convex, and then strikes the backing block *E* or *F* a slight blow with the copper hammer shown on the bench, to straighten the face of the type.

REQUIREMENTS IN REGARD TO TYPE

The type should be flat—top, bottom and middle—that is, along the face of the three characters. But if it is a trifle hollow, say less than 0.00025 in., it will be entirely satisfactory. It must not be convex, however, even to a fraction of a thousandth.

The inspector working on this fixture and doing the straightening of the type is so accustomed to the process that, as is usually the case in work of this nature, he handles the work with great rapidity.

An examination of Fig. 5 shows that the fixture for the printing test has, at the left-hand side, a plate giving the angular setting for every one of the type characters. These settings are made to the vernier at the right, and they supply the test not only of the flatness of the face of the type, but also of the accuracy of the angular milling. It is this milling by which the type must be located on its bar when the device is set around to the necessary angle—that is, to the angle at which the corresponding type bar will be operated when assembled in the typewriter.

As with other fixtures illustrated, the work holder is here operated mainly by the knurled-head screw, which passes through the loose jaw, and by the compression spring, which when released throws the jaw open sufficiently to allow the work to be readily removed and replaced. The work-holding slide is operated to and fro by the knob at the right, which is grasped in the inspector's fingers, and all the pieces requiring adjustment are readily attended to. The vertical block *B*, which corresponds to the printing platen of the typewriter in relation to the face of the type, is adjusted up and down in reference to the spring detent *G*. This holds it as required at any one of three positions, so that the backing face or platen surface *H* is opposite the top, bottom or the middle of the type bar for testing any one of the three characters formed thereon.

Standardizing Symbols for Screw-Thread Notation and Formulas

The Bureau of Standards is considering the symbols given below for use in its work on the standardization of screw-thread gages. In proposing the particular letters given, several points have been in mind, such as the use of symbols which can be found on the ordinary typewriter and the consistent use of large and small letters.

An attempt has been made to use the large and small letters in a systematic manner which will give the best results. In computations and development formulas, it is generally most convenient to use the radii of the various elements of the screw, while in using the formula it is generally more convenient to use the corresponding diameter. It has therefore seemed desirable to provide symbols for both the diameter and radii, and this has been done by using the large letters for the diameter and the corresponding small letters for the radii.

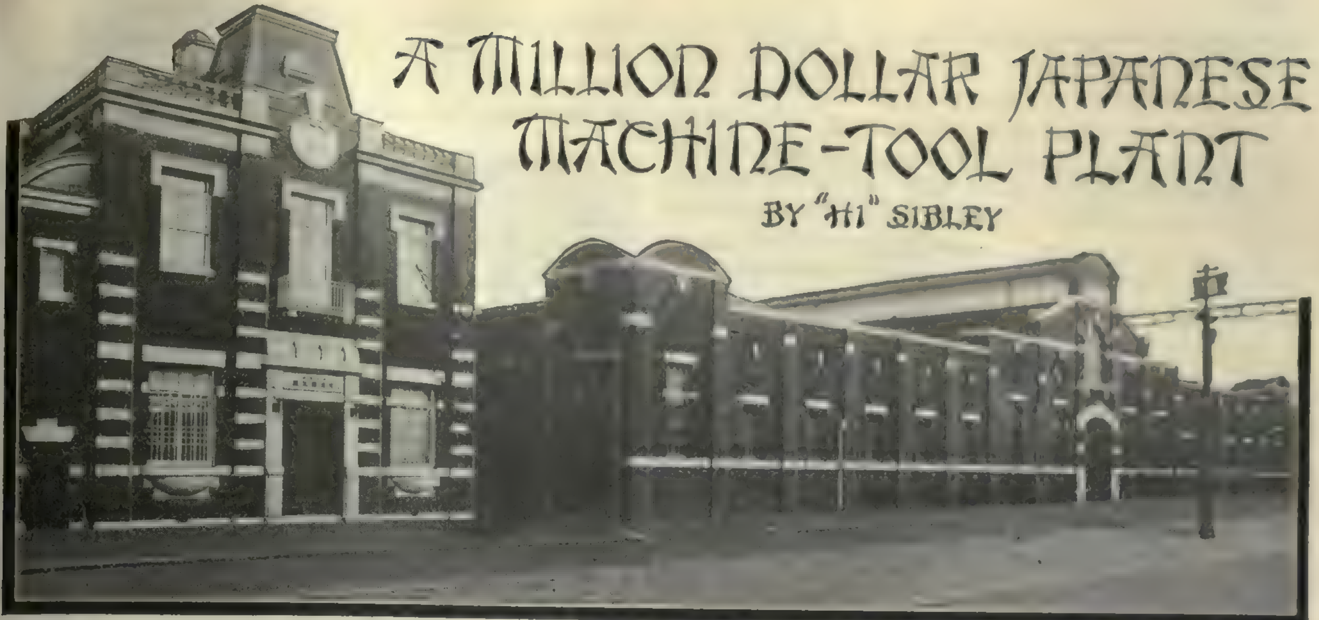
With a few exceptions, the capital letter has been used to indicate the largest quantities and the small, or lower-case, letter the corresponding smaller quantities. This has not been done in the case of the letter "N," as it was thought best to have the upper-case "N" a reciprocal of the upper-case "T," and similarly with the lower-case "n" and "t." The Bureau will be very glad of constructive criticisms and suggestions from those who are experienced and interested in this subject. The symbols follow:

Symbols for Screw-Thread Formulas

Full, or outside diameter	D
(Corresponding radius)	d
Pitch or effective diameter	E
(Corresponding radius)	e
Core diameter	K
(Corresponding radius)	k
Angle of the thread	A
(For half the angle)	a
Number of turns per inch	N
Number of threads per inch	n
Lead	$P = \frac{1}{N}$
Thread interval	$p = \frac{1}{n}$
Helix angle	s
Tangent of the helix angle	S
Width of flat at top and bottom	F
Distance from the flat to point that would be formed if sharp V-thread were used	f
Depth or height of sharp V	H
Depth or height of thread	h

Regarding Wire Measurements

Measurement over wires	M
Diameter of wire	G
(Corresponding radius)	g
Radius of curvature (Whitworth crest and root)	c



A MILLION DOLLAR JAPANESE MACHINE-TOOL PLANT

BY "HI" SIBLEY

TWENTY-SEVEN years ago S. Ikegai, president of the Ikegai Iron Works, Ltd., of Tokyo, Japan, was engaged, in a small way, in the manufacture of marine engines. Fishing being one of Japan's principal industries, this business became a lucrative and a growing one, and Mr. Ikegai was frequently obliged to enlarge his shop and buy additional equipment.

The cost of such machines as he required, imported from America or England, meant a considerable outlay for so small an institution, and Mr. Ikegai concluded that he could build his own lathes, at least, and set out to make one as an experiment. Considering the crude tools available and his somewhat superficial knowledge of what he intended to make, the first lathe was a creditable piece of work. Improved models followed. These he installed in his own shop, and their performance being satisfactory, orders began to come in from other establishments.

The future in machine tools began to look promising. Mr. Ikegai invited a number of his relatives to join him in the new enterprise, and they prepared to make lathes and other machine tools on an extensive scale. The Ikegai Iron Works, Ltd., is today the largest concern of its kind in Japan, and incidentally it is the most progressive and has the most modern shops. American methods are adopted as closely as is compatible with local working conditions, and the casual impression the American visitor receives is much the same, in general, as he would receive in a plant of that size at home.

Briefly, the concern is a family institution, all stock being owned by Mr. Ikegai and his immediate family. It is capitalized at 2,000,000 yen ($1,000,000) and has an annual output of about 2,200,000 yen. There are two plants, one devoted to marine-engine manufacture and the larger one exclusively to machine tools. The latter shops cover a floor space of about 40,000 feet, exclusive of the foundry.

A comprehensive line is manufactured, including several styles of light and heavy lathes, drilling machines, boring machines, millers, gear hobbers, turning mills, shapers, planers, slotters, keyway cutters and centering machines. As in America, the European War has given a great impetus to the machine-tool industry in Japan, and the entire output of the Ikegai Works has gone to the Japanese and Russian Governments. A recent government order from Russia called for 800 American-type lathes, 20 in. by 8 ft. The demand for marine engines has likewise greatly increased the output of that department, where 600 four-cylinder motors of 30 horsepower are being built. In addition to the foregoing a line of milling cutters and reamers is made, but at present all this output is being consumed in their own shop.

There are so many obstacles to be overcome in building machine tools in Japan, even a fairly satisfactory machine tool, that the Ikegai Works deserve especial credit. A high-grade machine tool (according to American standards) of Japanese manufacture is rarely encountered. Even the engineers of the Ikegai Works candidly admit that their product is not the equal of the average American machine tool in point of workmanship and efficiency. But quality is only comparative, and so we say the Ikegai Works deserve great credit.

FIG. 1. THE ANCIENT AND MODERN ARE COMBINED IN JAPAN'S MACHINE SHOPS

In many other plants it happens, unfortunately, that the principal stockholders are merely investors and not engineers. They cannot understand why a plant should be equipped with expensive, imported machines when Japanese-built equipment, which is essentially the same in appearance and operation, can be purchased for half the amount. And it may be said here that thrift is a most prominent Japanese characteristic.

MACHINE-SHOP EQUIPMENT*

170 Engine Lathes—Bradford, Pratt & Whitney, Lodge & Shipley, Gisholt and own make.
15 Planers—1 American Tool Works, 3 Cincinnati, others own make.
32 Drilling Machines—1 W. F. & J. Barnes horizontal radial, 7 W. F. & J. Barnes upright, others Alfred Herbert, Ltd., and own make.
11 Boring Machines—Asquith Engineering Works and own make.
41 (?) Millers—1 Pratt & Whitney thread miller, 6 Brown & Sharpe, 1 Cincinnati, others own make.
36 Grinding Machines—3 large Landis plain grinders, 3 small Brown & Sharpe plain grinders, 1 Milton Universal, 1 Bath, 1 Heald internal, 1 Sells drill grinder, 1 Universal tool grinder, others Brown & Sharpe, Pratt & Whitney and Knowlton; 1 Blodgett vertical surface grinder.
6 Gear Cutters—1 Gould & Eberhardt gear hobber, 2 Brown & Sharpe screw machines, 1 Cleveland automatic, 1 Garvin, 1 Ferro gear shaper, 1 Gleason.
23 Screw Machines—1 Acme combination flat turret, 7 Brown & Sharpe screw machines, 1 Cleveland automatic, 1 Garvin, 1 Warner & Swasey, 2 Brown & Sharpe automatics.
19 Shapers.
7 Slotters.
11 Miscellaneous—1 Ludwig Loewe backing off lathe, 1 Pratt & Whitney measuring machine, 1 testing machine, 1 Lee-Simplex cold saw.

Some confusion is caused by use of the French metric thread in government arsenals, although a change to the more universally used Whitworth thread is contemplated.

The wide variation in electric current in different parts of Japan limits the use of electrically driven tools. The currents are:

Government railways	A.C., 440-25 cycle
Naval arsenals	D.C., 220
Osaka and Kobe	A.C., 220-60 cycle
Tokyo	A.C., 220-50 cycle

Foundry Equipment—4 cupolas, total capacity 10 tons daily; 1 ten-ton electric crane of Japanese make, and hand hoists; 1 small Curtis air compressor with Japanese-make sand-blast apparatus.

No tumbling barrels are in use, as they are comparatively new in Japan.

*The figures are given by the Ikegai Iron Works, but they do not seem to tally.

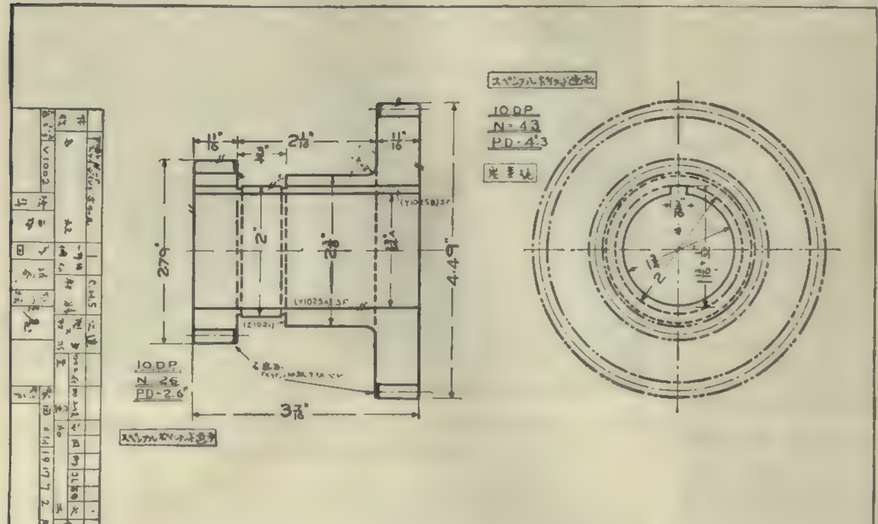


FIG. 2. FACSIMILE OF A JAPANESE WORKING DRAWING

Another important item is the Japanese mechanic. It must be remembered that the machinist trade is a comparatively new one in this country; there is no local precedent to follow. Whatever the Japanese machinist has learned in the way of new things is from foreigners, and often he does not grasp the basic principle of an operation. He is imitative rather than creative; he is clever in this way, but could not be called ingenious or inventive. Saito Man, a prominent Japanese writer, himself admits that "for energy or practical talents he (the average Japanese) cannot hold a candle to the American."

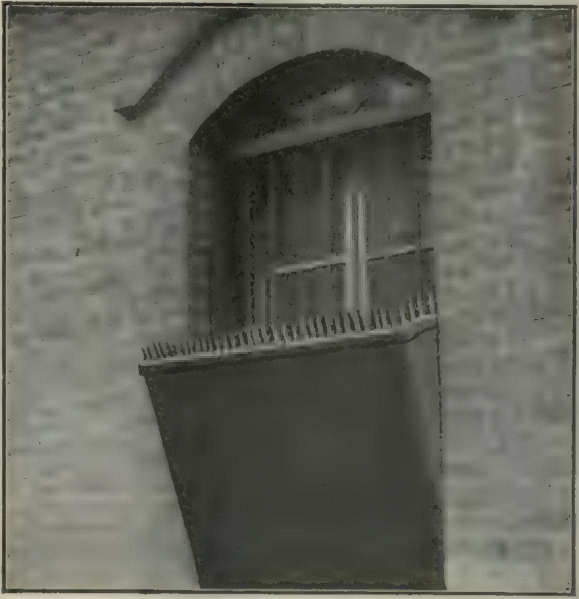


FIG. 3. TYPE OF WINDOW SCREEN COMMON IN JAPANESE MACHINE SHOPS

Foreign employers of Japanese labor agree on this point—that the native is a tireless worker, putting in 15 hours a day for months in succession without complaint—but in efficiency he is far below the standard set by America. His progress is measured by Japanese standards, and while Japan is advancing in modern civilization at a greater comparative rate than any other nation, it must be borne in mind that she has been open to the influence of European civilization less than sixty years, and many medieval customs still obtain there. That is the present status of the Japanese mechanic; but with his inherent native aggressiveness and ambition, he is some day going to compete with our most skilled workmen, and that day is not very far off. At the Ikegai Works a 10-hour day is in force, including Saturdays, but on the numerous national holidays the plant closes down. The workers are paid off every night, the foremen receiving about $50 per month, the machinists 60c. per day, and the unskilled or coolie labor about 30c. per day. The cost of living in Japan, however, has not advanced during the war in anywhere near the proportion that it has in other countries, and with his simple needs the worker finds his wages more in keeping with his scale of living than does the American. The diet of the native is almost entirely rice, fish and vegetable foods, without variation year in and year out, and meat is rarely eaten by the working classes.

As might be expected, manufacturing as we know it in America is not carried on extensively. Jigs are almost unknown, and the machinist works from a blueprint mounted on the machine, with the dimensions in both English figures and Japanese characters, and is constantly under the eye of a vigilant foreman. In the assembling room there is a considerable amount of fitting of parts. The finished machines, however, present a creditable appearance, everything considered, and to the layman might be of American make with the exception of the nameplate, for they are exact copies of American machines in some cases.

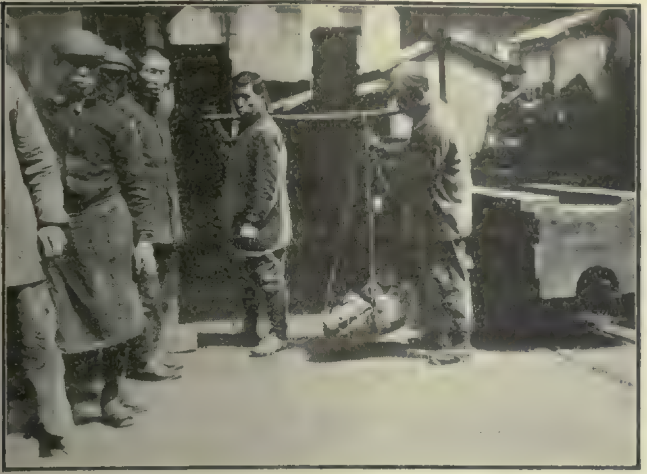


FIG. 5. A JAPANESE "TRAVELING CRANE"

The two Ikegai foundries employ 350 and 400 men respectively, 200 of whom are molders. Molding is a much old trade in Japan than is that of the machinist, and is a family trade so to speak, for the sons succeed the father. This is a custom in other old and established trades in Japan. The molders receive from 40 to 45c. per day, and turn out very nice castings, although they are not adept at some of the intricate work produced in American automobile-engine plants, which requires difficult core work.

Much of the molding, even on smaller work, is done in the foundry floor, and no molding machines are in use at this plant.

A satisfactory grade of molding sand, taken from pits just outside of Tokyo, is used in every foundry in Japan, but a large proportion of the pig iron has been imported, principally from China. This latter has become a tremendous item to the foundryman, for starting at about $50 a ton on April 1, it has advanced every few days until at the present writing it stands at $75.50 a ton (according to figures given by the Ikegai Iron Works), with the prospect of going still higher. Many of the metal trades have been seriously affected by the delay in shipments of all imports, owing to the excessive demand for steamship space, particularly on the transpacific lines. One manufacturer allows seven months for delivery from stock of an American machine and some raw material.

The Ikegai Works, being pioneers in machine-tool manufacture, and with engineers in charge who are alert to the necessity of modern machines, American methods and efficiency in competing with foreign trade, will no doubt continue to set the precedent for all other Japanese machine-tool manufacturers for many years to come. They deserve the greatest credit.

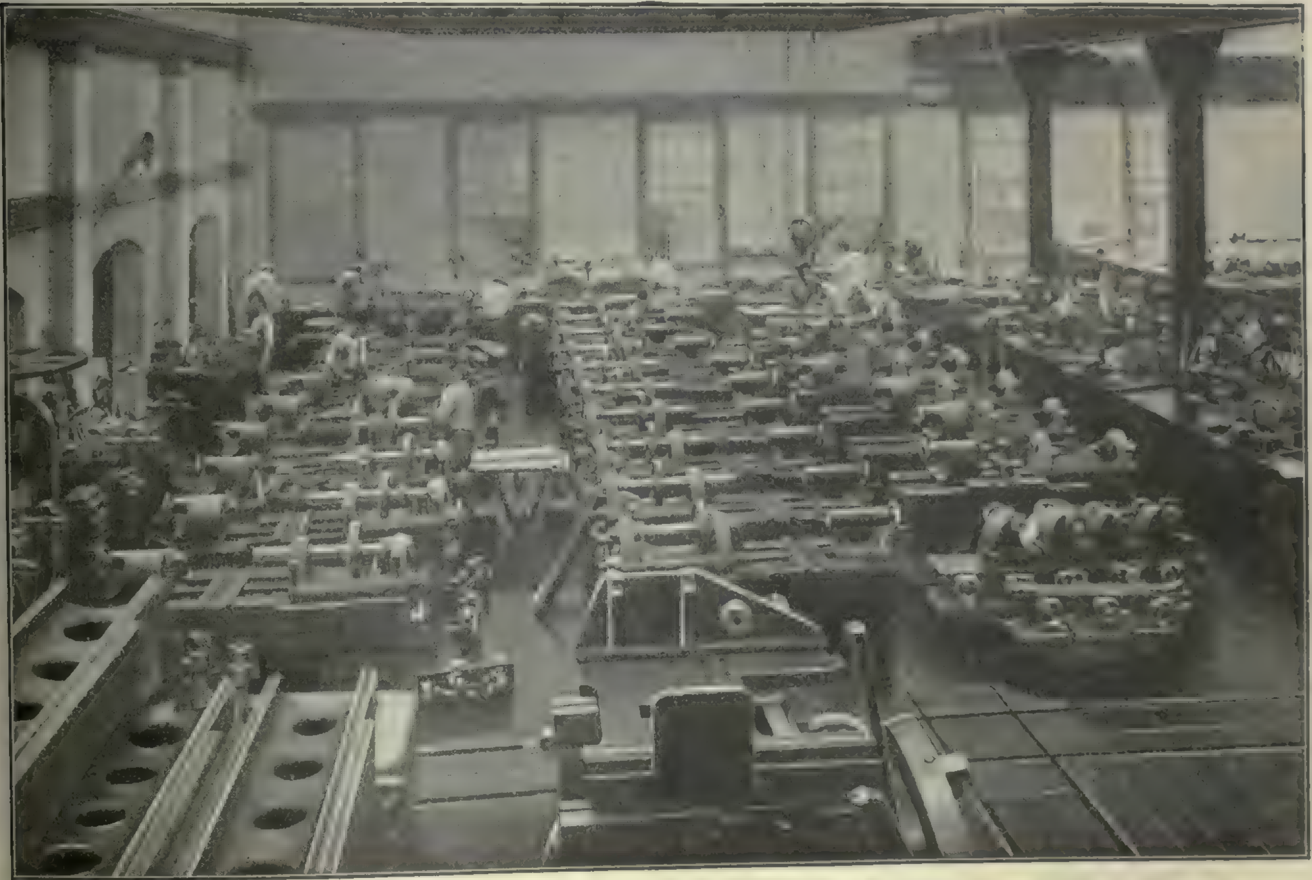


FIG. 4. VIEW OF THE LATHE-ERECTING DEPARTMENT

Why Force Us To Speak a Foreign Language?

By J. P. BROPHY

Vice President and General Manager, Cleveland Automatic Machine Co.

SYNOPSIS—*Here is the practical manufacturer's viewpoint on the attempt to foist the metric system upon American industries. Mr. Brophy, like other men who realize industrial conditions and human limitations, finds it difficult to conceive a sensible motive back of the metric movement. Perhaps the impractical theorism of the attempt to make us speak a foreign trade language is best illustrated in the recent recommendation of the metric propagandists to make all our munitions immediately to metric measurements!*

A QUESTION of extraordinary importance, which should claim the attention of all manufacturers in America, is the possibility of a law being enacted in this country forcing us to adopt the metric system of measurement.

Why our Government should interest itself to the extent of forcing such a measure through Congress, is beyond the writer's comprehension. I should imagine that those who have it within their power to enact laws would study carefully the complaints from those who would be affected, and I will venture to say that among business men and manufacturers in the United States there are few indeed who are asking for the adoption of the metric system. If a vote was taken among the men who form the backbone of industrial America, as to the adoption of this system, I will venture to say that 99 per cent. of them would be against it.

Simply because some other countries use the metric system is no reason why we should depart from our standard of measurement. There certainly is nothing complex, as far as we are concerned, in dealing with one another or those abroad, because of our present method of measurement.

EXPENSE INVOLVED

There would be an enormous expense in changing from one system to another; and the immensity of the whole proposition in educating even the most skilled men in the use of the metric system would be a problem of such magnitude that those who are not actually in the manufacturing business, where measurements of all kinds have to be accurate, would not have the slightest idea of the disaster this change would bring to thousands of our American factories.

Another important thing is that in any plant of any size all the drawings and tools of every description, marked as we measure today, would have to be changed. Also, before this system could be properly installed in any plant, the blunders from wrong measurements would be extensive and the cost would be extremely great.

If the company of which I happen to be manager is forced to adopt the metric system, I believe it would be just about as much of a task to get it into operation as it would be to start a new line of business—a task that frequently takes many years. There would be no end of turmoil and mistakes and a great loss the first year, at least in the slowing up of the actual production of our plant. The men in charge would have to be thoroughly educated as to what this system means, getting this into their minds thoroughly before attempting to make use of it in any place of business.

It would unquestionably require a great increase in the number of supervisors for a long time in order to avoid dangerous mistakes. This would mean nothing but trouble and expense; and when you are through with it, what have you gained?

Those who have anything to do with manufacturing plants are well aware of what bringing out a new machine means (or even a slight change in design), what an expensive thing it is actually to educate your men to become familiar with the different operations. This is something with which we all have to contend constantly.

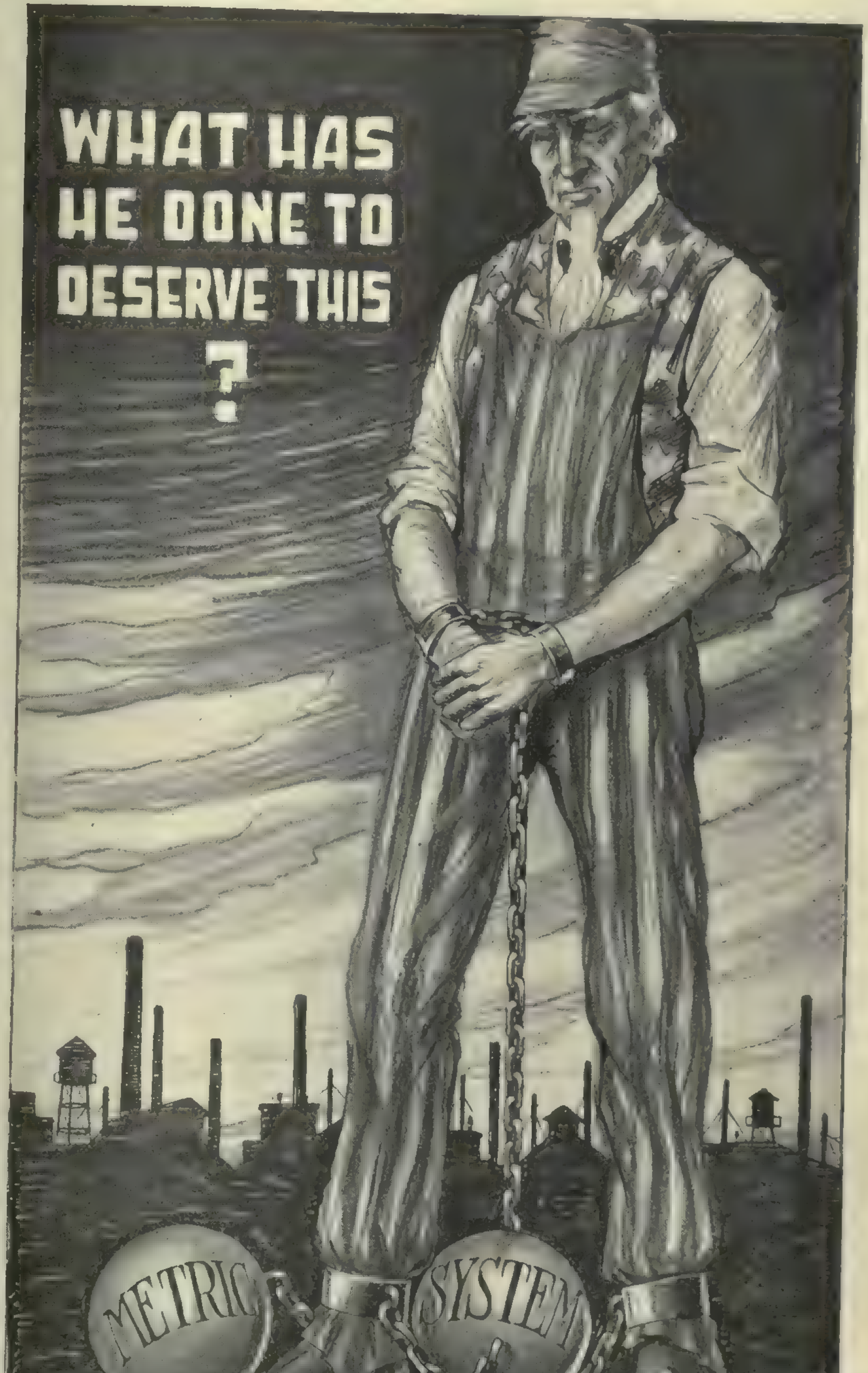
EDUCATING THE WORKMEN

To change all the measuring instruments in any large factory and educate the men who are using the present method of measurement, so they will be as proficient as they are today, is a mighty big undertaking. If you could start some business right from the bottom, using the metric system, educating your men slowly and adding to your force from time to time to enable you to teach them all the use of the metric system, it would be much easier; but how can this be accomplished where hundreds of mechanics are now employed? Attempting to introduce something so radically different from that now used would be detrimental to a vast multitude, and the loss would be actually staggering to contemplate.

In the very beginning, in changing from one system of measurement to another, great precaution has to be exercised in the drafting-rooms, as it takes some time to educate the draftsmen to produce drawings with the metric measurement system; and if you have a good-sized factory and a large number of tracings used in your business, imagine the task ahead of you in altering all these drawings, thousands of them perhaps, or in making new ones.

Anyone in a business requiring a large number of drawings will understand exactly what this means. You cannot gradually work into it, for the reason that you would have a regular mix-up from one end to the other. You will have to start in with these drawings complete in every respect.

It might be possible to educate your apprentices when they commence to work for you, as to the use of this system. It would be a regular schooling for them, and they would grasp, without doubt, the metric system of measurement about as well as they would the present standard of measurement. But how are you going to have drawings the apprentices are using mixed up with your regular drawings of today and do away with confusion and mistakes? This seems to the writer another impossibility—that is, if your plant is going to keep on showing earnings at the end of the year. Certainly, none of us care to start something that is going to


WHAT HAS
HE DONE TO
DESERVE THIS
?
METRIC
SYSTEM
H. P. PALMER · XVII ·

wipe out our profits for 12 months or more, and this is just what will undoubtedly happen to many of us if we attempt to use the metric system.

I cannot fully grasp why we should be forced to do something that is going to upset all our calculations from a business standpoint.

Did it ever occur to you that in changing to the metric system of weights and measurements you reach the very vitals of all business in this country from the smallest to the greatest? It certainly is a momentous question. The matter of weights itself is certainly a bothersome one. We should have to study this new way of doing things, and it would be almost as difficult for many as it would be to ask us to change our language and speak in the Chinese dialect. Perhaps this may seem exaggerated, but it is really not far from the truth.

Is there any necessity for us, at this late date, regardless of what may be done abroad, to attempt such drastic changes on something with which millions of our people are now thoroughly acquainted—that is, our present system of measures and weights, etc.?

Remember, when we are called upon to read drawings and specifications in the metric system of measurements for those abroad, with whom we may be doing business, this is accomplished with ease; and no complications whatever arise from this source, for the reason that a few of the leading men in nearly every company of importance that does business abroad have educated themselves so as to understand the metric system quite thoroughly. The English system of measurement is also well understood by nearly all foreign companies, as the leading mechanical men of all nations have educated themselves in this respect. This means that no complications arise at this time to call for this radical change, as far as business abroad is concerned.

Why do we want to demoralize our business by changing to a new system, because a few theorists claim we are not up to date if we do not adopt this system? We had better be out of date than to change to something that means damage to this country—losses that are bound to remain with us for many years.

If we are compelled to adopt this system, I will venture to say that it will be the next generation rather than this one before the system is absolutely established so all the people of this country understand it thoroughly. If the metric system was forced upon us tomorrow, it would be one of the greatest tangles the American people have ever had to contend with. It is almost ridiculous to think about, and still we have men of importance who make our laws who have failed to realize what a burden this would mean to the citizens of this country.

Henry Le Chatelier on Some Unsolved Problems in Heat-Treatment

By E. P. Buffet

Henry Le Châtelier, the veteran French steel metallurgist, has recently pointed out to the Academy of Sciences some scientific problems that might well engage the attention of industrial-research men. Passing over one relating to glass manufacture, we come to the following:

Metallurgy—Piercing projectiles for naval use demand a very hard point to go through carburized armor plate. In order to control their manufacture, there must be some means of measuring the hardness of hardened steel. But we have no reliable one at the present time. The Shore scleroscope utilizes the rebound of a little steel projectile ending in a diamond point. But the results are not regular. They depend not only upon the hardness, but upon various other elementary factors, notably the shape of the pieces hit. It would be very important to study the laws of concussion of elastic bodies. In this connection we are still at the point where we were brought and left by Leonardo de Vinci. The rebound averages three-quarters the height of fall, varying between 60 and 90 per cent. of it. Calculation combined with experiment would no doubt rapidly increase our knowledge so as to define certain conditions under which the rebound would depend only upon the superficial hardness of the body struck by the falling weight.

Pyrometry—The measurement of high temperatures plays a rôle in industry which daily grows more important. Our shops for hardening projectiles each use numerous pyrometers. But their indicators do not afford the precision desirable. The standard gas thermometer cannot be used, as it is too complicated to be brought outside of physical laboratories. The Siemens-Callendar platinum resistance thermometer is also very exact, but too fragile for ordinary shop use. Exclusive use is made of one of these pyrometers—thermo-electric, optical or heat radiation. Their readings are not, however, sufficiently exact. Their defect is not due to caprices of natural laws. The laws are all absolutely rigorous, but they bring simultaneously into play several elementary factors, several independent variables. If we neglect some of these factors or at least fail to assure ourselves of their absolute constancy during our experiments, the results will necessarily be inexact, more or less according to the importance of the factor omitted.

The thermo-electric force of a couple depends first of all upon the temperature of the joint, but also, to a less extent, upon the law of distribution of the temperatures along the wires between the hot joint and the cold joint. This is a phenomenon known qualitatively, but it has not yet had the required quantitative study. A homogeneous wire heated at the middle under such conditions that the degree of temperature differs from one part to another of the heated zone gives birth to a parasite thermo-electric force. This phenomenon varies in intensity with the nature of the metal.

The readings of the optical pyrometer depend upon the emissive power of the body observed. Up to date there have been measured the emissive powers of three substances—platinum, oxide of iron and oxide of nickel. There are many other common materials still to be investigated and these will, no doubt, be made the subject of serious study at some time in the near future.

The results given by the radiation pyrometer are influenced by the variable distribution of temperatures in the metal box of the instrument. There is need to study this influence and to define which conditions are necessary for eliminating this cause of disturbance. Any information on this subject would be of great value in heat-treating work.

Gang Core Boxes Lessen Foundry Costs

By J. V. HUNTER

SYNOPSIS — *These boxes for producing cores several at a time help to keep down foundry costs and are of especial service in view of the growing scarcity of labor for this class of work. Details here cover various forms of gang boxes, both solid and split and of both wood and metal.*

ONE may find many foundries where the number of workers in the coreroom will equal, or even in some exceptional cases outnumber, the molders working on the molding floor. With unusually intricate castings this may be necessary, but anyone interested in foundry costs will realize that it adds greatly to the cost of the work and just to that extent decreases the chances of successful competition when bidding on such work. Frequently, the coremakers are relatively less experienced workers than the molders, consequently are hired for less money; and when it is feasible to decrease the time required for molding, without increasing the total cost of doing the work, the modern foundryman uses all the cores possible that will speed up the work of the molder.

Many of our largest foundries are employing boys almost exclusively in the coreroom, because of the lower rate for which they can be hired and also in part for their greater adaptability in handling this light work. Intermingled with the boys are men to handle the heavier and more intricate pieces, for which a skilled coremaker probably receives as much on the average as a molder. Some foundries have used women in the coreroom, with a view to cutting down the labor cost; but the most advanced labor legislation is quite rightly prohibiting their employment for this purpose unless the women workers are housed in separate buildings, which practically makes their employment prohibitive to many foundries that formerly used this class of labor.

As the boys are yearly demanding more nearly a man's scale of wages, and getting it because of the growing scarcity of labor, the problem of holding down the coreroom costs is becoming a more serious one to every founder. The designer and the machinist are now coming more in evidence as aids to the old-fashioned patternmaker, by designing and building new equipment that will make the core boxes more efficient as producers of large output. To that end we are getting stock core machines, roll-over and jar-ramming machines, and many combinations of one or more of the principles. All these machines add greatly to the efficiency of those doing the work; but for producing small cores in large quantities, vast possibilities for improvement lie before the makers of wooden and metal patterns, in developing that branch of the art which has to do with the production of gang, or multiple, core boxes.

Some eight years ago I had occasion to insert some small cores to reduce the shrinkage of heavy lugs on an aluminum casting that had just been put on a squeezer plate. The match plate gave the molder four times his former output; but the cores required, which were not needed for the method of hand molding, kept one coremaker practically busy on their production, so that the cost of production was only cut in half instead of to one-fourth, as was at first estimated.

It is rather discouraging to have an estimated cost doubled, especially after making a considerable outlay for the production of a high-grade match plate. Such a result cuts down the credit that one gets for making any saving at all. I remember that job particularly, because the core was so simple and was used in such great numbers. Should the same job or a similar one occur again, as has happened recently, there would be a little greater outlay possibly to produce a gang core box suitable for the job, but the coremaker would be enabled to turn out possibly a hundred in the time required to make ten by the former method.

The principle of a gang core box, like that of a gang drill, depends on a multiplicity of parts, each capable of performing the same operation at the same time. In the case of the gang core box the operating part consists of a multiplicity of identical core boxes so united that they are capable of being operated as a single unit.

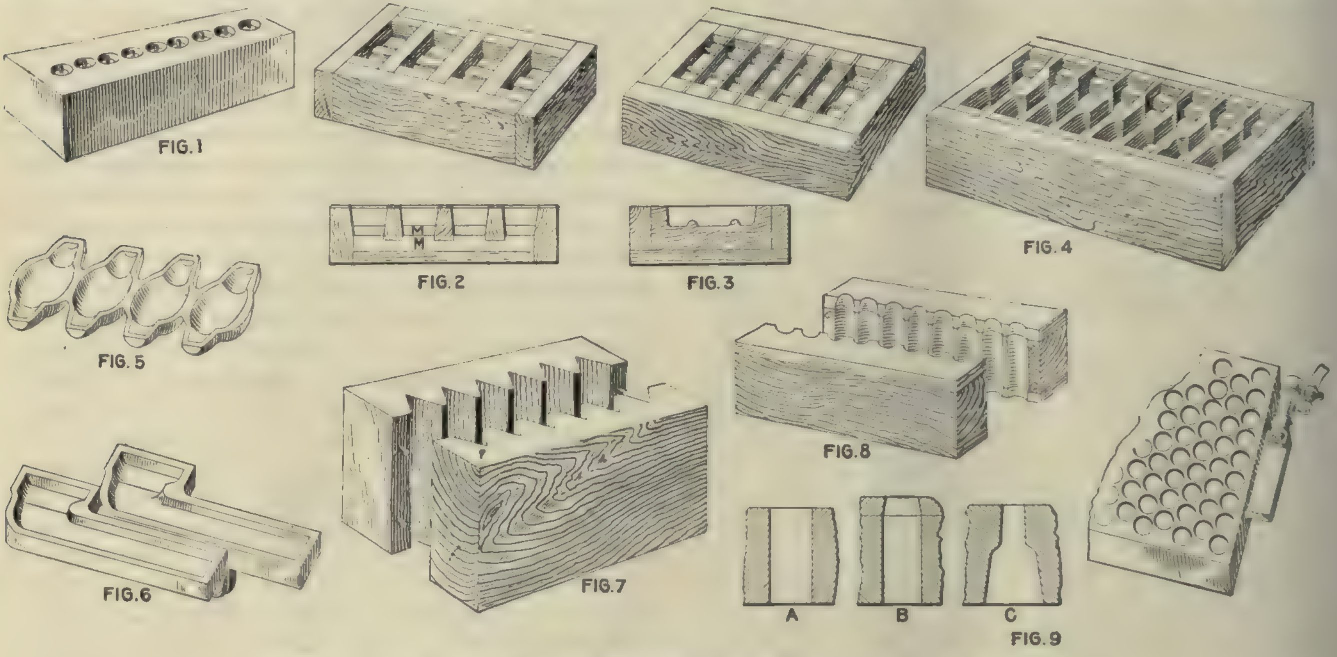
This does not by any means indicate that the patternmaker should make up a number of individual boxes and then by some means join them all together, although I have known of that being done; but by one method or another all should be joined into one component form. The simplest gang box that can well be imagined is illustrated in Fig. 1, which serves for forming at one time a number of small button heads for babbitt anchors in a cast-iron bearing shell. This was quickly made in a single block of wood, by boring a number of shallow holes in a row to the same depth and then working out a little draft in them for the clearance of the sand. Finally, a small headless brad was driven in the center of each hole and left standing up flush with the top surface of the core box. This brad leaves a hole in each tiny core, through which a small nail can be thrust to anchor each one to the main body of the bearing-shell core.

Now with this gang box, each time that it is filled, struck off and rolled on the plate we have produced a whole line of these tiny cores, and probably in this case with just as great rapidity as a single box could produce a single core, since no time would be taken up in the individual packing of each tiny core box, for the sand from one handful fills all.

MORE COMPLEX BOX

The above core box just described was formed from a single block of wood. If we now advance to a slightly more complex form, we have the condition seen in Fig. 2. This box forms a core with five straight sides and a recess in the bottom side of the core box. In making up this box the first step is to make up a strip of molding the shape of the two ends and bottom; this is the piece shown as *M* in the section below the perspective sketch. Like any molding that a woodworker would turn out, this molding strip can be made in any length, but in this case we are making up a four-gang box. Consequently, at the proper spaces it is sawed across, and small pieces for the division walls are inserted. Side strips are glued on to hold the division strips in place and strengthen the body, and the end blocks are put on. This particular core box is intended for a very great output of cores, so in order to strengthen it and at the same time prevent undue wear on the top surface, this is covered with a sheet of $^3/_{64}$-in. brass, cut out to the outline of the core recesses and firmly screwed down to the wooden blocks below with small woodscrews. This brass plate is not shown in the perspective sketch.

One objectionable feature of the box in Fig. 2 is that the division walls, being made of wood, must be of appreciable thickness, a half-inch or more, in order to have sufficient strength. This leaves the cores spread out unnecessarily when they are rolled out on the plate, and entails the additional operation of pushing them together in order to fill up the plate properly. At the same time if many cores are required to be made in a single gang, these division walls will add to the length.



FIGS. 1 TO 9. A NUMBER OF VARIOUS TYPES OF GANG CORE BORES

The above objection is overcome very readily in the design of the box shown in Fig. 3. In this case the division walls are simply thin strips of sheet steel or brass. These are inserted in a molding strip in a manner similar to that used in Fig. 2, after they have had a very slight amount of draft filed on their sides; in this case a wide saw cut furnishes a suitable slot into which they may be securely driven. If additional security is desired against these metal strips coming out, they can be given a slight extra length, so as to form a small dovetail in the side holding strips, as indicated in the cross-section below the perspective. With this box a metal top plate, as used in Fig. 2, will be neither needed nor desirable, because, first, it would be impracticable to try to cut it out to lie on the narrow division strips and hold itself in place there without constant bending and so damaging the cores; secondly, because the edges of the metal division strips will themselves furnish all necessary protection from the wear of the strike-off bar, etc.

In the foregoing descriptions all shape given to the cores, aside from that given by the bottom of the core-box, has been limited to straight side walls. In Fig. 4 is shown a simple and easy method of giving different outlines to these side walls as well; or by dividing the core into two sections, to be pasted together after baking, all four of the sides might be formed with various contours.

These contoured division walls, as in Fig. 2, could be cut out separately from wood and fitted into place, but forming each one individually would require a great deal of time; and they would probably lack uniformity as well as strength, and at the same time take up an unnecessary amount of space. Consequently, a single sample wall is made up and then used as a pattern to cast the requisite number of thin brass castings. These can be quickly filed smooth and, with the necessary draft, will form excellent division walls of any required shape. An excellent feature of this method of using inserted cast-metal side walls for the multiple core boxes is that all manner of shoulders or indentations (always furnished with the necessary draft, of course) can be provided in almost less time than would be required to work out the same shape for a single box in a solid block of wood.

Metal Core Boxes

Some core boxes that are to see exceptionally hard service it is often desirable to have made of cast iron or other metal that will not wear as does wood. From experience with a great many alloys of iron, brass and white metals, I have found that, although the cast-iron core boxes are harder for the machinist or patternmaker to finish, and more costly for this reason, still the lesser cost of the material counterbalances this expense. The cast-iron boxes will give double the satisfaction to the coremaker, because for some reason the core compounds do not make the iron boxes so sticky, so that they are much easier to keep clean.

In Fig. 5 is illustrated a gang box, of cast iron, which was produced by making up a thin wooden pattern of the required shape—as thin as possible, in order to keep it light. Wood, of course, would not have stood much handling in this form; and with the thin shell of metal on each side of the prints, it is possible in this case to lay the cores down on the baking plate in interlying rows, the prints fitting in between each other, so that almost a third more cores can be placed on a single plate.

Another cast-iron gang box is shown in Fig. 6. Although in this case only two sections are shown, as many can be made as are desired. In order to insure uniformity and save patternmaker's time, a different system was followed for this than for the previous box. The pattern consists of only a single section. However, it is provided with small flanged lugs on alternate sides of the bottom, or back, and from this as many sections can be cast as are desired.

These sections are then finished by the machinist, who after drilling bolt holes to correspond in the lugs, by means of which the sections are assembled and held together, then lays them on a faceplate before tightening the bolts so that they will all lie in a true surface.

Split-Box Construction

Straight cores of round rectangular shapes that will not admit of draft or pasting, which would be necessary if made from boxes of the preceding types, are made in the well-known split-box type, which also is adapted to development for the system of gang boxes. These can be made of either wood or metal, the former being preferable where the wear will not be exceptionally long continued. These cores are usually baked standing on end; and to this method the gang box adapts itself, since a whole row can be stood up at one time. Each row, as stood up, helps support the preceding; and the final end rows are supported by a little temporary wall of core sand.

In Fig. 7 is shown a box that produces a set of six rectangular straight cores, but without tapered ends, since they are to be laid flat in the mold.

For cores that are to be placed in the mold in a vertical position it is customary to taper the upper end, so that if it does not line up perfectly with the print, it will not scrape the sides and make a dirty mold when it is closed. If a stock core machine is used for making these cores, there are two additional operations in making the cores ready for use—sawing off the cores to the proper length, and grinding the taper on the end. Both operations require time; and if the cores are short and many of them are required, it is probable that time may be gained by producing them in a gang box, as shown in Fig. 8.

In this box as sketched, both ends are tapered for taper prints. Consequently, to make up the box cheaply and effectively, it is made in three parts, which are afterward glued together, the center section being a mere drilling job of two pieces clamped together temporarily. The end pieces are similarly treated, using a drill the size of the small end, and then reamed or chiseled to the desired taper. Up to a few years ago I had always made boxes with a straight end on the bottom and a tapered end on top; but after visiting a large malleable foundry where the manager explained the advantage of the double tapered ends to me, I have used this system and found it to work out most satisfactorily. A taper on the lower end gives a cleaner pattern lift from the sand, because there is no possible chance for a back-draft; and the semiskilled molders who are used for most squeezer molding work can set the taper core more readily. I have found that it is the practice of several foundries to use this system; and they employ a taper of 10 deg. for the bottom end of the core, and taper the upper end at an angle of 15 degrees.

Box for Filling a Complete Plate

From the gang core box that fills up the core-baking plate a row at a time the next step is the development of a gang box that will fill up a standard plate completely at each turnover of the core box. The development of such a box is shown in a partial view in Fig. 9. This particular box, of which one end is shown, together with a single cross-section view at *A*, is in daily use to produce 96 cores at each filling of the box. The cores are about 1¼ in. in diameter by 3 in. long.

This box was cast as one solid block of aluminum, planed on both sides to give the required thickness, and the holes were then laid out and drilled a scant amount under the desired finished size. A 1¼-in. reamer was ground to a slight taper, in order to afford draft, and from one side all the holes were reamed to the required size. A small-size air vibrator is attached to the handle at one end to facilitate the removal of the cores after ramming. This is rammed on a bench-type core jolt rammer. The jolting is begun with the first putting of sand into the box. By the time that it is filled, the ramming is finished with the exception that the top is butted off with a hand rammer and then struck off.

Variety of Former Possible

This same type of box is subject to development for many shapes of cores, two others being shown as *B* and *C* in Fig. 9. The first of these is made up by the use of two plates, the upper or thinner one being provided to obtain a tapered end on the upper portion of the core.

The production of the third shape requires more preparation, since an end mill must be produced for milling out to the correct shape after as much as possible of the metal has been removed by drilling. After the milling operation a highly polished steel mandrel of the same size as the mill is chucked in a drilling machine, and while revolving at high speed with a little oil lubrication, is forced with some pressure into each recess. The result of this in the soft aluminum metal is to polish out the little ridges left by the milling and insure a more perfect draft for the core.

Nowadays, with the removal of the European labor supply, the labor problem for the foundryman is daily becoming more acute. Perhaps if the machinist and the patternmaker will exercise their ingenuity to some extent in the little method outlined, it will aid somewhat in conserving the labor that the foundries still have available.

Surface-Gage Kink

By D. E. Mapes

A large number of duplicate castings had to be laid out with two holes out of line with each other, so I used two scriber points on the same surface gage and marked both lines in one operation. This reduced the working time on the job considerably without extra effort on my part.

Cam Layout for Loom Harnesses

BY CHARLES F. MERRILL

SYNOPSIS — *How a set of peripheral cams are laid out to control the movements of a series of loom harnesses that must travel up and down in correct relative order and through a predetermined length of stroke that is established by the position of the harness in the set.*

A PRACTICAL development of layout methods for a series of complimentary peripheral cams is represented in the construction of those used to operate loom harnesses. On cam looms there are usually from two to six harnesses, actuated by a similar number of cams through connections with the cam followers, or "treadles."

The several harnesses go through a recurring order of up and down movements, raising and depressing groups of warp threads in accordance with the character of the weave to be produced. Each time a portion of the warp is lifted and the remaining portion depressed, an opening is formed between them, through which the shuttle passes, inserting a pick of filling.

The term "pick" is also used in the sense of a unit of time considering the motions of a loom, and when so employed represents the period of one revolution of the loom crankshaft, which is the primary driving member of the mechanism. A harness is said to be "up" so many picks and "down" so many, and the sequence of these ups and downs determines the general character of the outline of the cam, as in Fig. 1. After changing position, the harnesses must all remain stationary during a certain portion of the period allowed for the pick, to give time for the shuttle to pass through the warp. The duration of this dwell varies under different circumstances, but it is usually specified in terms of degrees of crank revolution. The portion of each pick not occupied by the dwell is available for the change.

The relative order of the movements of the several harnesses affects the angular relation of the cams upon the shaft; but since the cams are usually made separate, with clutches for locking them together when more than two are used, this feature becomes a matter of assembling and need not require special consideration in laying out.

ESSENTIAL DATA

The divergence of the upper and lower warp lines, as shown by Fig. 2, makes it necessary for those harnesses farther from the apex of the opening to move through a greater distance than the nearer ones, to maintain a constant angle of opening. Consequently, each cam must have a throw that will impart just the right amount of movement to its particular harness. The middle points of all the throws are at a constant distance from the center of the cams.

From this somewhat general consideration of the subject, it will be seen that in order to formulate data for the angular and radial characteristics of a set of loom-harness cams it will be necessary to know the number of cams in the set, the number of picks to "the round," or revolution, the sequence of ups and downs, the period of drill or rest, the throw of each cam.

Other data, whose values depend on the proportions of the machine for which the cams are made, include relative location of cam and treadle centers, minimum heel radius, radius of the follower roll.

THE DRAWING METHOD

In the drawing method here presented, it is expected that the patternmaker will work directly from the original drawings, transferring the outlines of the cam curves to his patterns by pricking through at frequent intervals with a needle. To this end the drawing is made on duplex paper and laid out to shrink scale. This method is particularly applicable when the details of hubs, rims and arms are standardized, in which case the outline is all the work required of the draftsman when a set of cams is to be constructed. It allows the arrangement of the cam outlines about a common center, which avoids much repetition of circle dividing and facilitates checking the work.

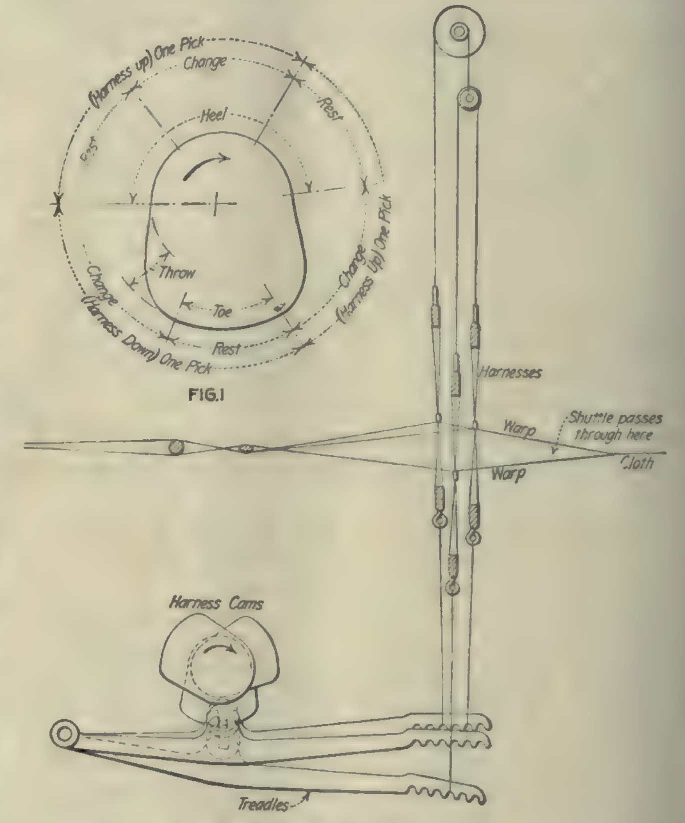


FIG. 1

FIG. 2

FIGS. 1 AND 2. THE CAM AND THE DIVERGENCE OF THE UPPER AND LOWER WARP LINES

TYPICAL LAYOUT

The layout illustrated in Fig. 3 is for a set of three cams, three picks to the round, $\frac{2}{1}$ (read "two up, one down"); rest equal to 150 deg. of crank revolution.

Having assumed values for the other construction data, the layout is commenced by drawing a base circle whose radius is the distance between cam and treadle centers. While in the actual machine the cams revolve for drawing purposes, the treadle center is revolved about the cams, and the base circle is its path.

A convenient starting point is selected and the base circle divided into as many equal parts as there are picks to the round. From each pick point, angles of change and rest are laid off, proceeding in a direction opposite to that of actual rotation. The angle of rest bears the same relation to the whole pick angle that the specified rest in degrees of crank bears to the complete revolution of that number.

In the present instance, the cams are running at one-third of the crankshaft speed, or three picks to the round, making the angle of rest on the base circle one-third of 150 deg., or 50 deg. The remainder of the pick, or 70 deg., is the angle of change.

It is convenient to lay out the cam of greatest throw first, since this one has the heel of minimum radius, for which a value is determined by the size of the shaft and thickness of the cam hub. This minimum heel is then indicated as by the circle 1. Another concentric circle 2 represents the pitch line of the roll when resting on this portion of the cam. The pitch line of the roll when at the other extremity of its movement is represented by circle 3. Midway between circles 2 and 3 is another 4, upon which fall the middle points of each of the cam throws. It will be noticed that, after the curves are plotted for the pitch lines, they will intersect on this circle. If they fail to do so, an error in projection must be looked for.

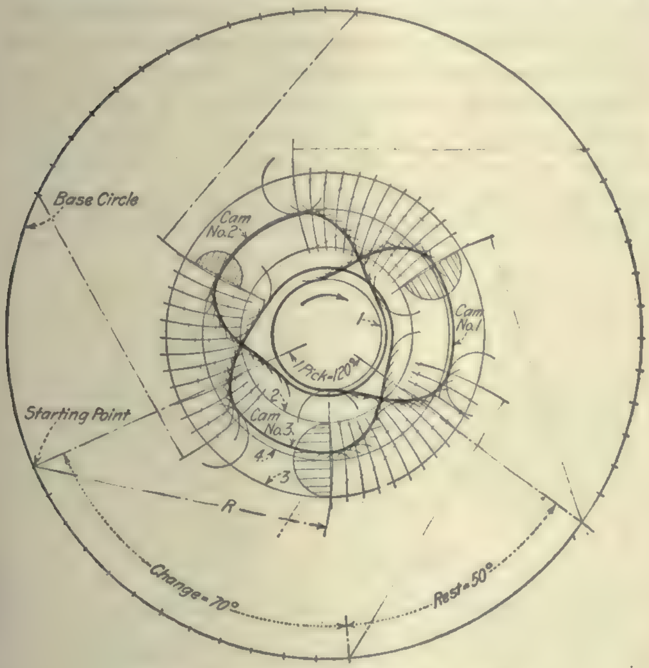


FIG. 3. LAYOUT FOR THREE CAMS

From each of the points on the base circle limiting the angles of change and rest, arcs are drawn intersecting circles 2, 3 and 4, the radius *R* being the distance from the treadle center to the roll center. Care must be taken to draw these arcs in the same position relative to the cam center and direction of rotation that the path of the roll occupies on the machine.

Through the intersections of the arcs drawn from the primary, or pitch, points and circles 2 and 3, chords are drawn which serve as bases for the construction of semicircles, whose diameters represent the throws of the respective cams. Dividing these semicircles into any convenient number of equal parts and projecting the divisions perpendicularly onto the chords, points are obtained which will give the radial graduations of the cam curves.

The angles of change on the base circle are also divided into as many equal parts as were the semicircles, and arcs intersecting circles 2, 3 and 4 are scribed with these division points as centers and radius *R*.

Then following the common method of plotting the crank curve, the graduations of the diameter of a semicircle are transferred to the arcs in the adjacent field. Passing beyond the dwell into the next field of arcs, similar transfers are made, but applying them to the arcs in the reverse order, plotting the return curve.

CURVING PITCH LINE AND THE CAM CONTOUR

A smooth curve passing through the points thus plotted will be the pitch line of the roll center. If the extremities of these curves are connected by arcs, the entire pitch for the cam will be completed. In practice, however, these arcs are superfluous.

The actual periphery of the cam is found by scribing successive positions of the roll at frequent intervals on the pitch line of the curve. A smooth curve is then drawn tangent to all these small arcs, and the extremities are joined with arcs drawn from the cam center, when the outline is complete. It will be found best to complete one cam at a time, thus avoiding confusion of construction lines.

Three-pick cams might also be required for a ⅓ (one up, two down) movement, in which case the short dwell would be on the heel and the long dwell on the toe. Exactly the same preparation would be made for drawing such a cam, simply adding one whole pick to the dwell on the toe, shortening the dwell on the heel by the same amount.

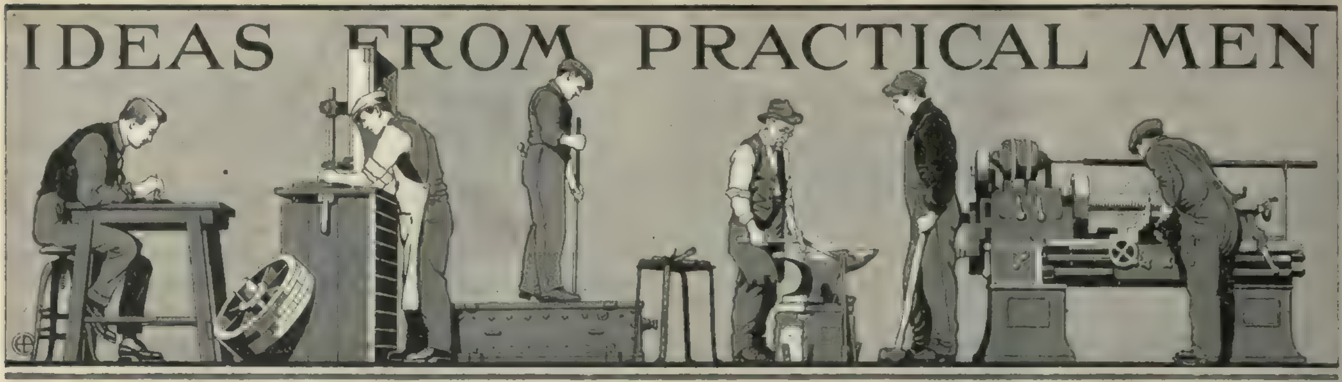
Machine Guns on Military Planes

By R. C. HEINMILLER

Mr. Colvin's timely article on "American Aircraft Development," page 661, Vol. 46, brought out very interesting points on the manufacture, operation and advantages of American military planes. There is one point that came to my mind, and that is the firing of a machine gun mounted on the single-propeller tractor plane.

In a recent issue of a popular mechanical magazine it was stated that the machine gun on this type of plane is fired so that the bullets pass between the blades of the revolving propeller. A short time after reading this, I heard a Government engineer give an illustrated lecture before an audience composed largely of engineers. In showing views of armed military planes, he stated that the machine gun and motor are synchronized so that the gun will fire between the blades of the revolving propeller. To many this seemed to be an attempt at humor rather than the statement of a fact. It might appear humorous to many of the readers of the *American Machinist* that a gun can be fired between the blades when the propeller is turning about 1300 r.p.m. An explanation of this point by the editor or some of the readers would prove very interesting.

IDEAS FROM PRACTICAL MEN

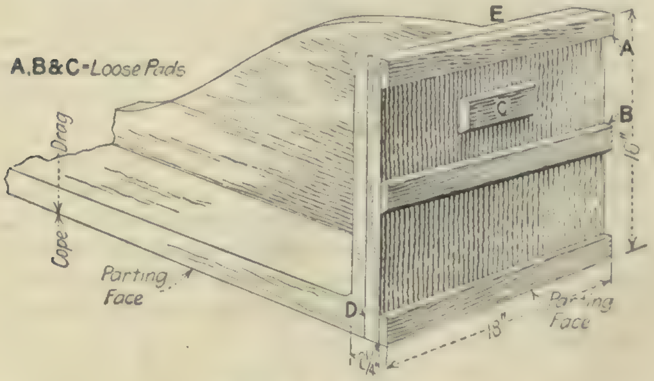


Patterns for Work With Projecting Members

By A. E. Holaday

Referring to the article by Mr. Duggan, page 532, Vol. 46, "Patterns for Work with Projecting Members," I would not make this pattern the way Mr. Duggan did, as the tendency nowadays is to simplify patterns for the molder.

Assuming that the strips *A*, *B* and *C* are about ½ in. in thickness and the body holding these strips is 2¼ in., I would make this part of the body in two pieces, parting the pattern at *D* with a narrow guide at *E*.



IMPROVED PATTERN

In making the pattern in this way the body could be drawn from the mold, leaving the part with the strips *A*, *B* and *C* in the mold. After drawing the main body from the mold, this part with the strips can then be moved back into the opening left by the main pattern, and then withdrawn all in one operation. Making the pattern in this way would not require any great amount of skill on the part of the molder.

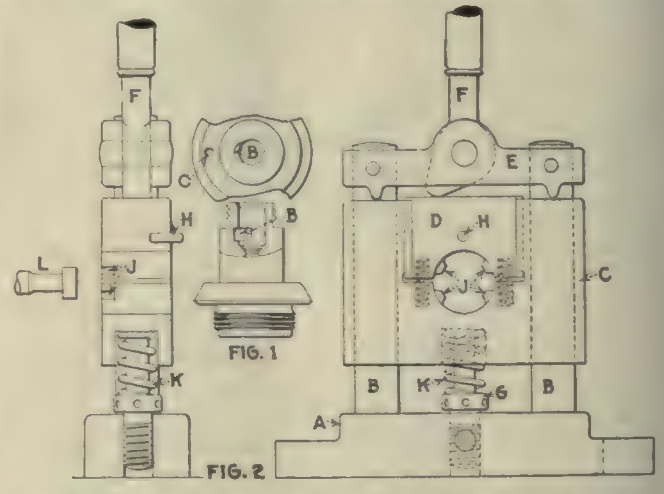
Time-Fuse Milling Fixture

By Donald A. Baker

The milling fixture described herewith was designed for milling the undercut *B*, Fig. 1, in the stem end of the type 80 fuse body.

The base *A*, Fig. 2, is of cast iron; into it are driven the two pins *B*, secured in the base. Two slides, *C* and *D*, are of machine steel, hardened and ground on the wearing and locating surfaces. The slide *C* is made a good sliding fit on the two pins *B*, while *D* is made a good sliding fit in *C*. A steel plate *E* is pinned to the upper ends of the two side rods and carries the cam *F*. An adjustable stop *G* is used to regulate the depth of the cut in the body.

In operation the action of the jig is as follows: A fuse body is put into the central hole of the jig, stem end forward, and located from the hole *C*, Fig. 1, in the platform, fitting over the pin, while the shoulder on the stem strikes against the four lugs *J*, Fig. 2. This arrangement is more positive than locating from the platform, as there is considerable tolerance in the length of the stem from the platform. When the body has been located, the handle of the cam *F* is brought forward, forcing the slide *D* down against the body. As it is now gripped tight with the tension of the spring *K* against it, the continued movement of the cam carries the work and the two slides down until the lower slide *C* strikes against the adjustable stop *G*, completing the undercut.



FIGS. 1 AND 2. MILLING FIXTURE FOR TIME FUSE

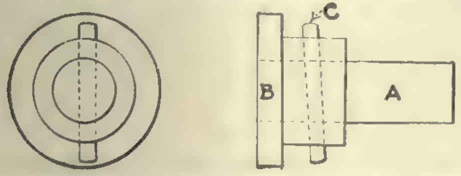
At *L* is shown the cutter. It is, of course, when in use, always within the jig; and either the spindle is made adjustable, or the jig is arranged to slide in and out for adjusting the cutter to the proper distance from the face of the jig, a set block being used for this purpose. Cutters should run between 4000 and 5000 r.p.m. A production of 5000 bodies per day can be obtained.

Drilling Pin Holes in Shafts

By J. J. Denham

Occasionally we have to replace worn stubshafts on hoisting engines with new ones. These shafts *A* are always fastened with a pin *C* into a flange *B*, which is so located inside a channel iron that it is impossible to drill and ream this new shaft for a pin while it is in position on the engine. As the flange is riveted to the channel, it is impractical to remove the flange.

Evidently the manufacturer of these engines drills and reams the flange and shaft together before riveting the flange to the channel, as the pin hole is never at right angles to the shaft nor does it pass exactly through the center of the shaft, as is shown somewhat exaggerated in the illustration.



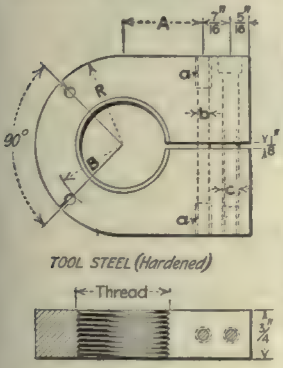
PIN HOLE TO BE DRILLED AND REAMED IN SHAFT

I wish the readers of the *American Machinist* who have similar jobs to do would describe a quick and economical way of drilling and reaming these pin holes in the flanges when the shafts are placed and the pins in the flanges when the shafts are placed and the pins driven. If there is no better means suggested, I will describe the method that we employ, which gives satisfactory results.

Adjustable Female Thread Gage

By L. P. Fosnot

The illustration, which is self-explanatory, shows a female thread gage that has met with high favor in the place where I am employed. I believe it will be of use to others. Notice the handy method of tabulating.



ITEM NO.	TOOL NO.	PART NO.	THREAD	PITCH DIAM.	REQ'D	DEP'T
1	D-14862	PD 2-74	0.85"×7 R.H.U.S.S.	0.7572"	2	12
2	D-15144	DC-2-139	1.375"×12 L.H.U.S.S.	1.3209"	2	12
3	D-14552	SD-1101B	2.75"×8 R.H.U.S.S.	2.6689"	2	12
4	D-14552	SD-1152D	2.50"×8 R.H.U.S.S.	2.4189"	2	12
5		DC-4X-2	2.875"×16 L.H.U.S.S.	2.8345"	2	12

ITEM NO.	A	B	R	a HEADLESS SETSCREW	b TOOL STEEL PIN-HARD	c FILISTER HEAD SCREW
1	5/8"	5/8"	1"	1/4"×3/8" LONG	3/16×1 1/4" LONG	1/4"×1 1/4" LONG
2	31/32"	29/32"	1 5/16	1/4"×3/8" "	3/16"×1 5/8" "	1/4"×1 5/8" "
3	1 11/16"	1 3/4"	2 1/4"	5/16"×1/2" "	1/4"×3 1/2" "	5/16"×3 1/2" "
4	1 11/16"	1 3/4"	2 1/4"	5/16"×1/2" "	1/4"×3 1/2" "	5/16"×3 1/2" "
5	1 11/16	1 13/16"	2 1/4"	5/16"×1/2" "	1/4"×3 1/2" "	5/16×3 1/2" "

ADJUSTABLE FEMALE THREAD GAGE

Operating Valve for Pneumatic Chucks

By James H. Lonie

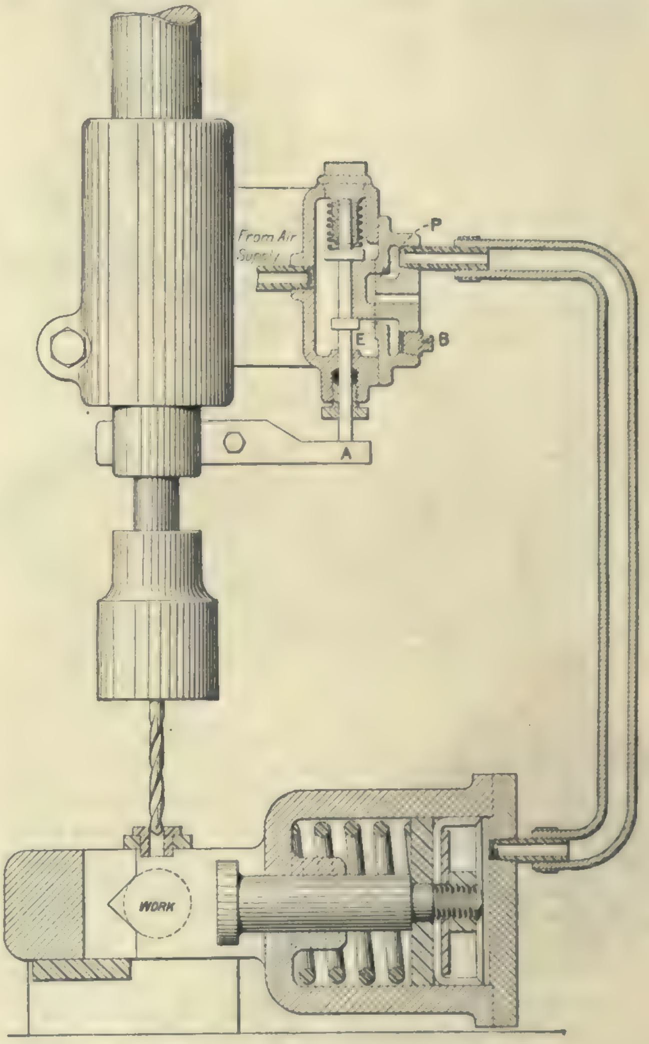
Having successfully used an air-operated chuck somewhat similar to the one described on page 465, Vol. 46, I was much interested in the device there shown.

In that case, however, an ordinary three- or four-way cock is used, and a considerable range of movement of the valve handle, and of the machine spindle as well, would be necessary, or a more or less complicated system of levers must be employed to reduce to a minimum the idle movement of the spindle.

When using such an arrangement, particularly on a drilling machine on which the spindle movements are automatically controlled by a cam or its equivalent, it is desirable to reduce the nonproductive spindle movement. Furthermore, an ordinary plug cock is kept tight with difficulty.

To overcome these objections, the special air valve shown in the diagram is suggested. This is a plain slide valve which, when the spindle is at its highest point, is held in the release position against the pressure of the coil spring by the stop *A*, which is secured to, and is adjustable upon, the lower part of the spindle quill.

When the spindle is fed downward, either by hand or power feed, the valve stem and valve are free to move, and are forced downward by the coil spring, uncovering the port *P* and admitting air behind the operating piston of the chuck. The chuck then closes upon the work and remains so until the spindle again rises to its highest point, when the valve is returned to its original position and the air exhausted from behind the piston.



SELF-ACTING PNEUMATIC VALVE

It will be seen that the valve has a short travel, and a relatively short movement of the spindle is required to produce the desired result. This is a very advantageous point.

In the diagram the valve is shown connected to a single-acting cylinder. If it is desired to use it with a double-acting cylinder, the plug *B* is removed and connection made to the other end of the cylinder, through the port *E*.

While a valve of this type is particularly adapted to drilling and tapping machines, it may be applied advantageously to other machines also.

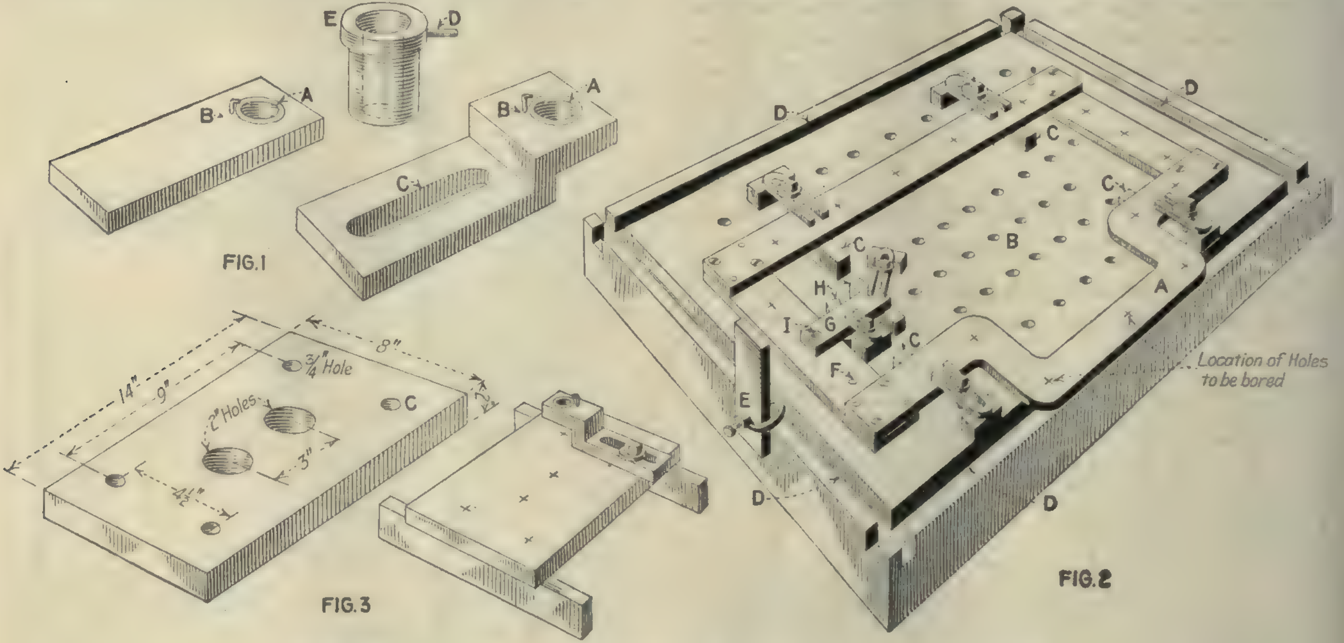
When used with an automatic drill and with a chuck from which the finished work falls by gravity, it is only necessary for the operator to place the work in the chuck, and a marked increase in the production results.

Auxiliary Bushing Plate in Toolwork

By Hugo F. Pusep

As the method of locating holes in jig work by the auxiliary bushing-plate method is practiced in very few shops, the majority of toolmakers are not familiar with its advantages in certain classes of jig and fixture work.

In Fig. 1 are illustrated two of the most common types of bushing plates. They are made of cold-rolled or machine steel of convenient size, either straight or offset, as the nature of the work demands. A hole bored near one end holds a hardened, ground and lapped bushing at right angles to the under side of the plate. This bushing is pressed into place and remains a permanent part of the plate. A set of slip bushings is made to fit this bushing. As the auxiliary bushing plate is used mostly for work with medium- and small-sized holes, the permanent bushings *A*, Fig. 1, if made 1¼-in. inside diameter, will take care of any size hole 1 in. or less in diameter. At *B* are shown hook pins against which the pins *D* in the knurled collar of the slip bushings bear, thus preventing them from turning while in use. A typical slip bushing is shown at *E*. One of the bushing plates in Fig. 1 has a milled slot *C*, the purpose of which will be shown later.



FIGS. 1 TO 3. AUXILIARY BUSHING PLATE AND ITS APPLICATION

In Fig. 2 is shown clearly how the bushing plate is used for locating, drilling and reaming the bushing holes in a skeleton drill jig for an automobile-frame assembly. There were altogether 18 holes of ¾-in. diameter to be drilled and reamed. The allowances for error for all center distances were plus or minus 0.0025 in. All the holes were laid out approximately, and the jig *A*, Fig. 2, was clamped on the cast-iron plate *B* by four U-clamps and kept clear of the plate *B* by four parallel blocks *C* to provide clearance for drills and reamers. The size of the plate *B* is determined by the sizes of the jobs that it is to accommodate. The one shown is 2½ x 30 x 40 in.; it has both sides planed parallel and the edges squared all around.

A number of holes are drilled and tapped for tap bolts for holding the work and the bushing plate. The grooves *D* provide means for clamping the measuring block *E* to the edge of the plate *B*.

The method of locating, drilling and reaming the holes is as follows: The baseplate *B*, Fig. 2, with the jig *A*, is laid on the table of a radial drilling machine, and the first hole *F* is drilled and reamed. The auxiliary bushing plate *G* is now set over the location of the next hole, its under side elevated about ½ in. above the jig and resting on parallel blocks *H*. In rapping the bushing plate into position, a ¾-in. plug is placed in the reamed hole *F*, and a 1¼-in. ground plug in the hole *I* of the bushing plate. Measuring from the block *E* and the plug in *F*, it is easy to set the bushing plate *G* for the next hole. After the bushing plate is set, the plug is removed and a suitable slip bushing inserted in the hole *I*. The cycle of operations is just as it is in any drilling and reaming through a bushing. For subsequent holes the same procedure is repeated.

I should like to draw especial attention to the grooves *D*, Fig. 2, and the measuring block *E*, two of which were made, although only one is used in connection with the job shown. The measuring blocks were made of tool steel 1 x 2½ x 7 in.; they were hardened and ground parallel on the 1-in. measurement. By this method of taking measurements from the squared edges of the baseplate, very accurate and quick settings of the bushing plate can be obtained.

In Fig. 3 is shown another way of using the auxiliary bushing plate. In this case the offset type of bushing plate is used. In Fig. 3, are given the dimensions of a top plate for a box jig. In this job six holes are called for, four of ¾-in. diameter and two of 2-in. diameter. A job of this kind could be done by the button method. No baseplate was used on this job, and all drilling, boring and reaming were done on an ordinary sliding-head drilling machine. The bushing plate is held to the jig plate as shown in Fig. 3. It might be well to mention that the hole *C* is drilled and reamed first in the ordinary way; for the rest of the holes the bushing plate is used, which is located accurately by means of a height gage and the surface plate. All four edges of the jig plate are carefully squared, thus eliminating all uncertainty in locating the bushing plate. All the holes check up to within 0.001 in., which is 0.0005 in. closer than the greatest allowable error.

An interesting feature about this job is the boring of the two 2-in. holes. A 1-in. drill was used in the first place, then a ¾-in. boring bar working through a ¾-in. slip bushing till the hole had been enlarged to 1½ in., after which a 1-in. boring bar and a 1-in. slip bushing were substituted and the hole bored to its finish size. The space between the offset of the bushing plate and the jig provides sufficient clearance for setting the boring tool bit and for calipering. By the aid of the slot *C*, Fig. 1, the bushing plate can be secured to any position over a jig plate of large dimensions, provided there is a hole for the bolt.

Making Drawings for Patternmaker and Machinist

By James H. Lonie

The following method has been successfully used to provide permanent and complete drawings for both pattern and machine shops at practically no increased cost over the usual method.

The drawing is made in ink on tracing cloth in the regular way, but only such dimensions and notes as are required by the machine shop are filled in.

A vandyke or brown negative print is then made from the tracing. This print is filed as the regular machine-shop tracing, and from it prints are made for the machine shop, as required.

All patternmakers' dimensions and notes are added to the original tracing, from which pattern-shop prints are made when needed.

With this method the machine shop is supplied with positive prints instead of the usual negatives. If, for any reason, this is objectionable, and it is desired to furnish the usual negative print to the machine shop, a positive vandyke may be made from the original negative vandyke and the negative blueprints for the machine shop made from that.

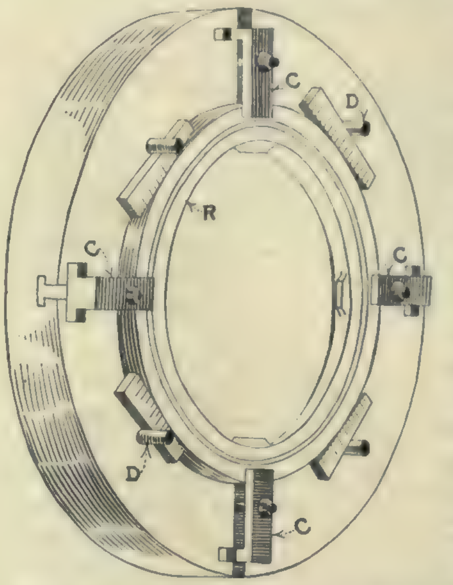
If castings from the same pattern are to be machined to different dimensions, a positive vandyke is made from the original negative, blanking off in the printing all dimensions which are to be changed, as well as drawing numbers, notes, etc., not needed, even including drawing lines if any are to be changed. The omitted numbers, dimensions, etc., are filled in, and a complete new tracing results at very small expense.

If a comparatively small number of blueprints are required, the vandyke may be made on paper; but if they are to be subjected to considerable handling, they should be made on cloth.

Centering Work with Graduated Wedges

By H. E. McCray

For centering circular work on the vertical boring-mill table we have developed a method that effects a marked saving of time over the usual chucking and truing up with an indicator clamped in the toolpost. The ring gear *R* is clamped to the boring-mill table by four toe clamps *C*. Four dowels 1½ in. in diameter are located equidistant from the center of the boring-mill table. Four wedges graduated in quarter-inches, as shown, are driven in between the ring gear and the dowels. When the same marks line up with the centers of the dowels on opposite sides, it is evident that the casting is correctly centered. Both dowels and wedges are hardened so that they are comparatively long lived. The centers of the dowel-pin holes are located by clamping a scriber in the toolpost, locating it the correct distance from the center, so that when the table is rotated, a circle is drawn on its face. When an air-operated jib crane is used, swinging directly over the table, the time for clamping and centering rarely exceeds two minutes, which is a saving of 700 per cent. over former methods.



GRADUATED WEDGES SAVE TIME IN CENTERING WORK

Are Ambitious Young Men Really Wanted?

By Fred Williams

In support of E. P. Baker, page 602, Vol. 46, I would like to say that regardless of the magazines, any young man who thinks that ambition should make him acceptable to the general employer will change his mind if he studies the help-wanted advertisements.

Even when his ambition and willingness are supplemented by 5 or 6 years in the toolroom, over 10 years in the drafting room, 6 years in a technical night school and a constant reading of technical publications and the press, which should ordinarily qualify him for most of the lower executive or assistant's positions within any reasonable time, he will still find it difficult to get a start with the firms who are presumably seeking qualified men.

Ambition or willingness is not sufficient, and nine-tenths of the advertisements in any trade journal will reveal it. In almost every case a "record" is one of the main requisites, but in many places today next to no opportunity is given to the young man of ambition to acquire a record. Certainly little effort is made in that direction even in certain concerns where efficiency is supposed to be the guiding principle.

It ought to be needless to suggest that such efficiency defeats itself. Every latter day authority on efficiency mentions the necessity and desirability of training young men, but few firms seem to have any time for such a program. They prefer to hire their men outside. But where should they come from?

Chart for Determining of Pulley Crown Dimensions

By H. R. Gilliam

The subject of pulley crowns has been given a great deal of consideration by various authorities, but in every instance it is found impracticable to develop for height of crown a mathematical rule that will give uniform results.

It is noticeable that all rules for determining pulley crowns are given in terms of width of face of pulley and do not consider what is probably an equally important factor, the diameter of the pulley.

A given point on the crown of a pulley will travel farther in making a revolution than a given point at the edge of the rim; and a belt in passing over the pulley either stretches or slips at the edge or at its center line, in conforming to the pulley crown, an amount equal to half the difference of lengths of arc of contact at the crown and at the edge. This amount is proportionately greater as the diameter of the pulley becomes smaller and is less as the diameter is increased.

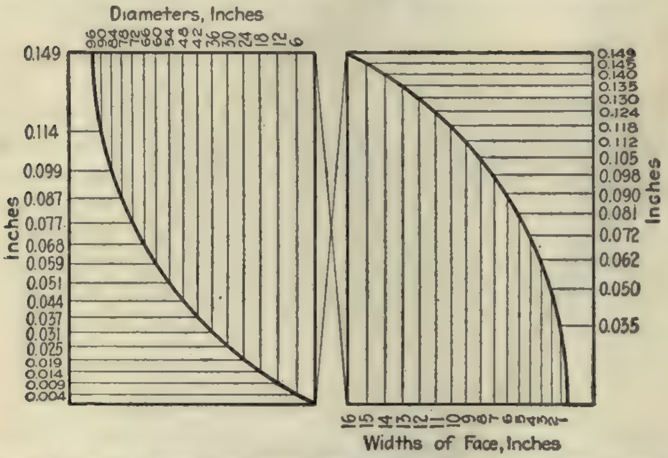


CHART FOR DETERMINING PROPER CROWN FOR PULLEYS OF VARIOUS DIAMETERS AND WIDTHS

The accompanying diagram was developed with the diameter as a factor in determining the pulley crown. Referring to the diagram for "Widths of Face," the values given are determined by the relative heights of the ordinates and read direct. The diagram for "Diameter" is the same as that for "Widths of Face" inverted, the values of which are likewise determined by the heights of the ordinates and also read direct.

The sum of the values shown for a pulley of a given face and diameter is the height of the crown for the pulley. For example, required the height of crown for a pulley of 48-in. diameter and 5-in. face. Reference to the diagram for 48-in. diameter shows the value 0.044 in., and for 5-in. face a value of 0.081 in. Then 0.044 + 0.081 = 0.125 in., the height of crown required.

It will be observed that the table eliminates the width of face as a factor at 16-in. width and that diameters are given up to 8 ft. only. Pulleys of greater diameter are usually made for a specific drive, where other factors, such as speed, length of belt, arc of contact, etc., can be given their proper consideration in establishing the crown.

Saving Scrap in Shearing Stock

By James A. Raught

Some time ago I was invited to visit a friend who was engaged in a small machine shop making sauerkraut machines. When I reached his place he was shearing stock for the knives out of thin spring steel. After watching him shear stock for awhile, I asked him if I might offer a suggestion that would save stock for him.

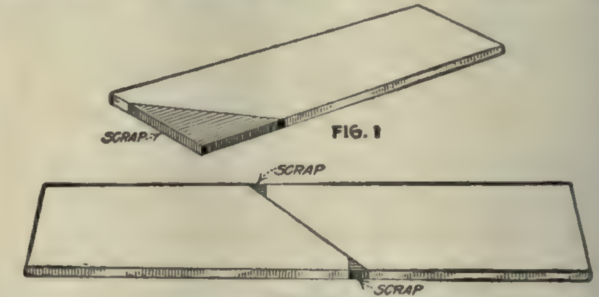


FIG. 1

FIG. 2

FIGS. 1 AND 2. TWO METHODS OF SHEARING STOCK

His method of cutting the stock is illustrated in Fig. 1, which shows a large piece of scrap. I took his combination square and scriber and laid out the stock as shown in Fig. 2. This proved a worth-while saving in both material and labor.

Personal Privacy

By Entropy

Charles M. Horton, on page 710, Vol. 45, expresses the idea that the better class of employees, draftsmen in particular, object to giving full information regarding themselves.

It seems, however, that this opinion is hardly borne out by experience. There are occasional men who object to inquiry and to furnishing photographs and to a number of other things like a physical examination, but they are remarkably few in number. Out of several thousand applications for jobs which I have handled, I recall but one case where anyone refused to complete an application blank, and that was a boy who gave up his chance for a job, in anger, because he could not spell Massachusetts. About one man in a thousand will object to being photographed for the benefit of himself and the company for which he wishes to work. About the same number object to a physical examination. In the latter case we suspect that the reason is an expectation that the applicant would fail to pass.

These figures are probably somewhat under the average of all employees, because it is well known in our case that all these things are required, so that many applicants know what to expect when they apply and they probably tip off many more.

As a general thing, it is usually easy to show an applicant for a job that his employer is entitled to all the information that is required. Parentage is nothing to be ashamed of. Most men have some degree of pride in the fact that their father or mother came from some far-off land or that they themselves were born in some given state. The number dependent for support indicates to the employment manager that the man should be kept at work steadily if possible. Education is something concerning which many men will exaggerate, for most of them know its value, as is evidenced by the avidity with which they seek it for their children.

Former places where one has worked are certainly things which most men are anxious to tell about, for the impression they make on the hirer. The physical examination is something which we often suspect men come to us for. They wonder if they can get life insurance, but rather than take the black eye which failure to pass that medical examination causes, they come to us to find out how they stand physically, without any serious intention of working for us any length of time, or possibly not at all.

The one thing about which secrecy seems to be legitimate and somewhat common is wages or salary previously earned. This is strictly a matter between the employer and the employee, but in the majority of instances applicants are glad to show that they have received greater pay on previous jobs as evidence of worth.

It really seems natural with the increasing number of really good jobs that can only be had after a searching inquiry into the histories of the applicants that men should gradually come to feel that their employer is entitled to full knowledge of themselves. It is a fact that we, on the other side, come to feel that a man who is reluctant about giving information is either hiding something that we ought to know or else that he is ignorant of modern practice.

Drawing a Deep Flanged Shell Without Annealing

By E. J. Leach

On page 385, Vol. 46, W. E. Chambose describes drawing a steel flanged shell. I believe this shell can be blanked and drawn in three, and possibly two, operations. Mr. Chambose states that he got a crease on the flange, due to the stock being bent below a horizontal plane and then straightened out. If he will examine this work, I think he will find that the metal has been broken down as a result of having been bent on too sharp a curve. If the radius of the curve is kept large enough, the stock can be bent to quite an acute angle and not cause this breaking down.

If Mr. Chambose has a double-acting piece of sufficient size, and will use dies similar to the illustrations shown, I think he will produce a shell without this mark and at a lower cost.

Fig. 1 shows the type of die used for blanking and cupping. The blanking punch acts as a flange holder for holding the stock when drawing. The head on the drawing pad, or die, irons out all wrinkles that tend to form in the stock. The cup does not have to be drawn entirely through the die, but can be left with a flange and can be about the size of Mr. Chambose's second draw. Of course, the blanking die must have shear ground on it, and the pressure exerted by the flange holder must be regulated to keep out all wrinkles and not thin the stock down too much. The head must have a large radius, so that the stock will not be broken and pulled in. About ¾ or ⅞ in. is recommended for the size cup here shown. The drawing punch must be regulated to draw the right depth. These points can be determined by trials.

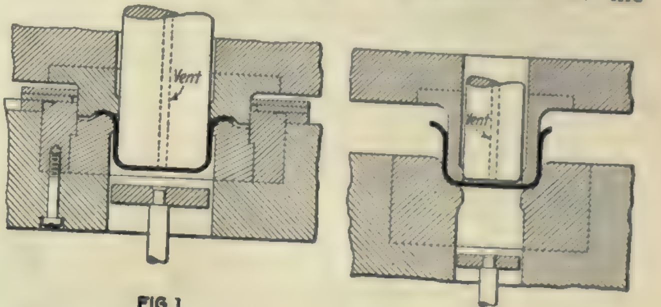


FIG. 1 FIG. 2

FIGS. 1 AND 2. DIES FOR A DEEP FLANGED SHELL
Fig. 1—Blanking and cupping die. Fig. 2—Drawing punch and die

Fig. 2 shows the type of die used for the drawing operations. It is also a double-acting die. The die block is belled out to take the cup from the preceding die and has a large radius on the edge of the drawing portion of the die. A flange holder comes down inside the shell and holds the stock so no wrinkles can form, while the ram draws the cup as before to the proper depth.

After the shell has been reduced to the proper diameter, the flange should be flattened out on a single-action press and then trimmed.

All dies should have guide studs, to aid in setting up and keeping them in line. I made one stud larger than the other so the die and punch will not turn but will go together the same each time.

Bevel Protractor Kink

By D. E. Mapes

In a shop where I worked the floor was very uneven. The layout table used in this plant was a movable one, but no provision had been made to set it level after moving it from place to place. It was a troublesome matter to get the table level for small jobs.

We found that the quickest way out of the difficulty was to use a protractor head and adjust this head until the level shows correctly. The work is then leveled with the head and the rest of the measurements taken in the usual manner.

A further use made of the protractor is in setting up jobs in the milling machine or drill press which are not level.

My practice was to adjust the protractor head level to the machine, then set the job to the protractor the same as the layout table.

Climbing the High-Cost-

STEEL is 500 per cent. more costly than before the war; pig iron has advanced from $14 to $55 a ton, and other machine-shop materials have soared skyward in like manner. The world of business has become full of artificial hills up which both manufacturer and consumer must climb laboriously to market.

Especially is this true of our own machine-shop field, for we apply labor to raw materials and must make our profit not on the raw material, but on the value that fabrication adds to it. And artificial inflation of values is most largely in raw materials.

When communities are threatened by emergency, we suspend civil law and declare martial law. When industries are threatened by emergency, we should suspend the law of supply and demand, as applied to raw materials, and prevent "unconscionable profits" to a few from crippling the activities of many. We gain

High-Price Hill. An Editorial

encouragement from the attitude of the War Industries Board on this subject, as expressed in their statement of Aug. 9:

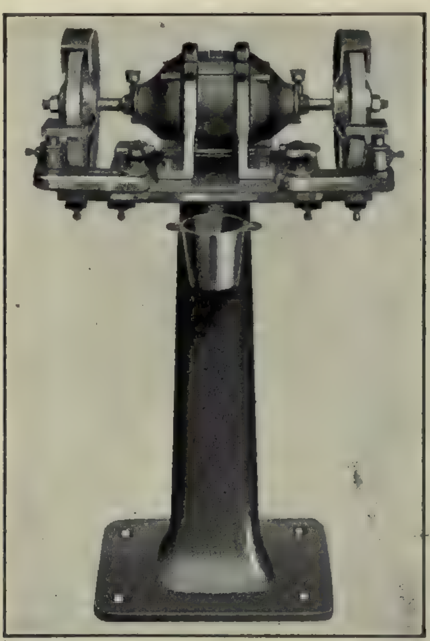
"The war makes enormous drafts upon raw materials absolutely necessary to the industrial life of the nation and to the ordinary existence of the people. This has resulted in bidding up of prices for what is left of many materials of prime necessity in manufacture to a point obviously out of all relation to the cost of production, and involving unconscionable profits on our national resources; and the consequence is that the cost to the public of all the articles in the manufacture of which such materials enter has reached a level never before known."

The War Industries Board must tear down these artificial hills and put industry back on the level. We cannot climb these hills on high speed!

SHOP EQUIPMENT NEWS

Johnson Electrical Grinding and Buffing Stand

A machine designed especially for small-shop purposes and very useful to rubber-tire vulcanizers is the grinding and buffing stand illustrated herewith. The spindle is mounted in ball bearings, and these as well as the motor are carefully dustproofed. Wheel guards and work rests are adjustable.



ELECTRIC GRINDING AND BUFFING STAND

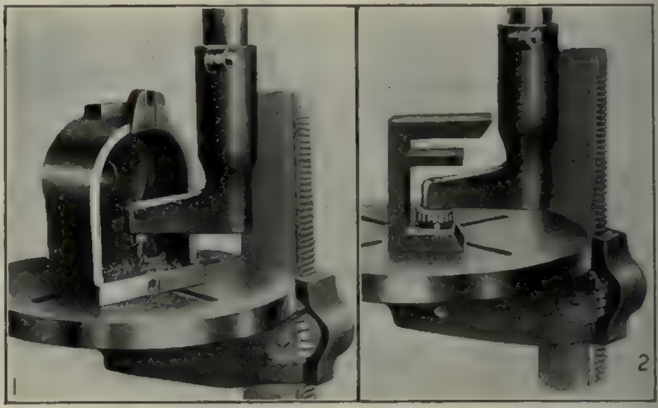
Height to center of spindle, 38 in.; length of spindle over all, No. 1 frame, 24 in.; No. 2 frame, 25 in.; diameter of arbor at wheels, ¾ in.; guards for wheels, 10 x 1½ in.; maximum floor space, 14 x 18 in. Has one-, two- or three-phase alternating-current motors, as ordered, and runs 1800 and 3600 revolutions per minute

This machine is made by the United States Electrical Manufacturing Co., Los Angeles, California.

Harris Offset Drilling Attachment

The H. E. Harris Engineering Co., Bridgeport, Conn., is now marketing the offset drilling attachment shown in the accompanying illustrations. Fig. 1 indicates how the attachment is used for drilling, while Fig. 2 shows a milling operation.

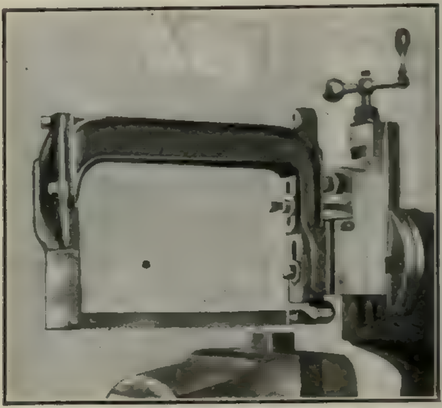
The attachment is used on the drilling machine and is especially valuable on drilling, facing or counterboring operations in out of the way places that cannot be reached with an ordinary drilling machine. Eight sizes are manufactured, in order that all standard drill spindles may be fitted; but special types will be made up if required. The drive is through a squared shaft and heat-treated vanadium-steel gears, and the attachment may be swiveled about the drilling machine to any desired position. The spindle of the attachment runs in a hardened and ground tool-steel sleeve and is equipped with a ball thrust bearing.



FIGS. 1 AND 2. OFFSET DRILLING ATTACHMENT

Moller Saw Attachment for Shapers

The hacksaw attachment for shapers, illustrated, has been recently placed on the market for use in connection with the manufacture of dies, gages, fixtures, tools, etc. The advantages claimed for this device are the positive control of the saw when attached to the shaper ram, and the permissible clamping of the stock at any



HACKSAW ATTACHMENT FOR THE SHAPER

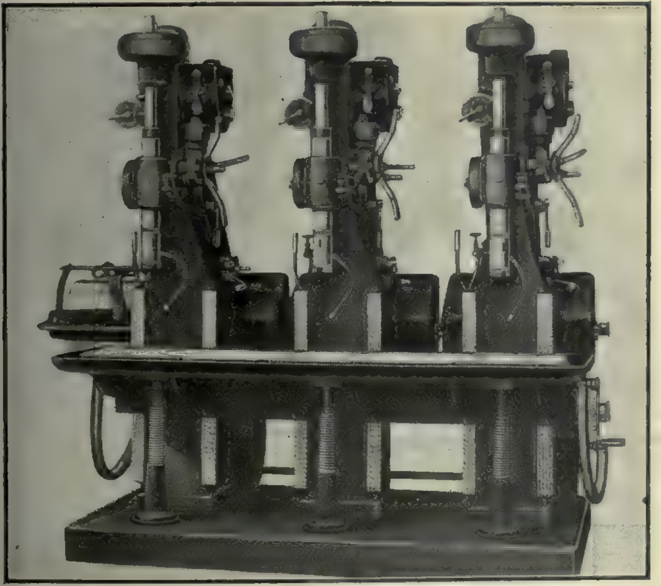
desired angle in the shaper vise. The shaper also permits various cutting speeds for different metals.

The frame of the saw is cast in two parts, connected by screws that serve to adjust and tighten the blade. Spring supporting guides hold the saw and allow a slight oscillating movement, which it is claimed prevents considerable breakage. The saw is relieved on the return stroke of the ram. The distance from the cutting edge of the blade to the under side of the frame is 9 in. The device is the product of J. A. Moller, P. O. Box 242, New Rochelle, New York.

All-Geared Gang Drilling Machine

The Barnes Drill Co., 830 Chestnut St., Rockford, Ill., is now marketing the self-oiling 22-in. all-geared gang drilling machine shown in the illustration. The machine is built for heavy-duty work, and every bearing except those on the spindle sleeves and the cross-spindles is self-oiled, oil being circulated by a geared pump in the reservoir of the machine. Eight speeds and ten feeds are provided and operate independently for each head. All gears are cut from chrome-nickel steel and are heat-treated and tempered. The feed gears are flooded with oil at all times, and a safety collar protects the machine against damage from overload.

Where tapping work is to be done, any or all of the spindles may be equipped with an automatic reversing mechanism, which may be set to reverse the spindle when any desired depth of thread has been reached. The reversing mechanism also allows the spindle to be stopped automatically instead of reversed at any predetermined depth. Hand reverse for tapping can be furnished if the automatic feature is not desired. Two sets of standard geared speeds may be had, 58 to 575 or 28 to 280 r.p.m. Two- and three-spindle units are built.



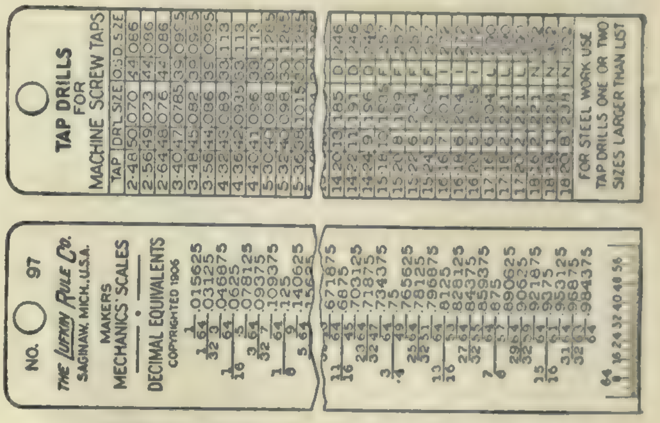
ALL-GEARED 22-INCH GANG DRILL

Capacity, up to 2-in. high-speed drills in steel; center of spindle to face of column, 11 in.; maximum distance table to spindle nose, with No. 4 taper 33¼ in., with No. 5 taper 32 in.; spindle travel, 14 in.; diameter spindle sleeve, 3⅜ in.; diameter driving end of spindle, 1$\frac{15}{16}$ in.; diameter spindle nose, 3$\frac{1}{16}$ in.; width of 8-pitch steel rack on spindle sleeve, 1⅛ in.; ratio of back gearing, 4 to 1; vertical travel of table, 23 in.; distance from floor to table, 42 in.; size of planed table surface, three-spindle machine 14 x 75½ in., two-spindle machine 14 x 47½ in.; distance center to center of spindles, 28 in.; height of machine, 85½ in.; weight, three-spindle machine 7832 lb., two-spindle machine 5300 pounds

Lufkin Reference Table for Mechanics

The illustration shows both sides of a flexible spring steel reference table, designed for pocket use of machinists, that is now being made by the Lufkin Rule Co., Saginaw, Mich. It measures 1$\frac{7}{16}$ x 6¾ inches.

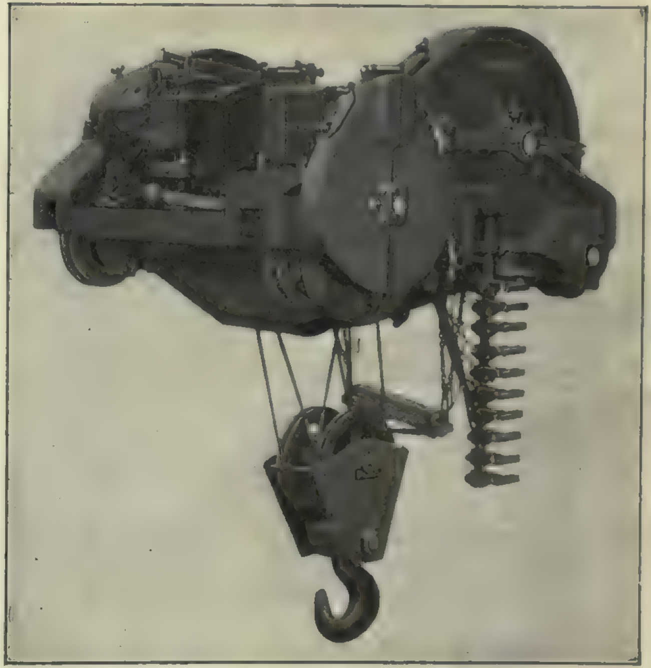
On one side are given machine-screw tap sizes, each followed by the tap-drill size number, its decimal equivalent, the body-drill size number and its decimal equivalent. On the reverse side are the decimal equivalents of fractions of an inch, and at the lower end is an inch graduated in sixty-fourths. A hole is provided at the top in order that the device may be hung up.


TAP DRILLS FOR MACHINE SCREW TAPS
TAP
DRL SIZE
FOR STEEL WORK USE TAP DRILLS ONE OR TWO SIZES LARGER THAN LIST
NO. 97
THE LUFKIN RULE Co. SAGINAW, MICH., U.S.A.
MAKERS MECHANICS' SCALES
DECIMAL EQUIVALENTS
COPYRIGHTED 1906

LUFKIN MECHANICS' REFERENCE TABLE

Champion Traveling Crane

The crane trolley here illustrated has been placed on the market by the Champion Crane Co., Cleveland, Ohio, to meet the very severe crane specifications of the steel mills. These cranes are designed with a view to accessibility and interchangeability and are provided with a safety device that prevents overhoisting.

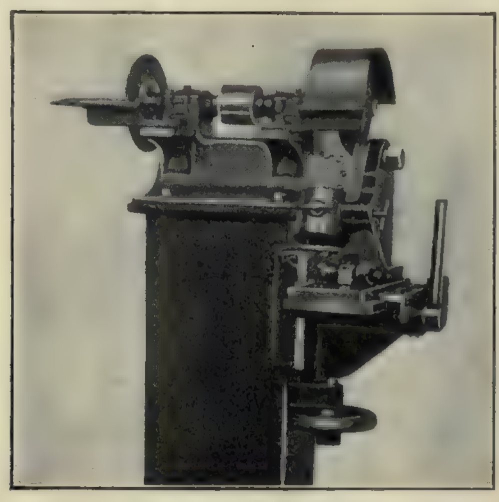


NEW CHAMPION CRANE

All castings are of ample size. The shafting is of forged steel. Gears are of steel, with cut teeth. The pinions are cut from 40-point carbon steel. A hook of special forged steel swivels on chrome-nickel steel balls. Split bronze bushings permit either grease or oil-ring lubrication. A mechanical load brake of Weston multiple-disk type is supplied in addition to the dynamic brake. A powerful foot brake stops the crane on the runway without reversing the bridge motor. All wiring conforms to the National Board of Fire Underwriters' rules.

Sleeper & Hartley Nail-Die Grinder

The machine illustrated has been placed on the market with the idea of providing a machine with which nail dies can be rapidly and accurately ground to shape. The spindle is double ended, carrying two wheels, one of which is used for squaring the dies, while the other, having a V-shaped edge, serves for grinding the pointing dies. The table carries a support designed to receive the holders in which the dies are mounted for grinding and is adjustable vertically and laterally, by means of handwheels. The die holder may be rotated in the support in order that the die may be located in any one of three grinding positions.



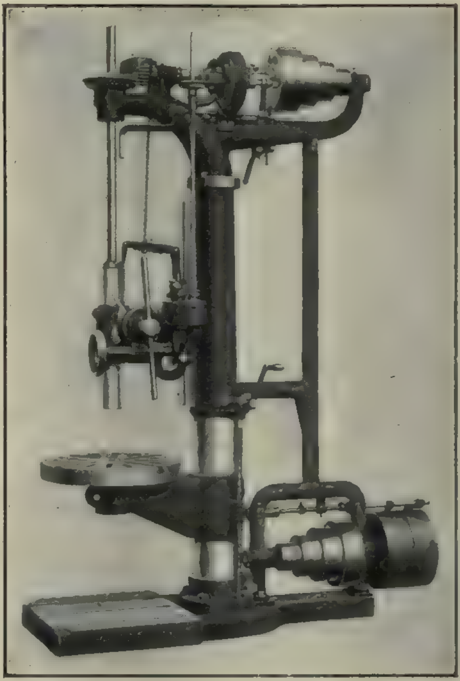
NAIL-DIE GRINDER

The floor space occupied is 16 x 22 in., and the weight is 350 lb. Sleeper & Hartley, Inc., Worcester, Mass., are the manufacturers.

Silver Drilling Machine

The 25-in. upright drilling machine illustrated is now being marketed by the Silver Manufacturing Co., Salem, Ohio. It is supplied with eight spindle speeds, four being secured by cone pulleys, the remaining four being dependent upon the back gears, which are fully inclosed in the upper cone pulley. There are six positive gear feeds, which may be changed while the machine is running.

The spindle is machined from high-carbon crucible steel and is provided with a ball thrust bearing. The spindle and sliding head are counterbalanced, the weight being inside of the column and secured by a chain. An automatic stop is provided for the downfeed and is set by means of graduations on the column for any required depth. The customary type of swinging table is used. It is raised or lowered by means of a crank-operated screw. A tapping attachment consisting essentially of four beveled gears, an intermediate pinion and two positive clutches can be furnished if desired. This is mounted on the head and is so constructed that the reverse mechanism may be thrown out of gear.

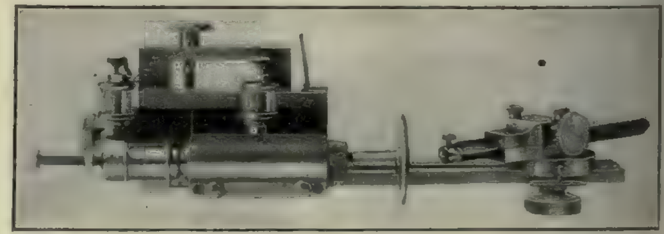


SILVER DRILLING MACHINE

Maximum distance spindle to base, 48 in.; maximum distance spindle to table, 31 in.; distance from column to spindle, 12⅞ in.; travel of table on column, 16 in.; travel of head on column, 22½ in.; diameter of table, 21½ in.; diameter of column, 6⅝ in.; diameter of spindle, 1⅝ in.; diameter of sleeve, 2¾ in.; feed of spindle, 9¼ in.; Morse taper hole in spindle, No. 4; ratio of bevel gears, $2\frac{3}{11}$ to 1; ratio of back gears, 3¾ to 1; size of drive pulleys, 4¼ x 12 in.; face of cone steps, 3½ in.; spindle speeds, eight, 14 to 315 r.p.m.; feeds, six, 0.0056 to 0.031 in. per revolution; floor space, 22 x 62½ in.; height, $87\frac{7}{16}$ in.; weight, 1650 pounds

Thread-Grinding Attachment

The thread-grinding attachment shown in the accompanying illustration is being placed on the market by the International Equipment Co., 1553 South 58th St., Philadelphia, Penn. This attachment is said to be well adapted to the making of thread gages, taps and dies, and it may be used for regular cylindrical grinding. It is readily put on any lathe and is claimed to be almost entirely free from vibration.



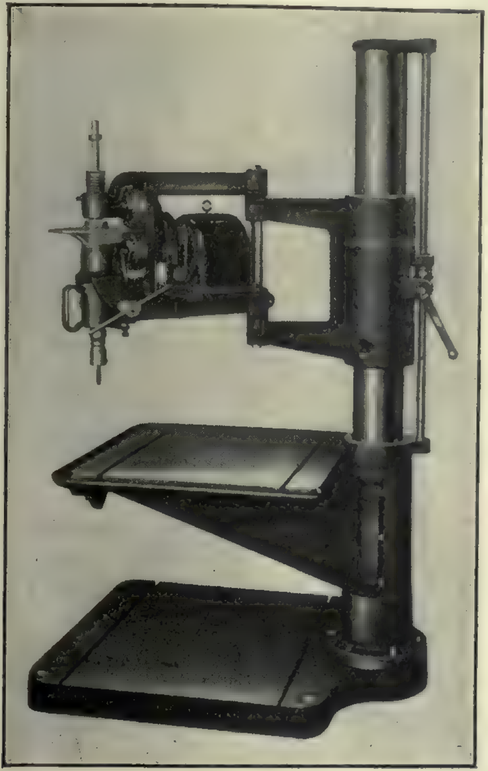
THREAD GRINDER

Spindle speed, 5500 r.p.m., operated from countershaft; weight 35 pounds

The diamond dressing tool can be attached or removed in a few seconds, making it possible to dress the wheel to perfect shape. Relieved taps and hobs, etc., also the teeth of formed cutters, may be ground to shape.

Rickert-Shafer Radial Tapping Machine

The radial tapping machine illustrated is being manufactured by the Rickert-Shafer Co., Erie, Penn., and is known as the ½-in. model R. The spindle is driven by an electric motor mounted on the outer section of the arm through a friction drive. All bearing bushings are of bronze, while SKF ball bearings take up the thrust. By means of this arrangement there is no tendency for the arms to fold up, as is common when the spindle is driven by either belts or gears and shafts, from a point at the rear of the machine. Either a positive-drive tapping chuck or a quick-change chuck is furnished, as desired. A plain or swiveled table is supplied.



RADIAL TAPPING MACHINE

Capacity in steel, ¼ to ½ in.; height over all, 79 in.; working-surface table, 30 x 30 in.; working surface of base, 36 x 36 in.; height of table, 28 in.; distance from table to chuck, 22 in.; distance from base to chuck, 46 in.; maximum distance spindle to column, 44¼ in.; minimum distance spindle to column, 8 in.; spindle travel, 4¾ in.; spindle speed, 250 or 500 r.p.m.; horsepower required, 1; net weight, 2000 pounds

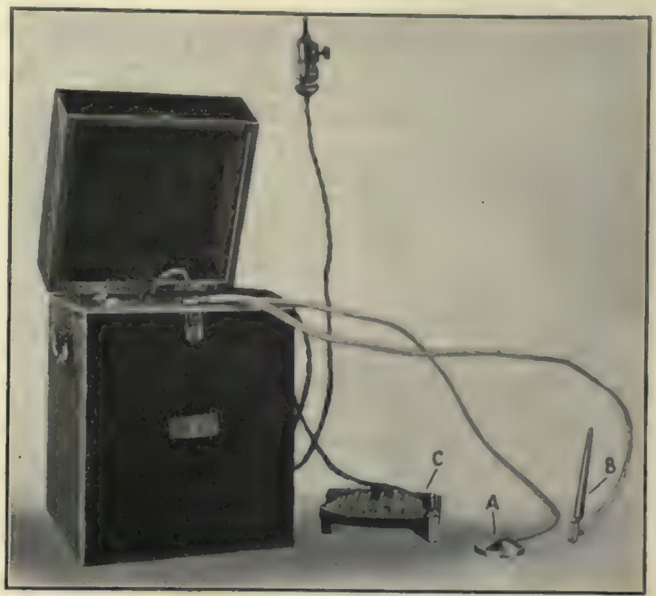
The machine is claimed to be particularly adapted to tapping such work as automobile crank cases and cylinder heads, engine- and turret-lathe parts, piano backs and other work where multiple tapping is required.

Electric Etching Machine

William Brewster & Co., Inc., of 30 Church St., New York City, are placing on the market an electric machine for marking tools and other articles of steel or iron.

The advantages claimed for this machine are low cost of operation, freedom of work from acid spots and rust, and speed of operation. The quality of the work is limited only by the skill of the operator. No wax or acid is required.

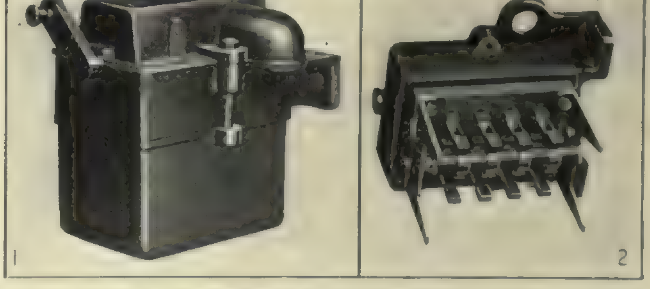
To operate the machine, it is connected to the 110-volt, 60-amp. alternating-current lighting circuit, as shown in the illustration. The tool to be etched is laid against the contact plate *A*, and the name or other marks are written on it with the copper-pointed pencil *B*. The depth of the etching is controlled by the resistance block *C*. No current is used when the pencil is not in actual use. The manufacturers will build these machines to operate on voltages and frequencies other than that specified if desired. For use on direct-current circuits a direct-current alternating-current converter will be furnished. The complete outfit weighs about 40 lb. and occupies a space 10 x 10 x 14 inches.



ELECTRIC ETCHING MACHINE

Crocker-Wheeler Oil Switch

The Crocker-Wheeler Co., Ampere, N. J., is now marketing the oil switch shown in the illustrations. It is designed for use with small reversing alternating-current motors. Fig. 1 is an outside view of the switch, while Fig. 2 shows the switch contacts in reversing position. The moving contacts are mounted on a fiber rod and connect the center row of contacts with one outside row for forward movement, and the center row with the other outside row for reverse movement. The moving contacts are free to turn on their axes, so that new contact surfaces are continually presented to the fixed contacts, the life of the switch being thereby greatly prolonged. Contacts may be renewed if necessary.



FIGS. 1 AND 2. EXTERIOR AND WORKING PARTS OF THE OIL SWITCH

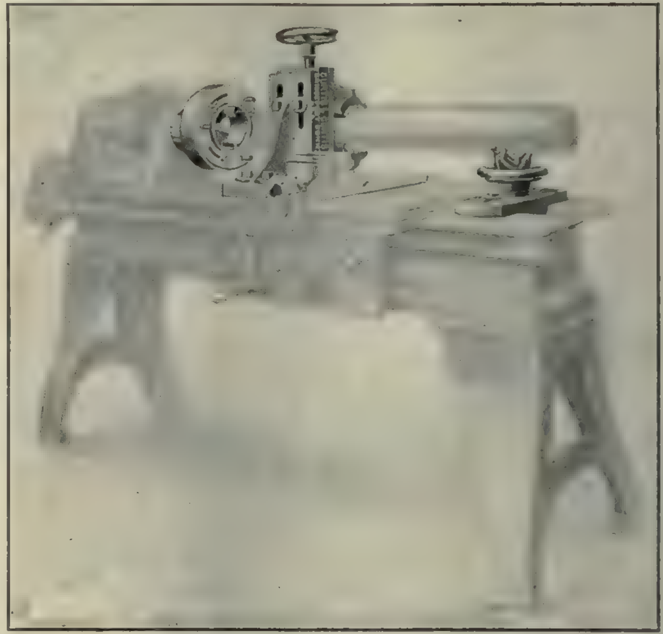
A removable cover permits access to the terminal board. No special ells or fittings are required when conduit wiring is used. The switches, which are furnished either with or without latches for holding the contacts in desired position, are built in a number of sizes for various voltages and currents.

Curtis Pipe-Threading Attachment

All who have occasion to thread any wrought-iron or steel pipe know well the difficulty with which this work is attended when not accomplished on a regular pipe-threading machine. In most machine shops it is done on an ordinary lathe with the usual chasing tool. This is not only very inconvenient, on account of the length of the pipe, but it is very difficult to cut a thread that will give a good joint, on account of the thread being tapered.

To meet this want of those whose work does not warrant the purchasing of a regular power pipe-threading machine the attachment illustrated has been made and can be placed on any lathe, within certain limits of size. With it the lathe can be turned into a power pipe-threading machine in a few minutes, and pipe of any length threaded very rapidly and correctly. This attachment consists of a die-carrying head, attached to the spindle like a chuck, an adjustable self-centering vise attached to the carriage, and an adjustable pipe rest, attached to the bed of the lathe to support long lengths of pipe. The pipe is held securely by the vise on the carriage, and fed to the revolving dies by moving the carriage by hand, or this can be done automatically by using the lead screw of the lathe, set to the number of threads corresponding to the standard of thread to be cut. When the thread is cut the length required, the dies can be opened by turning the faceplate, and the pipe is taken out without running back. All the dies are made adjustable to any variations of the fittings and from one size of pipe to another, so that each set of dies threads several sizes of pipe without changing.

To fit this attachment to any make or size of lathe, no machine work is necessary except on the flange connecting the diehead to the spindle. The attachment shown has a range from 1 to 4 in. right hand, inclusive, and is attachable to lathes of any make or size from 14 to 24 in. swing.



PIPE-THREADING ATTACHMENT

This attachment is made by the Curtis & Curtis Co., Bridgeport, Connecticut.

Personals

Theodore Swann, Alabama, has become president and general manager of the Southern Manganese Corporation.

William Stampleman, formerly with the Universal Tool and Die Works, is now secretary of the Ever Ready Machine and Tool Works, 180-182 Worth St., New York City.

Harry A. Reichenbach, who has been efficiency engineer for the Bethlehem Steel Corporation, has resigned to accept a similar position with the Alpha Portland Cement Co., Easton, Penn.

E. F. Entswille, mechanical engineer at the Bethlehem Steel Co., Steelton, Penn., has been promoted to general superintendent of the Donaghmore plant at Lebanon. He will be succeeded by **Frank E. Howells**, who is now assistant mechanical engineer at the Steelton plant.

Fred L. Watson, who held the position of treasurer of the American Steel and Wire Co. from 1897 to 1915, has removed his headquarters from Chicago to New York, where he has become assistant to the president of the Federal Export Corporation and treasurer of the Commercial Iron and Steel Corporation.

Business Item

The Pangborn Corporation, Hagerstown, Md., which has purchased and taken over the Sand-Blast Department of the Curtis Pneumatic Machinery Co., St. Louis, Mo., will carry complete stocks and be prepared to give prompt service.

Forthcoming Meetings

The twelfth annual exhibit of foundry and machine-shop equipment and supplies will be held under the auspices of the American Foundrymen's Association in the Mechanics Building, Boston, Mass., from Sept. 25 to 28, 1917. The officers of the exhibit committee are: President, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; vice president, Benjamin D. Fuller, Westinghouse Electric and Manufacturing Co., Cleveland, Ohio; secretary and treasurer, A. O. Backert, 12th and Chestnut Sts., Cleveland, Ohio; manager of the department of exhibits, C. E. Hoyt, 123 West Madison St., Chicago, Illinois.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

The American and Canadian engineers and architects of Norwegian birth and descent will hold an informal congress and reunion at the Chicago Norske Klub, Logan Square, Chicago, Ill., Sept. 27 to 29, 1917.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

The annual congress of purchasing agents, under the auspices of the national association, will be held at Pittsburgh, Oct. 9 to 11. The program includes business sessions for the mornings and visitation and inspection of industrial works during the afternoons. Special features are: Tour of Pittsburgh's principal business districts by automobile during the late afternoon of the first day, and cabaret dinner in the evening, to be held at one of the country clubs. The banquet will be held at the Convention Hotel the evening of the second day, Oct. 10, with speakers of national prominence in attendance.

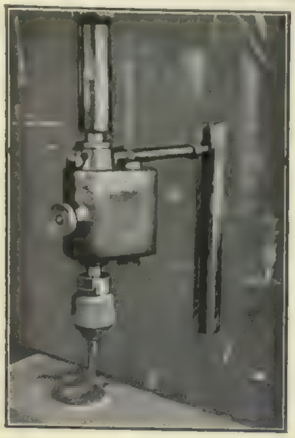
All purchasing agents as well as others interested are welcome and expected to attend and participate in the activities of the convention. Special arrangements are planned for the entertainment of the ladies.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 6-in. cards and file as desired

TAPPING ATTACHMENT

Wahlstrom Tool Co., 5520 Second Ave., Brooklyn, N. Y.



"American Machinist," Aug. 16, 1917

Designed for tapping holes up to ⅜ in. in diameter on the drilling machine. Made with either No. 2 or No. 3 taper shank. Reverse motion is accomplished by an upward motion of the drill spindle, which causes a reverse at increased speed. Where springy pieces are tapped, the oscillating feature of the attachment is engaged by the knob in front. This feature imparts to the tap a motion similar to that secured when tapping by hand

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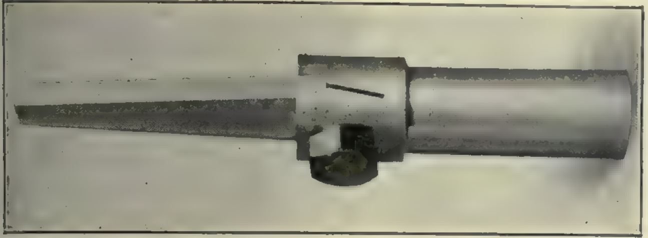
REAMER, TAPER

Charles E. Skelton, 107 North Franklin St., Syracuse, N. Y.



"American Machinist," Aug. 16, 1917

Designed for reaming taper holes using a high-speed steel blade and a low-carbon steel holder. Cutting edge ground on circle with heel backed off sufficiently to allow for maximum cut without "hogging in." Method of holding blade allows for lining up reamer with spindle where turret hole is out of line

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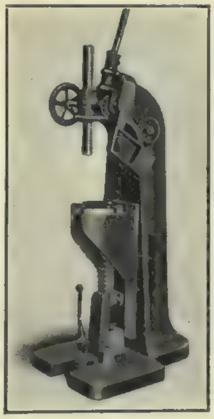
PRESS, ARBOR, QUICK-ACTING (FOX)

Sunderland Machinery and Supply Co., Omaha, Neb.



"American Machinist," Aug. 16, 1917

Diameter of work, 19 in.; largest arbor, 3¼ in.; capacity over table, 30 in.; size of rack or ram, 2 3/16 x 22 in.; movement on ram, 17½ in.; leverage, 60 to 1; height, 60 in.; floor space, 24 x 33 in.; weight, 1100 lb.; table counterweighted and provided with mechanism to facilitate quick movement

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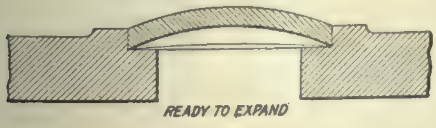
PLUG, WELCH EXPANSION

M. D. Hubbard Spring Co., Pontiac, Mich.



READY TO EXPAND

"American Machinist," Aug. 16, 191

Used for closing round cored holes in castings. Holes to be closed are counterbored to fit the plugs, which are inserted with convex side out, being then expanded and fastened in place by striking with a punch or hammer. Made in sizes from ¼ to 3⅝ in. in diameter and of various metals, as required

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GRINDER, ELECTRIC WET AND DRY

United States Electrical Tool Co., Cincinnati, Ohio

"American Machinist," Aug. 16, 1917

Made in two sizes with 3- and 5-hp. electric motors, carrying two 12 x 2-in. and two 18 x 3-in. wheels respectively. Bearings are self-aligning ball type, and Westinghouse motors are used. Speed of 3-hp. machine, 1800 r.p.m.; 5-hp. machine, 1120 r.p.m. Furnished for direct current of 110, 220 or 550 volts and two- or three-phase alternating current of 220, 440 or 550 volts at 25 or 60 cycles

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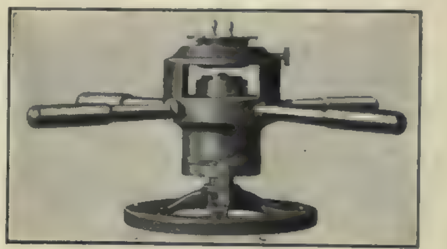
SHEET-METAL TESTER

Pittsburgh Instrument and Machine Co., 101 Water St., Pittsburgh, Penn.



"American Machinist," Aug. 16, 1917

For testing the drawing, stamping, compressive and folding qualities of sheet metals. The metal being tested is held on a ring-shaped die, and a ball-shaped anvil is forced into it, the desired information being obtained by noticing on graduated dials the amount of movement of the ball before rupture of the sheet occurs. Wire and strip stock may be tested if desired

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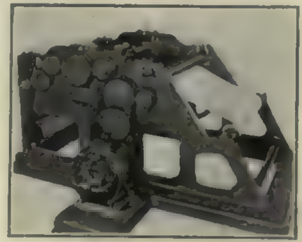
PUNCHING MACHINE, ROTARY

Malm Machine Co., Dayton, Ohio



"American Machinist," Aug. 16, 1917

A rotary punch press for punching rubber gaskets, washers, shoe soles, heels and other similar types of work, will handle cured or uncured rubber up to 36 in. wide and 1½ in. thick. Cutters are carried on a rotary drum meshing with a punch shaft, the material being fed in between the two. Has phosphor-bronze bearings, cast-iron gears and a hand flywheel. A counting and stacking attachment is also incorporated

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GRINDING WHEELS

White-Heat Products Co., Frazer, Penn.

"American Machinist," Aug. 16, 1917

Made of abrasive grains welded together, the result being a strong wheel claimed to cut fast and last a long time. The wheels can be finished from the raw material in 48 hours, enabling quick deliveries to be made on special orders. Abrasive grains imported from France, where they are made by a special process from French bauxite. The wheels are claimed to be fast and free cutting and are said to generate little heat in the material being cut

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Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Qutations were current as follows at the points and dates indicated:

	Aug. 17, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$47.00	$47.00	$14.00
No. 2X Northern Foundry, Buffalo.....	53.00	53.00	19.75
No. 2 Northern Foundry, Chicago......	55.00	55.00	18.50
*Bessemer, Pittsburgh	55.95	57.95	21.95
*Basic, Pittsburgh	52.95	53.00	18.95
No. 2X, Philadelphia.................	53.00	54.50	19.50
*No. 2, Valley.......................	53.95	55.00	18.25
No. 2, Southern Cincinnati...........	49.90	49.90	16.40
Basic, Eastern Pennsylvania..........	50.00	50.00	19.00

*Delivered Pittsburgh; f.o.b. Valley, 95% less.

STEEL SHAPES—The following base prices in cents per pound are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Aug. 17, 1917	One Month Ago	One Year Ago	Aug. 17, 1917	One Year Ago	Aug. 17, 1917	One Year Ago
Structural shapes ...	5.25	5.25	3.25	4.50	3.25	5.00	3.10
Soft steel bars......	5.00	5.00	3.30	5.00	3.30	4.50	3.10
Soft steel bar shapes.	5.00	5.00	3.25	4.50	3.25	4.50	3.10
Plates, ¼ tol in. thick	9.00	9.00	4.00	8.00	3.65	8.00	3.50

BAR IRON—Prices in cents per pound at the places named are as follows:

	Aug. 17, 1917	One Year Ago
Pittsburgh, mill	5.25	2.60
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Aug. 17, 1917	One Month Ago	One Year Ago	Aug. 17, 1917	One Year Ago	Aug. 17, 1917	One Year Ago
*No. 28 black......	8.50	10.50	10.00	3.65	9.00	3.20	10.00	3.20
*No. 26 black......	8.45	10.40	9.90	3.55	8.90	3.10	9.90	3.10
*Nos. 22 and 24 black	8.40	10.35	9.85	3.50	8.85	3.05	9.85	3.05
Nos 18 and 20 black	8.35	10.30	9.80	4.45	9.20	3.70	9.80	3.00
No. 16 blue annealed.	8.70	10.20	9.70	4.45	9.20	3.70	10.20	3.60
No. 14 blue annealed.	8.60	10.10	9.60	4.35	9.10	3.60	10.10	3.50
No. 12 blue annealed.	8.55	10.05	9.55	4.30	9.05	3.55	10.05	3.45
No. 10 blue annealed.	8.50	10.00	9.50	4.25	9.00	3.50	10.00	3.40
*No. 28 galvanized...	10.25	13.00	13.00	5.00	10.75	4.70	11.50	4.75
*No. 26 galvanized ..	9.95	12.70	12.70	4.70	19.45	4.40	11.20	4.40
No. 24 galvanized...	9.80	12.55	12.55	4.55	10.30	4.25	11.05	4.30

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring fair-sized lots, the following quotations hold:

	Aug. 17, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	40%	45%
Cleveland	40%	45%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—This material per 100 lb. sells as follows:

	Aug. 17, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	13.30	6.30
Chicago	12.50	5.25

In coils an advance of 50c. usually is charged.
Note—Stock scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in fair-sized lots:

Welding Wire*	
⅜, 11/32, 5/16, ¼, 7/32, 3/16 No. 8, 5/32 and No. 10 ⅛ .... No. 12 .... 3/32, No. 14 and 1/16 .. No. 18 .... No. 20	21.00@30.00

¹ Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Aug. 17, 1917	Cleveland Aug. 17, 1917	Chicago Aug. 17, 1917
Tire	5.00	5.00	4.50
Toe calk	5.00	5.50	4.75
Openhearth spring steel...	7.00	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Ordinary carbon tool steel, base price	14.00	13.00	....

*In bars.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	42%	15½%	¾ to 1½.....	33%	17%
½	46%	31½%			
LAP WELD					
2	42%	15½%	2	26%	12%
2½ to 6......	45%	31½%	2¼ to 6......	28%	15%
BUTT WELD. EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	38%	20½%	¾ to 1½.....	33%	18%
½	43%	30½%			
¾ to 1½......	47%	34½%			
LAP WELD. EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4......	43%	31½%	2¼ to 4......	29%	17%
4½ to 6......	42%	30½%	4½ to 6......	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	29%	15%	38.8%	24.8%
3½ to 6 in. steel lap welded	26%	7%	36%	21%	42.8%	27.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound:

	Aug. 17, 1917	One Month Ago	One Year Ago
Copper, electrolytic (carload lots).....	28.00	28.00	28.00
Tin	62.75	62.50	38.00
Lead	11.00	10.37½	6.00
Spelter	9.00	8.75	9.00
ST. LOUIS			
Lead	10.75	10.12½	9.37½
Spelter	9.25	8.50	9.37½

At the places named, the following prices in cents per pound prevail:

	New York			Cleveland		Chicago	
	Aug. 17, 1917	One Month Ago	One Year Ago	Aug. 17, 1917	One Year Ago	Aug. 17, 1917	One Year Ago
Copper sheets, base	36.00–40.00	42.00	35.50	38.00	39.50	39.50	37.00
Copper wire (carload lots)	38.50	39.50	30.00	38.00	33.00	38.50	33.50
Brass pipe, base...	43.00–45.00	47.50	46.50	46.00	45.00	46.00	45.00
Brass sheets	40.00	39.12½	44.50	36.00	42.00	40.50	39.00
Solder ½ and ½ (case lots)	39.25	39.50	24.62½	39.50	24.75	39.25	24.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Aug. 17, 1917	One Year Ago
Mill	$42.00	$42.00
New York	38.00	45.50
Cleveland	34.00	38.00
Chicago	39.00	42.50

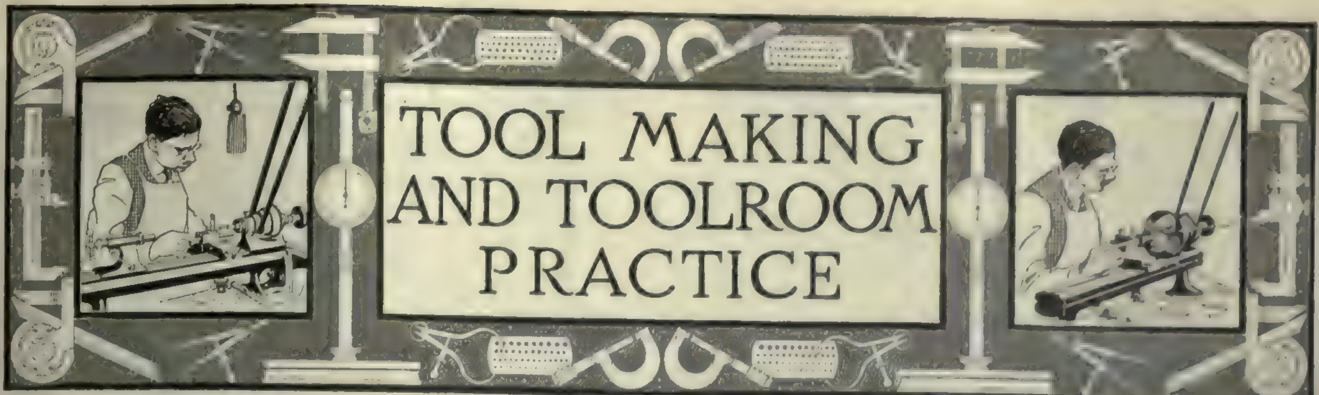
ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.. 19.00

	In Casks		Broken Lots	
	Aug. 17, 1917	One Year Ago	Aug. 17, 1917	One Year Ago
New York	21.00	17.00	21.50	18.00
Cleveland	23.00	16.75	23.25	17.50
Chicago	22.50	17.00	23.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound for spot delivery, duty paid:

	Aug. 17, 1917	One Year Ago
New York	15.00	10.50
Cleveland	16.50	13.00
Chicago	16.50	15.00



TOOL MAKING AND TOOLROOM PRACTICE

Checking Angles with Swedish Blocks

BY H. B. LEWIS

SYNOPSIS—*The illustrations herewith are from photographs recently taken in the inspection room of one of America's foremost manufacturers, and show the quick and reliable methods of checking gage angles by using the Johansson standard gage blocks.*

IN FIG. 1 is shown the Johansson way of adjusting the sine bar *A*. The buttons *B* on the bar are ½ in. in diameter and 5 in. apart from center to center. This distance is accurately spaced and checked by laying a combination of blocks totaling 4.500 in. between the buttons. One button is then rested on blocks of a certain height and the second button elevated to the height required to give the desired angle. This latter height is taken either from the drawing itself or, if the angle only is indicated, by reference to tables of angles and sines. The sine for the specified angle is multiplied by 5, and to this product is added the distance from the first button to the surface plate. A combination of Johansson blocks is then built up to give exactly the height thus obtained. In this way any angle in degrees, minutes and approximate seconds can be set up, as the heights of the buttons can be modified by using different combinations of blocks giving sizes by increments of 0.0001 in.

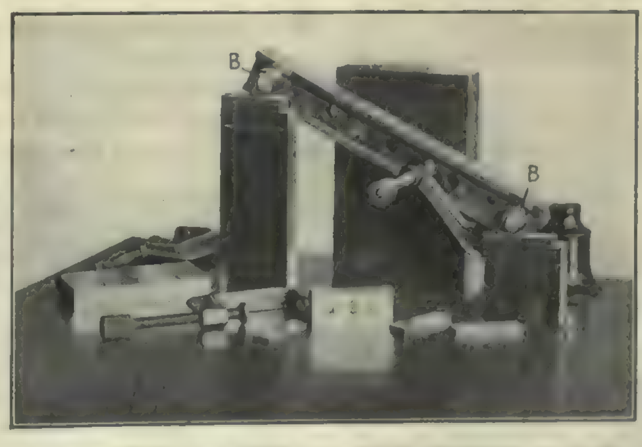


FIG. 1. SETTING A SINE BAR WITH SWEDISH BLOCKS

An actual application of this method is seen in Fig. 2, where the inspector is checking the taper end of the gage *A*. This taper forms an included angle of 37 deg., 9 min. and 12 sec. The sine bar *B* has accordingly been set up by the method shown in Fig. 1, to give that angle. In order to raise the work a handy distance above the surface plate the blocks *D*, of a convenient size, have been brought up against the sine bar. The angle formed by the line of the sine bar and the top of these blocks is the same angle at which the sine bar has been set, as the two sides of the blocks are parallel and the top line is, of course, parallel to the surface plate. If the taper on the gage is correct, it will fit this angle exactly. This is tested by holding a light back of the glass plate to which the sine bar is clamped.

In Fig. 3 is shown a way of checking an angle, using the gage *A*, which is to be checked as a sine bar. The raised piece *B*, which is doweled onto the lower left-hand corner of the gage, has one corner worked out. The under face of this worked-out corner is at a certain angle to the line between the two pins *C* and *D* at the right and left of the gage. It is simple geometry that if the alternate interior angles formed by a straight line crossing two other straight lines are equal, the two latter lines are parallel. If the two pins *C* and *D* are set at an angle to the surface plate equal to the angle formed by the under face of the doweled piece, the line of that under face will be thrown parallel to the surface plate. The pins are therefore placed in a line which meets the surface plate at the specified angle, using the method already described. The thin block *E* is then fitted in between the top of the left-hand pin and the under face of the doweled piece. This forms a continuance of the line of this face. If this line registers parallel to the surface plate, its angle is correct. This is tested by running the indicator *F* along the block *E*.

In Fig. 4 the gage *A* being checked is a special shaped hollow plug. This can be seen held in the V-block *B* by the small clamp and thumb-screw on the right. The V-block, with its lower side resting on the sine bar *D*, is held to the upper right corner of the angle plate by the large clamp *E*. On the right side of the gage extends a fork into which have been fitted the two Johansson blocks which project to the right at *F*, just below the thumb-screw. On the opposite side of the gage there is a deep groove, or slot, which can hardly be seen in the illustration as the two small Johansson blocks *C*

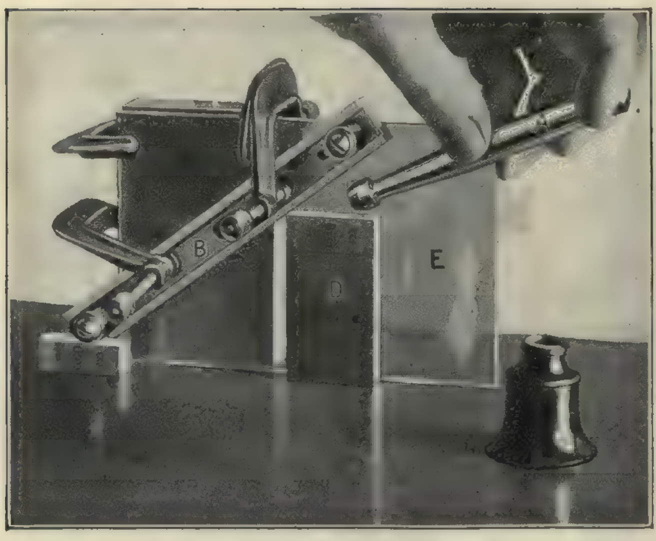


FIG. 2. TESTING A TAPER WITH THE SINE BAR

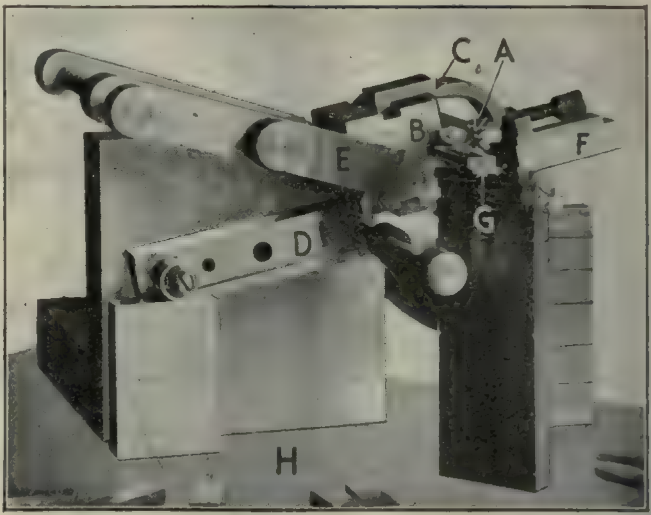


FIG. 4. A DIFFICULT GAGE TO CHECK

at the left have been fitted into it. The opposite sides of this slot are not concentric but are parallel and at an angle of 11 deg. to the inner faces of the fork. Johansson blocks are first used to check the distances between the prongs of the fork and the sides of the slot. If these are correct, the blocks are held securely in place by a snug fit.

The V-block *B* is placed on its side, resting on two parallels. The gage is placed in the V and turned until the surface of the blocks projecting from the fork is in a line parallel to the side of the V-block. The gage is then securely clamped and the V-block placed on a sine bar which has been adjusted at an angle of 11 deg. As the alternate interior angles are equal, the surface of the blocks projecting from the slot at the left are thrown parallel to the surface plate *H*. This is tested by sliding a combination of Johansson blocks beneath the blocks projecting from the slot as is shown in the illustration, or by running an indicator across the top, as in Fig. 3.

No angle difficulties are met with in checking the gage shown at *A* in Fig. 5, but a glance will show how several direct measurements are easily and quickly made with the Johansson blocks, which, singly or in combination, equal the specified dimensions.

Extreme accuracy is required in all of the work shown. In some instances an error of 0.0001 in. is sufficient to cause the gage to be rejected.

Figs. 6 and 7 show side and plan views of a fixture gage for checking rifle parts. Many of the measurements, in which extreme accuracy is required, would be most difficult without Johansson gages; for instance, the distance between the top side of the test pin *A*, across which the top block of the left-hand combination of gages is extended, and the under side of the sliding test pin *B*, which is seen resting on the other combination of blocks, Fig. 6. These two combinations give the exact distance from the base to each point, and the difference between the two is the distance from the top of one pin to the bottom of the other.

In the plan view, Fig. 7, is shown the method of checking the high limit on the horizontal sliding test pin *A*. This must bear an exact relation to the surfaces of the

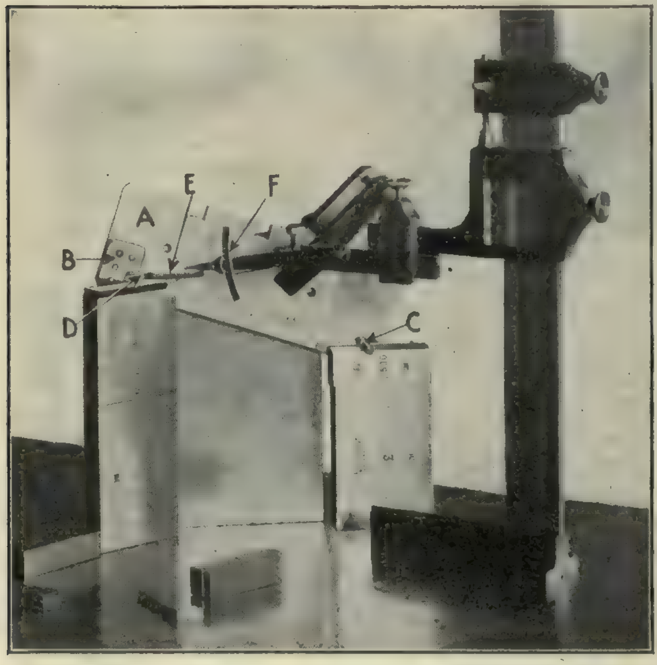


FIG. 3. USING A GAGE AS A SINE BAR

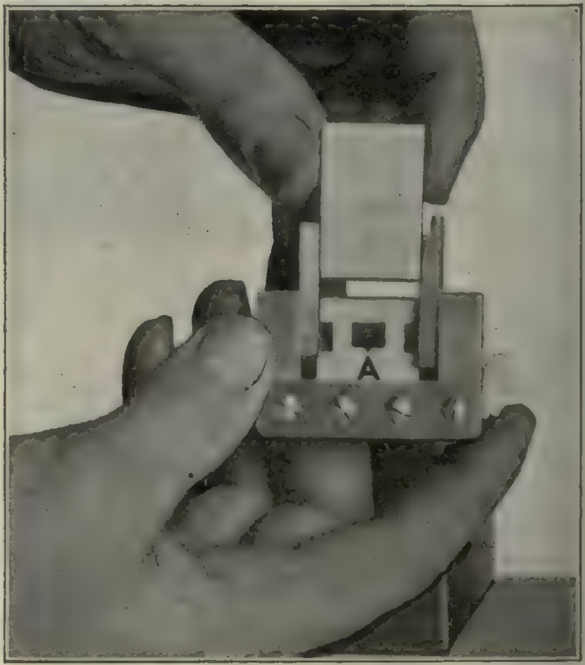


FIG. 5. CHECKING SIZES DIRECT

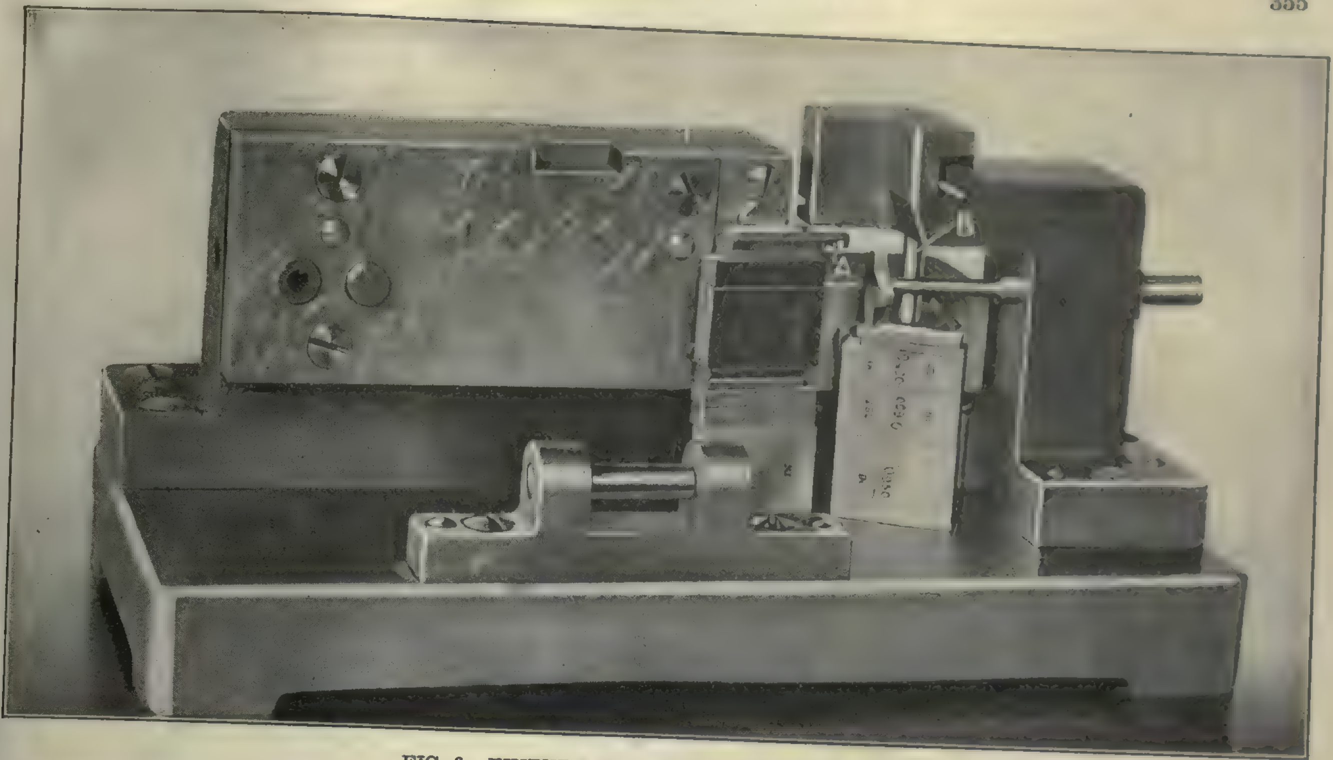


FIG. 6. FIXTURE FOR CHECKING RIFLE PART

height buttons *B*, upon which rest all the three combinations of Johansson gages. Agreements between these four measuring points can be quickly checked by drawing the indicator across the high limit of the test pin and the combination of blocks.

It is said in the shop of Mulliner & Enlund Co., Syracuse, N. Y., where this rifle gage was made, that many hours of valuable time were saved on this job alone.

In the same shop very satisfactory results have been obtained in laying out and spacing holes in drill jigs by the size-block method, Fig. 8. The right angle *A*, carefully ground and lapped, is securely clamped to the plate *B*. The jig *C*, square and with sides parallel, is clamped on the plate at such a distance from the sides of the right angle that the first hole to be bored, the upper left-hand hole in the illustration, is in line with the spindle axis.

After this hole is bored, the other holes are spaced in relation to the first hole and in relation to each other by shifting the jig *C* up or to the left a distance equal to the distance between the center points of the holes. The distance of each shift is measured by inserting the combinations of Johansson gages *D* between the sides of the jig *C* and the right angle *A*. The jig can be shifted across the plate in successive stages until the center point of each hole, whatever the distance between holes, has been brought accurately in line with the axis of the spindle. At each move the jig is securely clamped, and the hole drilled and finished with a tool or grinder.

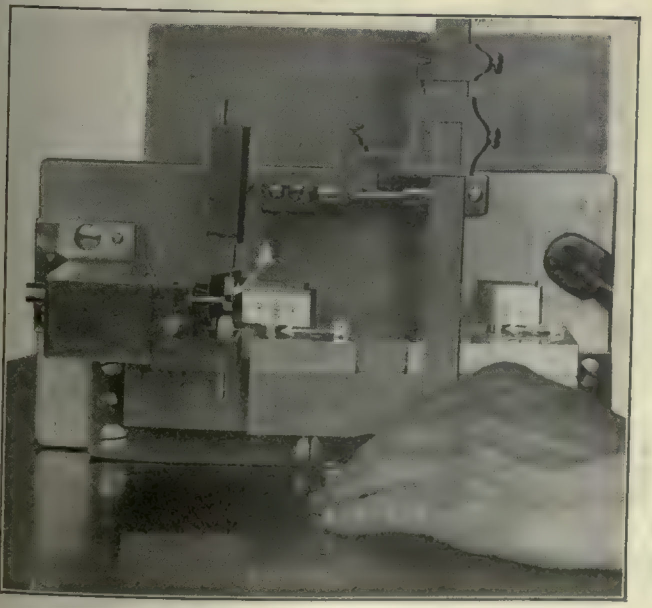


FIG. 7. FIXTURE FOR TESTING RIFLE PARTS

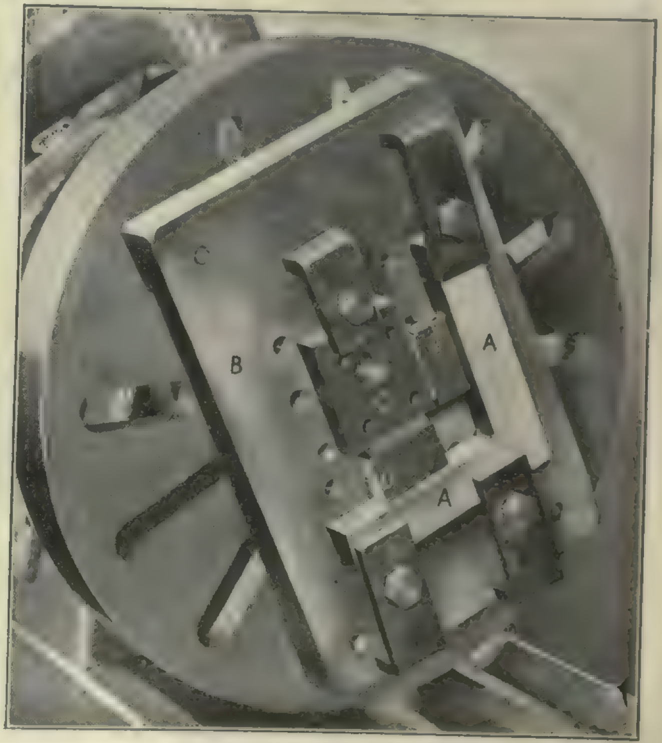
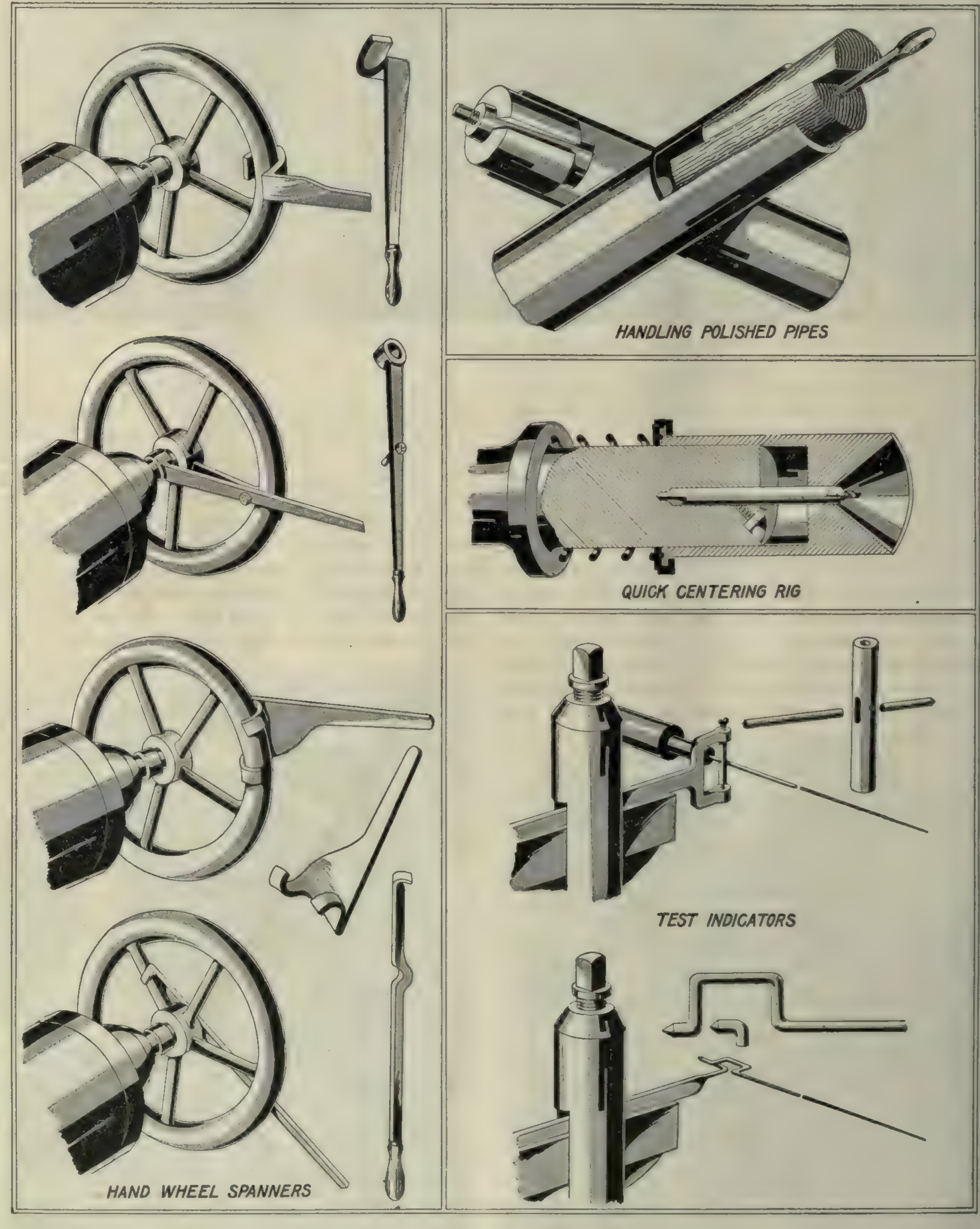


FIG. 8. SPACING HOLES ACCURATELY

From a Small-Shop Notebook

By J. A. LUCAS

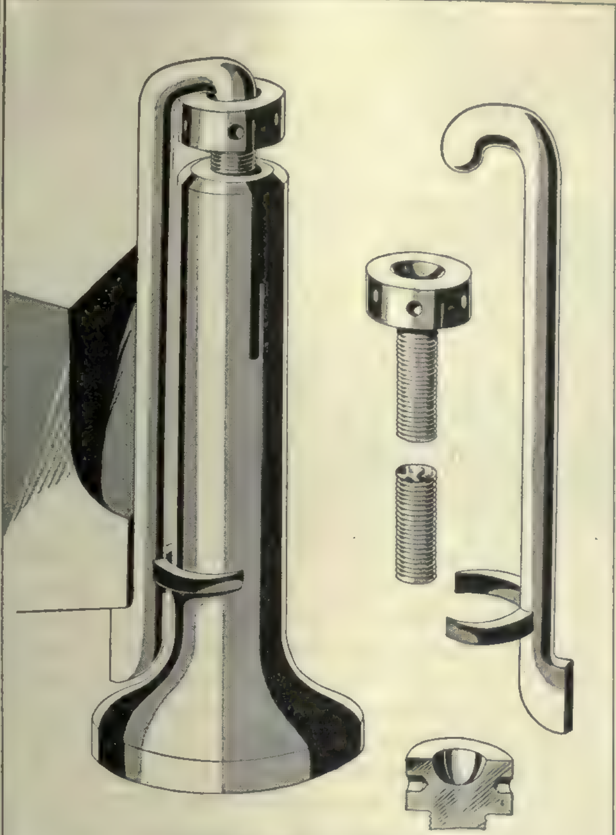

HAND WHEEL SPANNERS

HANDLING POLISHED PIPES

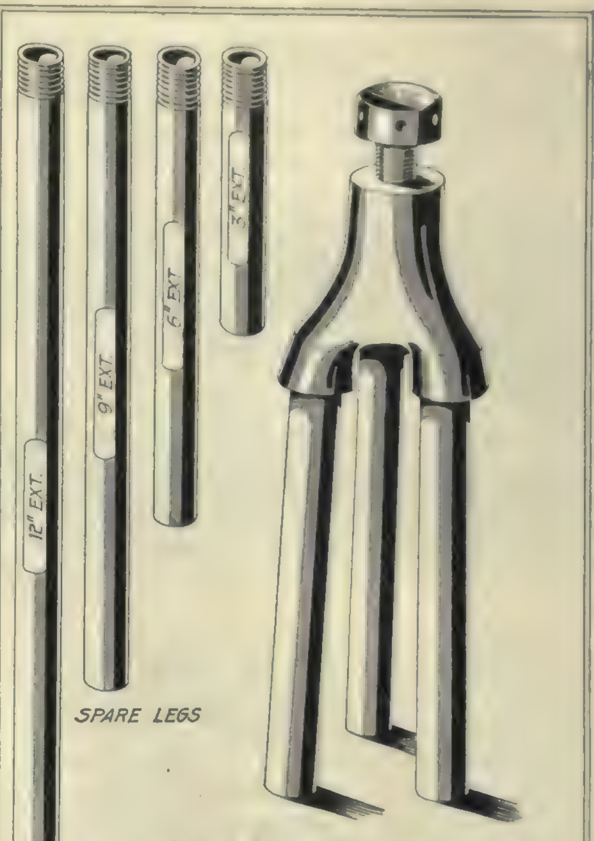
QUICK CENTERING RIG

TEST INDICATORS

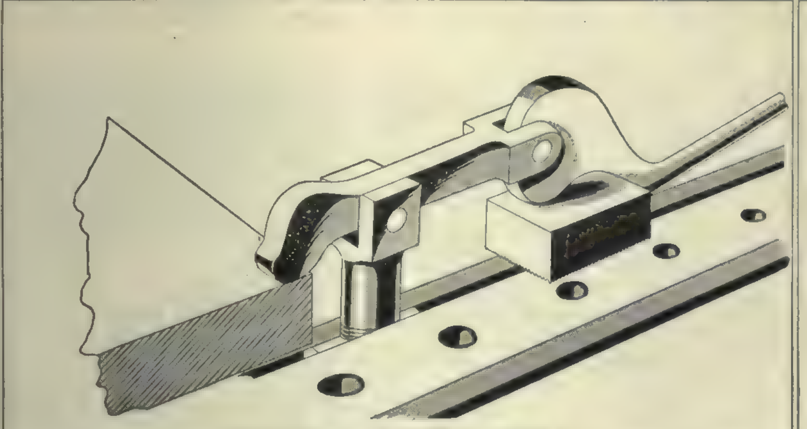
SOME USEFUL SHOP KINKS



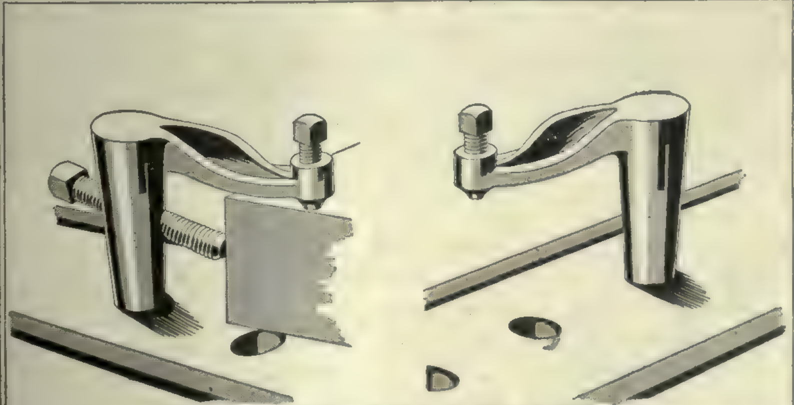
MAKING HIGH JACKS LOW



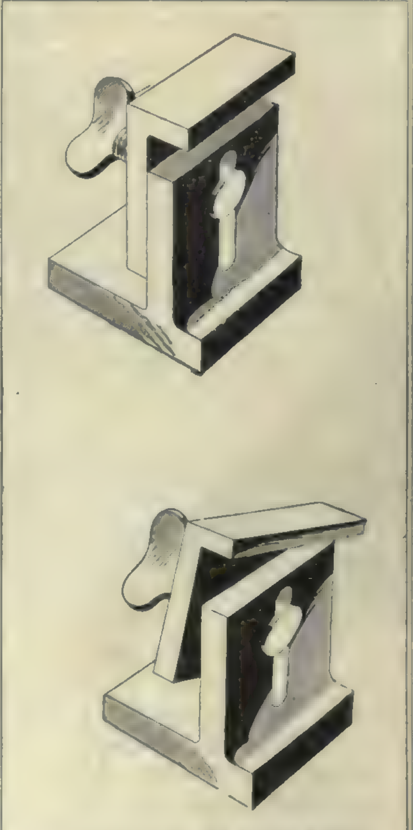
MAKING LOW JACKS HIGH



ECCENTRIC CLAMPING DEVICE



DOUBLE-ACTING CLAMP FOR PLANER



ADJUSTABLE PLANER JACKS

VARIOUS TYPES OF JACKS AND CLAMPS

How Shall We Define Raw Material?

By A. M. Watcher
Secretary and Treasurer, Queen City Machine Tool Co., Cincinnati, Ohio

In reading your editorial on page 167, the writer is reminded that there seems to be some confusion as to just what is "raw material"; you mention in this category "coal, iron, copper, brass, tin and zinc." Brass does not really belong with the other items, nor iron, except as iron ore. I beg to submit the following as one man's thought on the question, to see if this matter might be considered in a different light than is usual and get a better understanding as to what is raw material.

Strictly speaking, "raw material" is the natural product, in the ground or elsewhere, before any labor is expended on it. Iron ore, coal, copper, tin, zinc, lumber, salt, etc., are unquestionably "raw material" when they are in their natural state, before any work has been done toward marketing them; but in actual practice, what is one man's raw material is another man's finished product.

As an example with which all machine-tool and allied concerns are familiar, take iron, for instance. Suppose we eliminate the big producer and take only the smaller concerns whose activities are confined to one branch of the iron industry. When the ore is in the ground, as stated above, it is what we call natural resources and is strictly "raw material"; but just as soon as any labor is expended on it—when it is mined, loaded on cars or boat, and brought to the market—it is the mine owner's finished product, but it is the furnace man's raw material.

So on up, all along the line. Pig iron is the furnace man's finished product, although it is the foundry man's raw material. The question might be raised right here as to where scrap iron comes in. It can be disposed of as raw material until the junk man does his "bit" on it, when it becomes his finished product and is another of the foundry man's raw materials. Castings, the foundry man's finished product, serve as raw material to the machine-tool man. Here we might speak of steel, the makers of which use about the same raw materials as the foundry man, but under a different process produce steel, their finished product, but another of the machine-tool man's raw materials.

So the writer wants to submit the thought that we must either consider only our natural resources as raw material or classify as has been done before, considering material in course of refining as one man's raw material and another's finished product.

Here, it seems to the writer also, comes up a point in standardizing a protective tariff, if we are ever to have one again. The ore in the ground is really worthless, unless it is worked. From this ore in the ground, up to any one of the finished products mentioned above, even including the ore when delivered to the market ready for the furnace man, all cost, including transportation charges, etc., is really labor; also, the original investment in the property and profit charged are really represented by the labor of capital, one might say.

Granting that the above is logical, why not an ad valorem duty on all products in proportion to cost of labor in its exploitation? Looking at it this way, say iron ore is worth $4 per ton as the mine owner's finished product delivered to the market; pig iron would be worth about $20, when the market is normal, delivered to the foundry man; castings about $60 and machine tools about $300 per ton; bar steel, in normal times, would be worth in the neighborhood of $40 per ton, based on the assumed price of pig.

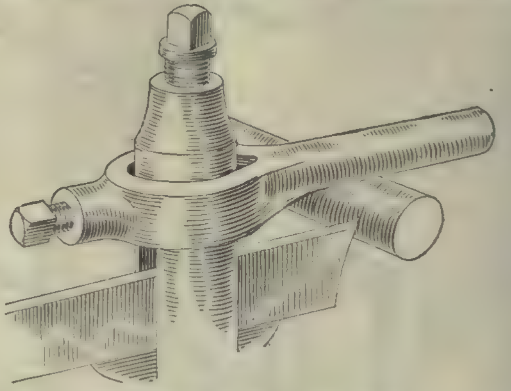
A duty, based on the value of the different items above, but of the same percentage on each, would seem to be about right, if figured to take care of the difference in labor cost in this country and abroad. Taking 25 per cent. ad valorem duty as a fair tariff on machine tools, for instance, it would seem fair to make the same ratio of duty apply on all imports of iron and steel. On the basis of figures submitted, machine-tool builders, at 25 per cent., would get protection to the extent of $75 per ton; the foundry man, on gray-iron castings, $15; the steel man, on low-grade steel, $10; the furnace man, about $5; and the mine owner, $1 per ton.

This same idea might be worked out on practically all items on which a tariff was desirable on account of the difference in cost of labor here and abroad. On items not indigenous to this country, the duty could be made on a basis of free trade or tariff for revenue only, when in the crude state. Take diamonds, for instance; why not put a low duty on the rough stones as mined, but a high duty on the cut diamonds proportionate to the difference in cost of labor here and abroad, or in excess of it, thus encouraging the importation of all such items in an unfinished state, when possible of being worked in this country, to encourage this work being done in this country by citizens of the United States?

Emergency Follow Rest

By William T. Slider

A few days ago, while passing through the shop, I noticed an "old-timer" turning a small long shaft on a large lathe, an emergency job. His steadyrest jaws could not reach so small a shaft, and the shaft was too long to be turned without a rest of some description.



EMERGENCY FOLLOW REST

He took a straight-tailed dog, put it on over the tool post in the manner shown in the illustration and adjusted it to bear upon the shaft. He had a follow rest that, so far as doing the work effectively, could not well be beaten. The job was turned smooth, without chatter and in record time.

When I felt obliged to commend him, he replied that he had used the same method years before.

A Yosemite Garage Under Canvas

YOSEMITE National Park, located only 240 miles from San Francisco, is easily accessible to the traveler by either railway train or automobile, and engineers and others who spend any time in examining the work going on along the railroad, highways and river valleys leading to the park find much to surprise and interest them.

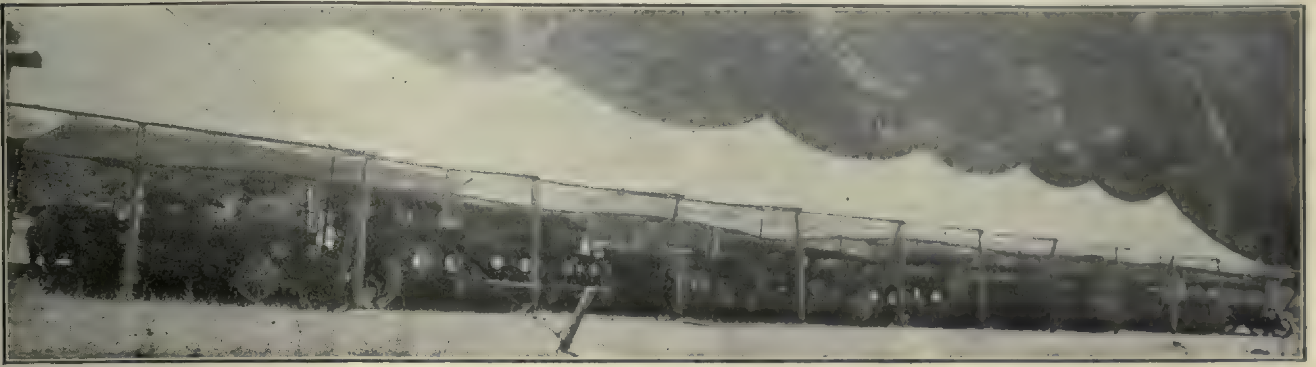


FIG. 1. THE TENT USED FOR STORAGE PURPOSES

The main line of railway running down the central part of California through the San Joaquin Valley passes through the town of Merced, at which point branches off a 78-mile road, the Yosemite Valley Ry., to El Portal, the gateway to the park.

In the City of Merced and along the railway line there are a number of engineering enterprises of importance in the way of mining projects, logging camps, big sawmills and hydro-electric power plants.

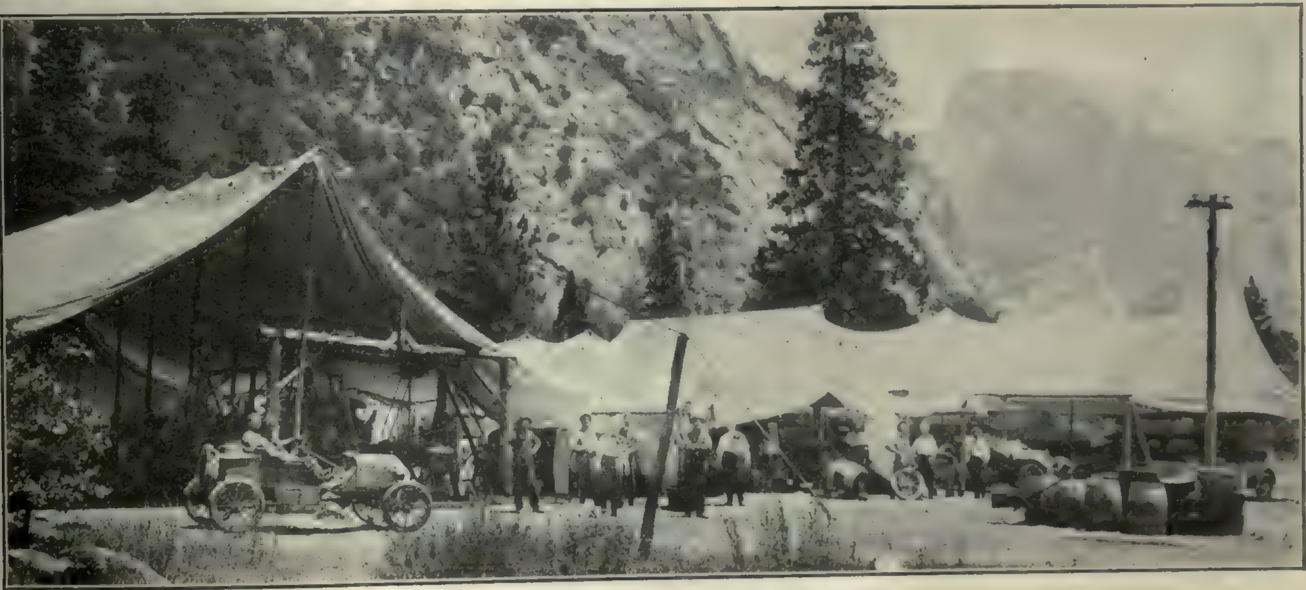


FIG. 2. THE MACHINE AND REPAIR TENTS

There are four highways from various cities in this section leading into Yosemite, and along each of these there are certain undertakings of interest. The four park entrances for vehicles are the automobile routes via Coulterville Road, Big Oak Flat Road, Wawona Road and Tioga Road.

The State of California has long been a paradise for automobilists, due to the fact that there has been constant and consistent improvement in the highways leading to its principal cities. There are also many cross-roads of less importance passing through small towns, although they often form the only means of communication existing between these out of the way places.

The number of automobile users in the state has increased by almost an unbelievable percentage since the popular adoption of cars throughout the country. Moreover, the wide use of the automobile by residents of the state has been almost duplicated by visitors and temporary residents from eastern states, who spend a portion of each year in the Far West.

Many business men traveling out of the larger towns use automobiles exclusively and in preference to railway service, finding that they save time by doing so. The tendency toward the almost universal use of the automobile, particularly in central and southern California, has brought about this improvement in the highways referred to above.

The four roads leading into Yosemite Valley during the year of the Panama-Pacific Exposition were kept through the season in a condition that enabled thousands of car users to make the trip to the park a journey of pleasure from start to finish.

While the native Californians have become more or less accustomed to diversity of scenery in their state and are less inclined to make the journey of two or three hundred miles to the Yosemite Valley than might be imagined by most of us, there are still a good many of them who regularly come from San Francisco, Los Angeles and other cities to spend two or three weeks or more in the Valley or in camping out in some of the surrounding hill sections.

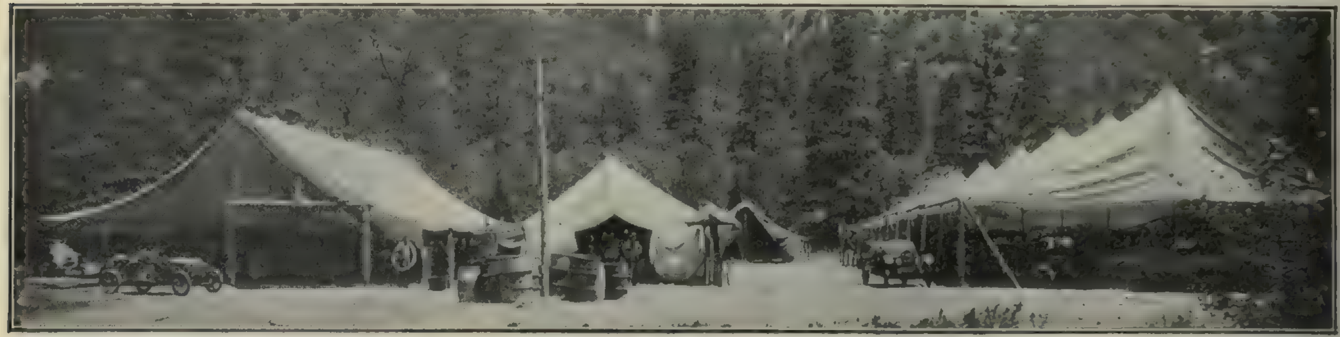


FIG. 3. A GENERAL VIEW OF THE WHOLE GARAGE

The great distances between towns along certain roads makes it necessary for a car driver to keep his machine in good order and to know that he is well supplied with gasoline and oil when he leaves any town. The thousands of visitors to the park in 1915, made up of Californians and Easterners, led to the building of numerous garages at various points across the state. For taking care of cars that arrived in the Valley, a general garage, very large in capacity, was fitted up and maintained throughout the season on the floor of the Valley in Indian Canyon. This garage was put up and operated by Lounsbury & Shaeffer, of Merced.

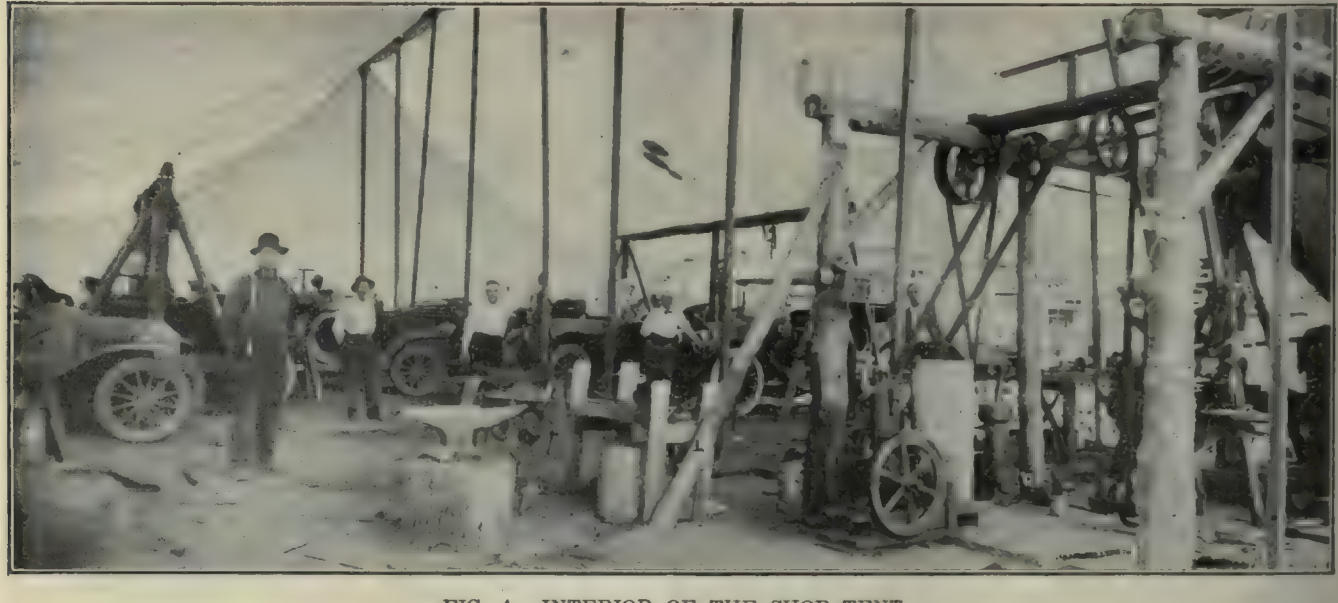


FIG. 4. INTERIOR OF THE SHOP TENT

The necessity for such a garage and service station will be appreciated when it is stated that during the season of 1915 a total of 2270 automobiles entered the Valley. The number of people visiting the park in private cars was 20,814, by far the greatest number of visitors that has ever gone to the park in one season.

The grades at some points on the highway to the park are very severe, and at times after heavy rains a good deal of care must be exercised on the part of the driver to avoid excessive strain on the motor, transmission, steering mechanism, etc.

The garage people found plenty to keep them occupied in inspecting and overhauling automobiles, many of which entered the Valley at the conclusion of a long tour, possibly the greater part of the way across the continent. Many others made the trip from San Francisco or some other nearby city.

The capacity of the garage, an open-air affair with a canvas roof, to all appearances like a great tent, was sufficient to house over 80 machines at one time. A general view of one of the long tent garages is given in Fig. 1, where the space under the canvas roof of the garage is completely filled with cars and equipment. The machine shop, as will be seen, is provided with a lathe, drilling machine, forge equipment and other apparatus, the machinery being driven by a small gasoline engine.

The lineshafts and countershafts for the tools are carried by rough structures built up of timber from which the limbs have been shorn, but which are not squared up or even smoothed up in the round trunk. It is a rustic structure erected on a platform, a temporary although substantial flooring for the tools to stand on. Beyond the tool equipment will be seen an overhead structure for slinging hoists to enable car bodies or other heavy work to be suspended while repairs are being attended to.

Specifications for Leather Belting

By LOUIS W. ARNY
Secretary the Leather Belting Exchange, Philadelphia, Penn.

SYNOPSIS — *The difficulties of selecting belting by the conventional methods are here pointed out and a promise is given of definite data.*

ABOUT a year ago there was some discussion in the columns of the *American Machinist* as to specifications for leather belting. As some work has been accomplished since in the effort to make better specifications possible, some review may be in order at this time, for leather belting is an important factor in power transmission, since it is so largely used and is capable of such wide adaptability.

The conditions surrounding the manufacture and use of leather belting have been such as to make impossible any complete specifications, not the least of which has been the fact that those best acquainted with leather and leather belting were not technically informed about the chemistry and engineering of their material and their product, and that those who had essayed work in the chemistry and engineering were ignorant of the properties of leather. Such experimental work as has been done on this important subject has but little value in its present form, because those who have done it have not worked on standardized belts, or have had but little knowledge of the character of the belts on which they have worked.

Peculiarities of Leather

Leather is not a homogeneous product. It is made from the hides of animals each one of which, besides having its individual peculiarities, differs from that of others of the same kind in size, age and physical condition. The hides, too, are different in texture and strength in their several parts, and they are tanned in many different tanneries operated under different processes, with different management, different tanning materials, different water and air, and the commercial product—leather—necessarily must be of the greatest variety.

The process of manufacture of leather belting must be primarily one of the selection of suitable material from the wide variety presented. Some of the hides, some of the tannages and some of the parts of the hide must be better than others, and a most important qualification for the leather belt maker must be a knowledge of his material and markets. But the experiments on which present belt engineering is based have ignored these differences, and some have been carried on with belts of one kind and some with belts of a different kind. Hence the variety of results, the lack of definition in results, and the general state of misinformation which exists in the minds of the engineering profession and the users of leather belts, as well as among the leather belting manufacturers.

The more exact methods that have developed in the industries generally have led to numerous attempts to classify leather belts and to specify their desirable qualities, but leather belting has not lent itself to such specifications because of the difficulty of providing specifications that would identify the quality of the material.

When, however, it is specified that the belting should be made from "No. 1 packer hides," or that it shall have been tanned by "the old-fashioned slow process," or that "the belt shall be cut only from that part of the hide lying within 15 in. of the backbone," it is impossible for the buyer to determine on the delivery of the goods whether these requirements have met with compliance, because in the finished belt no leather expert could know from the belt itself whether it had been made from a "No. 1 packer hide," or a country abattoir hide, or a South American hide, nor could it be determined whether it had been tanned by the "old-fashioned slow process" or some other; nor could he say, if it were a narrow belt, whether it has been cut within 10 in. or 20 in. of the backbone.

Unsatisfactory Specifications

The folly of making specifications that can not be identified, and consequently will not be enforced, must be apparent. The leather belting industry is made up of as good a class of merchants as exist in any business, and a high standard of business ethics prevails among them; but it is not surprising when such invitations are extended by the buyer to come in and defraud him that they should lack acceptance in some quarters.

The United States Government in one, and perhaps more, of its departments specifies that its leather belting shall be made of leather tanned with white oak bark. The writer was engaged in the leather and belting business for forty years and has never seen a piece of white-oak-bark-tanned leather, and there has been none on the market during that time, at least not in commercial quantities. The wealth of the nation could not buy enough of it to make sufficient leather belting for the equipment of one small machine shop. Possibly at some remote period in tanning history the bark of the white oak may have been used as a tanning agent, but if so, it has long since given place to the other varieties of oak. For many years, nevertheless, this department of the Government has continued to specify white oak, and during all those years it has bought and accepted belting tanned with some other bark or tanning agent, without knowing or caring. It is not surprising, therefore, that in ignoring this impossible specification, others not so impossible, and of more importance, also should be ignored.

The quality of the material of which leather belting is made is the prime requisite, and this involves its selection, and the selection of the parts of the hide; and on these points the buyer thinks he is entitled to such information as is necessary to enable him to make an intelligent selection of belts for his purpose. But heretofore, and at this time, such information is not available for him, and his only recourse is to test out belts made by certain houses of standing and reputation, and to continue to buy them on brand or trade mark.

In this particular, leather belting is not sufficient from many other things that are bought without an intelligent knowledge of the subject by the buyer, the only differences being that most buyers flatter themselves that they know a good piece of leather when they see it; and they are inclined to act on their own poor judgment rather than depend upon the guarantee of the maker.

It is surprising how very ignorant are mechanics, master mechanics, chief engineers and purchasing agents of the qualities of a leather belt, and it is equally surprising how much they think they know about it. Most concerns would be infinitely better off if they would buy their leather belting as they buy their Havana cigars, by the label on them. The only way in which it has been possible for a man to fit himself as an expert in leather has been to devote his life to the business.

Recognition of the Problem

That this condition is not in consonance with the enlightenment of the times is apparent to none so forcibly as to the leather belting manufacturers. They realize the necessity of improving the quality of their goods; of preventing substitution of qualities by making more apparent the differences between the qualities of their several grades; of increasing its efficiency; of improving the methods employed in production, and of reducing the cost of reliable qualities to the consumer. It is their ambition to produce a standard leather belt, made under specifications that will insure its uniformity within a very narrow variation, and to provide methods by which such specifications may be formulated that will insure this uniformity and that will enable the engineer and the buyer to identify it when delivered.

The leather belting manufacturers know that it is to their interest that they shall be better informed regarding the engineering possibilities and capacities of their product, and that their customers, the users of leather belting, should be equally well informed on these important subjects. They understand the wonderful adaptability of leather for power transmission, its flexibility and its capacity for carrying large loads, and its amazing durability. They know that leather belts well adapted to the service required of them are practically indestructible; that they last almost forever; that there are many leather belts in existence that have been running under heavy loads for twenty, thirty and forty years, and it is to their interest that the buyer shall be so educated in its use, and that engineering data shall be so simplified and modified that the buyer shall be able to buy intelligently those kinds and qualities of belting best suited to his requirements.

With this end in view the Leather Belting Exchange, an organization of leather belting manufacturers representing about two-thirds of the leather belting production of the country, has now instituted a research into all the various questions bearing on this subject.

It is well known that there are existent some physical or chemical differences between well tanned and poorly tanned leather, between center or backbone cuts and belly cuts, and it is proposed to determine scientifically, by a thorough study of the subject, the nature of these differences and to provide suitable tests by which these differences may be made manifest. Physical tests have been applied, but alone they do not solve the problem. It is possible to test the tensile strength, but this alone is valueless because the better parts of the hide show the smallest tensile strength and the poorer parts, the belly, show the greatest. Chemistry alone has not solved the problem, but it is hoped that by a combination of physical and chemical study with microscopy and microphotography some results may be attained.

For the purpose of this research, the Leather Belting Exchange has established a fellowship with the Mellon Institute of Industrial Research, and this work will progress as rapidly as possible. Its large scope promises to supply some very valuable data to those interested in the application of leather belting. This promises to be a very extensive work. It will include a study of the fundamental conditions of hide fiber structure, of tanning as related to leather belting and of belt manufacture as applied to the development of the specifications for a standard quality of belting. After this standardization has been accomplished, it will become necessary and possible to revise engineering practice.

To accomplish the best results in this phase of the work a number of the leading technical institutions of the country, which have done work on leather belting, and some of those individuals who have given special attention to the subject, have consented to act as a commission or a supervising committee so that the best results will be attained with the least duplication of effort, and that the work shall be done under auspices that will command instant respect and the results prompt acceptance. Not the least in this collaboration will be the work which will be contributed by the leather belting manufacturers themselves.

Practical and Scientific Knowledge Necessary

The scientists engaged in the work will be in constant touch with men who know leather practically, and the combination of the practical and the scientific, it is hoped, will accomplish results which have heretofore evaded both when working independently. This part of the work is under the supervision of an advisory committee of the Leather Belting Exchange, which committee is composed principally of engineers and college men who have been trained in scientific methods and have had a number of years of practical experience in tanning and leather belt manufacture, and who are well qualified to assist the scientists of the Mellon Institute in the prosecution of the work. Behind them is the mass of practical experience of the most intelligent and most important of the leather belting manufacturers. It is confidently anticipated that such comprehensive work as that outlined, backed by the financial resources of the Leather Belting Exchange, will produce results.

The exchange is fully aware that in its use of the best qualities of leather it is in possession of a unique material; that no other material will stand the use and abuse of service for many years as will a good leather belt: that no other material is so nearly indestructible. A case has recently come to hand where a leather belt placed upon the pulleys in 1877 is still running, and good for many more years of service, reducing the cost of transmission to figures so infinitely small as to be almost negligible. The leather belting manufacturers know this indestructible character of a leather belt properly made and suitably installed, and through the Leather Belting Exchange they propose to provide the means by which its efficiency may be further improved and every assistance rendered the buyer to enable him to secure the proper kind of a belt and to have it properly installed.

Training Aviators for the British Army

By Fred H. Colvin

SYNOPSIS — *The military aviator must be far more than a skillful pilot; he must understand wireless, gunnery, map making, bomb dropping, and to a certain extent be a navigator as well. When we realize that all this knowledge is acquired by young men under 25 years of age for the most part, we begin to realize what can be done by intensive training.*

FEW of us appreciate, when we read of the daring exploits of an aviator on the battle front in France, just what he does from day to day and just what he has to know. Nor have we even a faint idea of the training which a military aviator must undergo in these days. The schooling which an aviator must go through today is different from what was required of him only a few years ago, so rapid have been the developments on the western front. Only three years ago the military aviator was a mere theory; there was no definite conception as to his duties except that he was to fly and see what he could of the enemy lines, with an occasional bomb-dropping mission. Today, however, his whole status has changed, and he is perhaps the most versatile personage in the whole army.

We are apt to think of the aviator as a sort of special chauffeur, such as we might find at the wheel of a fast racing car—a man skilled in driving and with nerve enough to take chances with death in order to win the race. But such a driver is an amateur in comparison with the military aviator, for the mere piloting of the airplane is but a minor part of the duties of the military pilot. The modern aviator must not only be skilled in guiding his machine—and this includes all the tricks of looping, falling and other maneuvers to get away from or to mislead the enemy—but he must be an expert with the machine gun, must understand wireless telegraphy, must operate special cameras for observations and map making, must be a navigator insofar as it comes to flying by compass and following routes laid out from place to place, must learn to depend on the compass, to judge distances of cannon range and correct the gunners when their range is inaccurate.

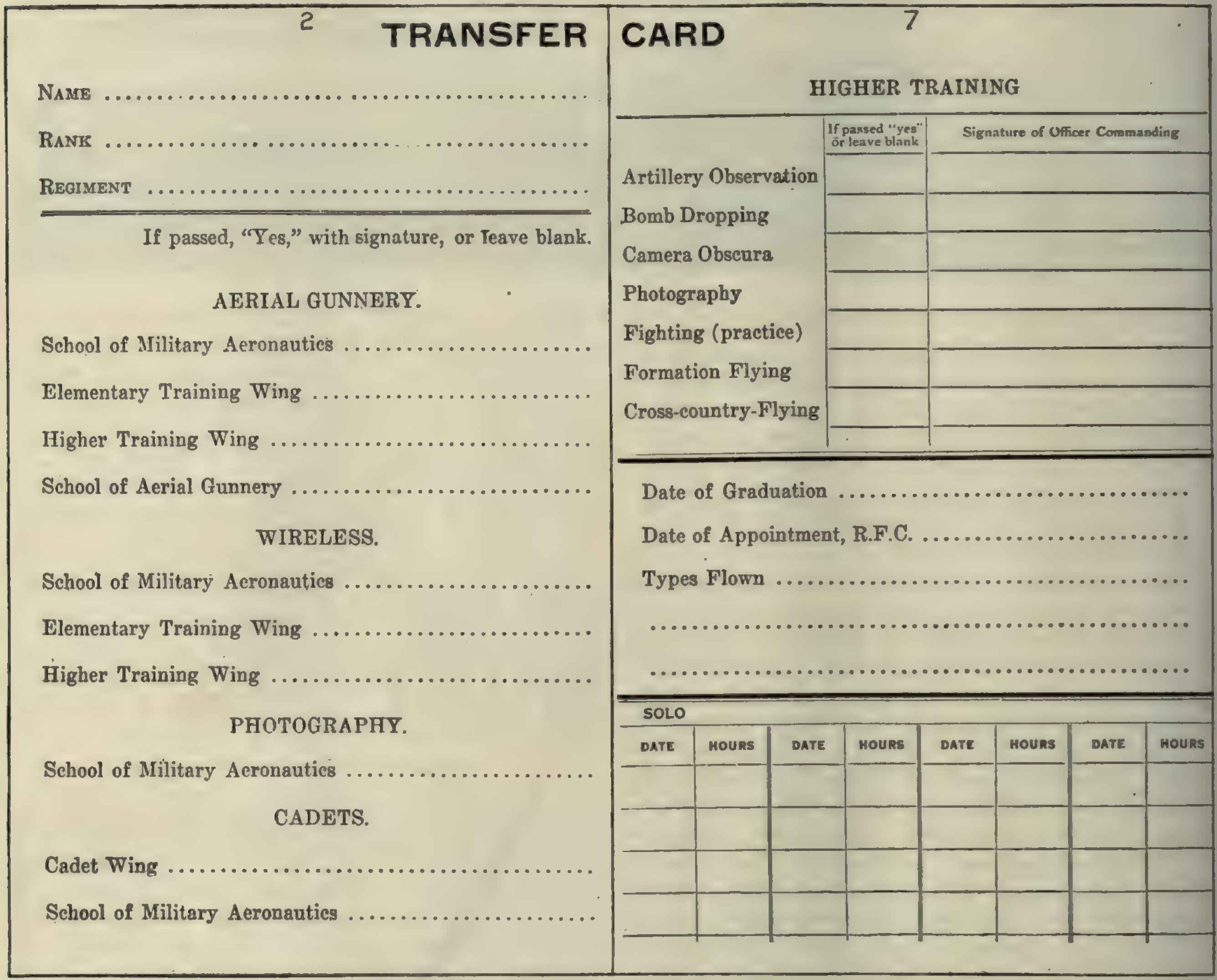
In addition to all this the modern flier must become familiar with the theories of aviation, learn to know engines and their troubles, and last, but not least, be thoroughly familiar with military discipline in all its details. For when the success of a whole engagement may depend upon all the various units coöperating accurately and exactly, it is out of the question to have the aviator or any other important factor get to his post 5 or 10 min. late because he did not appreciate the necessity of obeying orders exactly and to the minute. And this is all the more striking when we consider that the ages of the best aviators vary from 18 to 25, ages which do not usually respond to demands for hard and fast discipline in any line.

HOW AVIATORS ARE TRAINED

Candidates for the aviation corps come from civilian life at the ages already mentioned, and if they pass the medical tests are assigned to the cadet wing. The exact qualifications are extremely hard to define and depend more on how the young man "sizes up" after a little observation than on any set rules which can be laid down. Many college men make excellent fliers, but not so much on account of being college men as because they are alert, have receptive minds and are live wires generally. Their studies in Greek and mathematics have not much to do with it, as very little of the latter is necessary. In fact, many bright boys with only an elementary education make excellent military aviators. About the only calculations needed are to correct drift due to the wind, and with a good drift indicator even this is hardly necessary.

The main requirements for a military aviator are intelligence and courage rather than any specified knowledge as to mathematics, mechanics or other branches of the higher education. The more of these he possesses the better, but they are not essential to the making of a good military pilot, as has been demonstrated in many instances. It is because the college man usually possesses the first two requirements that he makes a good pilot, while his other accomplishments help him in the fine points of his various duties at the front. An ordinary education, including the three R's, makes a sufficient foundation if the first two requirements are in his mental make-up.

As all military pilots are classed as officers, beginning with a commission as second lieutenants when they get into actual military flying, it is found expedient to give them two or three weeks' military training in the early stages of their instruction. This makes them familiar with military drill in its various phases and fits them to take charge of small bodies of men in the flying camps, as well as to command other pilots as they show aptitude in their work and are advanced to first lieutenant, where they are in charge of a "flight," or part of a squadron, usually a third, or six, machines. Then comes squadron commander, wing commander, etc.



2 **TRANSFER CARD** 7

NAME ....

RANK ....

REGIMENT ....

If passed, "Yes," with signature, or leave blank.

AERIAL GUNNERY.

School of Military Aeronautics ....

Elementary Training Wing ....

Higher Training Wing ....

School of Aerial Gunnery ....

WIRELESS.

School of Military Aeronautics ....

Elementary Training Wing ....

Higher Training Wing ....

PHOTOGRAPHY.

School of Military Aeronautics ....

CADETS.

Cadet Wing ....

School of Military Aeronautics ....

HIGHER TRAINING

	If passed "yes" or leave blank	Signature of Officer Commanding
Artillery Observation		
Bomb Dropping		
Camera Obscura		
Photography		
Fighting (practice)		
Formation Flying		
Cross-country-Flying		

Date of Graduation ....

Date of Appointment, R.F.C. ....

Types Flown ....

....

....

SOLO

DATE	HOURS	DATE	HOURS	DATE	HOURS	DATE	HOURS

FIG. 1. PAGES 2 AND 7 OF THE TRANSFER CARD

The Primary Training

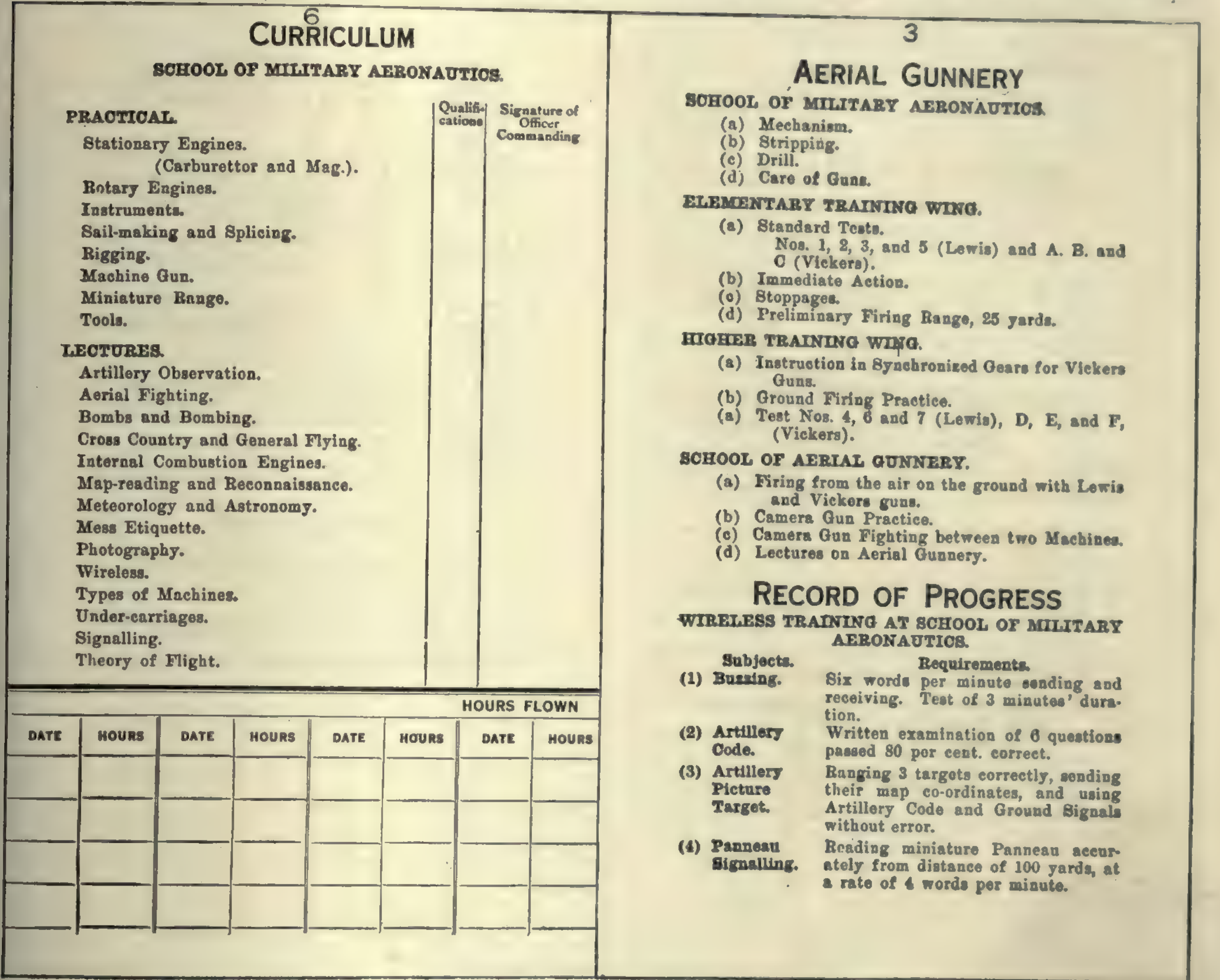
The preliminary, or primary, training includes, in addition to the military drill, a foundation of elementary theory of flight, of plane and engine construction, of wireless, photography, map making, gunfire control and the many activities which go to make up the duties of the military pilot at the front. This involves the use of actual engines, sometimes more or less in section, to show their construction and to become more or less familiar with their theory and method of operation, as well as the parts which are liable to give trouble and the way to remedy such difficulties. In the same way the general construction of the planes and other parts of the machine is pointed out, not with a view of making the pilot an expert mechanic, but to give him a general knowledge, both for his own information and for its effect on the mechanics who will look after the machines for him. If the mechanics know that the pilot has a fair general knowledge of his machine, they are apt to respect his mechanical as well as his flying ability and look after his machine more closely.

Here also the aviator learns about stripping a motor and a plane, and the care of guns, the handling of wireless instruments, the artillery code, the artillery picture target, Panneau signaling and photography, with especial reference to cameras for aërial service. This instruction consists largely of lectures which are illustrated and explained in various ways, and on which examinations must be passed before the student can be passed to the first, or elementary, flying squadron. His record of progress is shown in the accompanying pages of the transfer card, Figs. 1 to 4.

But there is more to the examinations than the written tests. The whole character of the student is constantly under observation, and only those with the necessary qualifications, quite aside from book knowledge and mechanical ability, can be passed into the next grade which goes to the first training camp for actual flying. For unless the student has the necessary qualifications to do good work at the front, or at least to make an instructor, there is no use in taking up valuable time and smashing machines in the effort to get him into the air. It is what he does after he becomes a flier that counts.

Their training includes military drill and the school of aëronautics with its theory of aviation, the study of engines and planes and their construction, machine guns, instruments of aviation, wireless, map reading, location from the starts, etc. This preliminary training may take one month or two, according to the pupil. When, in the opinion of the commanding officer, the student is qualified to proceed, he is assigned to the primary flying school for a course which usually takes about two weeks.

In addition to mere theory of flying the student is taken up with the instructor in a two-seated machine having double controls, and receives from 3 to 6 hours in the air with the instructor. This takes the place of the former method of "grass cutting," or "taxying," where the student drove a low-powered and clipped-wing machine around the field to learn the controls and gain confidence. The student gradually controls the machine more and more until the instructor finally relinquishes the controls and the student drives in the air and makes the landings, with the instructor always at hand to take the control of the machine should it become necessary.



6

CURRICULUM

SCHOOL OF MILITARY AERONAUTICS.

	Qualifications	Signature of Officer Commanding
PRACTICAL.		
Stationary Engines. (Carburettor and Mag.).		
Rotary Engines.		
Instruments.		
Sail-making and Splicing.		
Rigging.		
Machine Gun.		
Miniature Range.		
Tools.		
LECTURES.		
Artillery Observation.		
Aerial Fighting.		
Bombs and Bombing.		
Cross Country and General Flying.		
Internal Combustion Engines.		
Map-reading and Reconnaissance.		
Meteorology and Astronomy.		
Mess Etiquette.		
Photography.		
Wireless.		
Types of Machines.		
Under-carriages.		
Signalling.		
Theory of Flight.		

HOURS FLOWN

DATE	HOURS	DATE	HOURS	DATE	HOURS	DATE	HOURS

3

AERIAL GUNNERY

SCHOOL OF MILITARY AERONAUTICS.

(a) Mechanism.
(b) Stripping.
(c) Drill.
(d) Care of Guns.

ELEMENTARY TRAINING WING.

(a) Standard Tests.
Nos. 1, 2, 3, and 5 (Lewis) and A. B. and C (Vickers).
(b) Immediate Action.
(c) Stoppages.
(d) Preliminary Firing Range, 25 yards.

HIGHER TRAINING WING.

(a) Instruction in Synchronized Gears for Vickers Guns.
(b) Ground Firing Practice.
(a) Test Nos. 4, 6 and 7 (Lewis), D, E, and F, (Vickers).

SCHOOL OF AERIAL GUNNERY.

(a) Firing from the air on the ground with Lewis and Vickers guns.
(b) Camera Gun Practice.
(c) Camera Gun Fighting between two Machines.
(d) Lectures on Aerial Gunnery.

RECORD OF PROGRESS

WIRELESS TRAINING AT SCHOOL OF MILITARY AERONAUTICS.

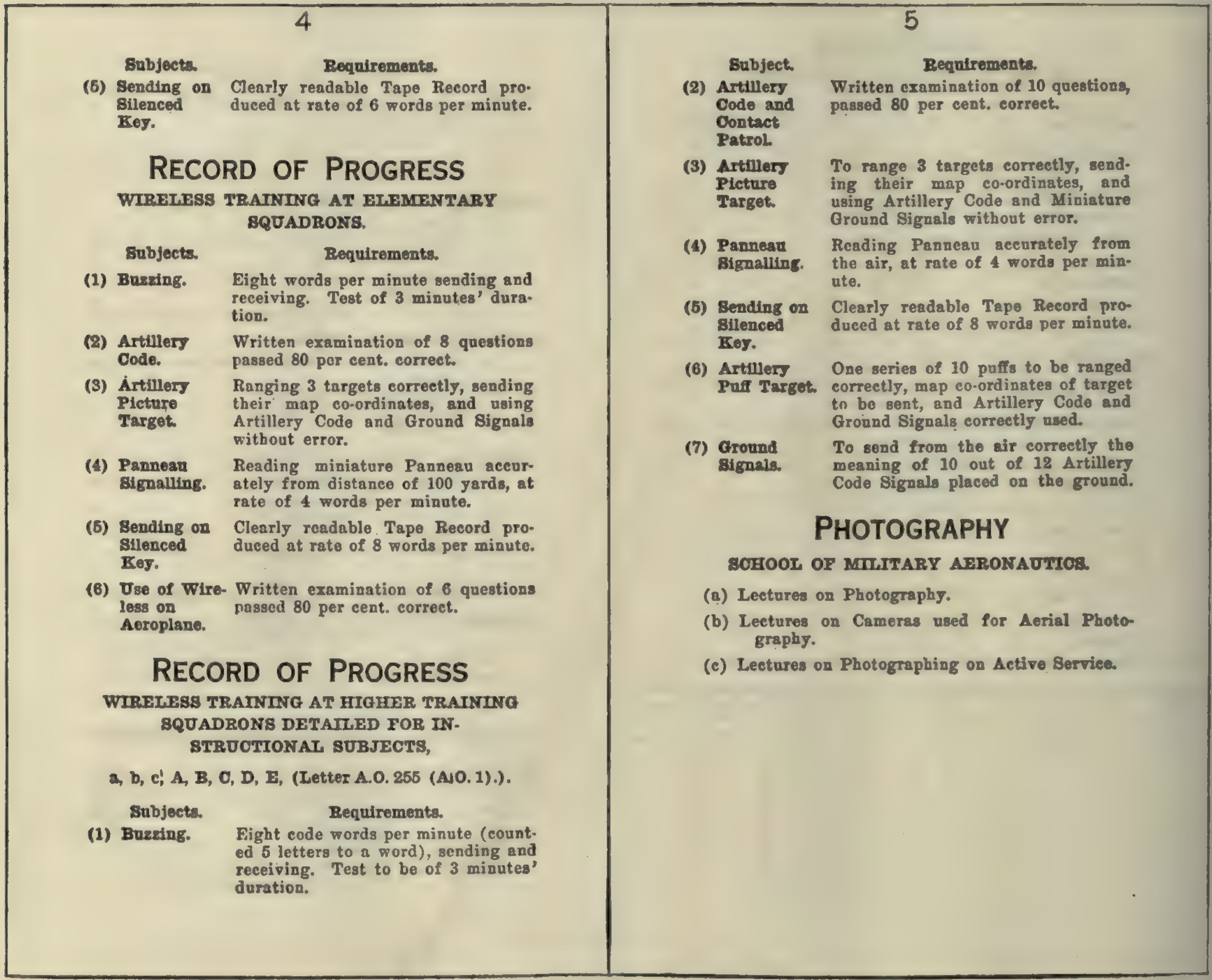
Subjects.	Requirements.
(1) **Buzzing.**	Six words per minute sending and receiving. Test of 3 minutes' duration.
(2) **Artillery Code.**	Written examination of 6 questions passed 80 per cent. correct.
(3) **Artillery Picture Target.**	Ranging 3 targets correctly, sending their map co-ordinates, and using Artillery Code and Ground Signals without error.
(4) **Panneau Signalling.**	Reading miniature Panneau accurately from distance of 100 yards, at a rate of 4 words per minute.

FIG. 2. PAGES 6 AND 3 OF THE TRANSFER CARD

When the student becomes competent to start and land a machine he is made to fly alone, or "solo," for from 5 to 7 hours and is then, at the discretion of the commanding officer, transferred to one of the advanced flying camps, where he generally spends about six weeks.

At this advanced camp his flying is divided into three parts, the first two weeks with the cross-country squadron, the second with the wireless squadron and the last two weeks with the gunnery squadron. The cross-country work covers quite a wide area of country and considerable high flying and has three tests which must be passed before going into the wireless squadron. The cross-country test is to fly a 60-mile triangular course, landing at two checking points and returning to the home camp. Then there are two height tests, one of 3000 and the other of 8000 feet, with four figure 8's to insure good control in turning in both directions, flying at the high points for at least 15 min. to give confidence at these heights and finally to volplane, or glide, to earth with the engine shut off and land reasonably near a circle 50 yd. in diameter, which is clearly marked by a border of broken stone.

There are also flights in flight or squadron formation, a typical formation being shown in Fig. 5. The officer in charge of the flight leads at *A*, the next two, *B* and *C*, fly a given distance behind, to one side and above the leader, the next two, *D* and *E*, following in similar order. The last man *E*, to guard against rear attacks, flys in the center and still higher, to be able to swoop down on an attacking plane at any time. The main difficulty encountered in formation flying is to maintain the exact relative positions, due to the difference in the speed of the various machines.



4

Subjects.	Requirements.
(5) Sending on Silenced Key.	Clearly readable Tape Record produced at rate of 6 words per minute.

RECORD OF PROGRESS

WIRELESS TRAINING AT ELEMENTARY SQUADRONS.

Subjects.	Requirements.
(1) Buzzing.	Eight words per minute sending and receiving. Test of 3 minutes' duration.
(2) Artillery Code.	Written examination of 8 questions passed 80 per cent. correct.
(3) Artillery Picture Target.	Ranging 3 targets correctly, sending their map co-ordinates, and using Artillery Code and Ground Signals without error.
(4) Panneau Signalling.	Reading miniature Panneau accurately from distance of 100 yards, at rate of 4 words per minute.
(5) Sending on Silenced Key.	Clearly readable Tape Record produced at rate of 8 words per minute.
(6) Use of Wireless on Aeroplane.	Written examination of 6 questions passed 80 per cent. correct.

RECORD OF PROGRESS

WIRELESS TRAINING AT HIGHER TRAINING SQUADRONS DETAILED FOR INSTRUCTIONAL SUBJECTS,

a, b, c; A, B, C, D, E, (Letter A.O. 255 (A/O. 1).).

Subjects.	Requirements.
(1) Buzzing.	Eight code words per minute (counted 5 letters to a word), sending and receiving. Test to be of 3 minutes' duration.

5

Subject.	Requirements.
(2) Artillery Code and Contact Patrol.	Written examination of 10 questions, passed 80 per cent. correct.
(3) Artillery Picture Target.	To range 3 targets correctly, sending their map co-ordinates, and using Artillery Code and Miniature Ground Signals without error.
(4) Panneau Signalling.	Reading Panneau accurately from the air, at rate of 4 words per minute.
(5) Sending on Silenced Key.	Clearly readable Tape Record produced at rate of 8 words per minute.
(6) Artillery Puff Target.	One series of 10 puffs to be ranged correctly, map co-ordinates of target to be sent, and Artillery Code and Ground Signals correctly used.
(7) Ground Signals.	To send from the air correctly the meaning of 10 out of 12 Artillery Code Signals placed on the ground.

PHOTOGRAPHY

SCHOOL OF MILITARY AERONAUTICS.

(a) Lectures on Photography.
(b) Lectures on Cameras used for Aerial Photography.
(c) Lectures on Photographing on Active Service.

FIG. 3. PAGES 4 AND 5 OF THE TRANSFER CARD

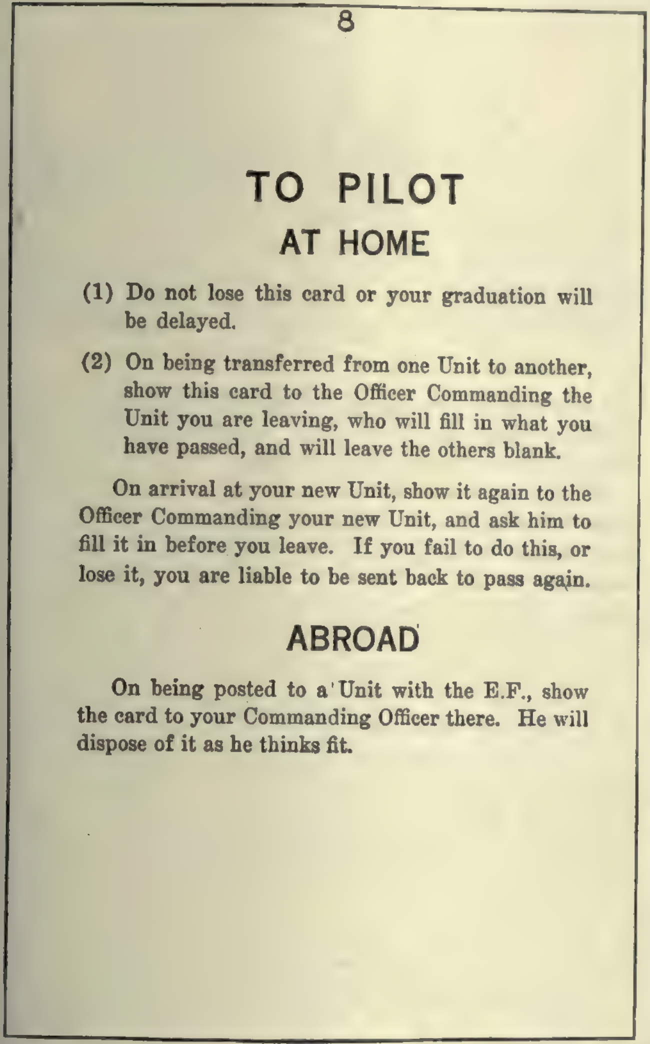
Having passed these tests, the student goes to the wireless squadron for another two weeks, where he is instructed in artillery observation, in bomb dropping, and in what is called "contact patrol," which means that he must make his observations at a height of only 500 or 600 ft. from the earth. The artillery observation instruction has been very carefully worked out to reproduce actual war conditions in the simplest and most satisfactory manner. It includes the use of his wireless apparatus in signaling the batteries and the use of smoke puffs to represent the shots fired.

This involves the employment of a code of signaling which has been very generally adopted, known as the "clock" code. This gives a simple means of locating angles without the use of either degrees or the nautical terms, such as "south-southeast."

Having been detailed to observe the shots of a battery at a given target, the airman first locates his target and then some prominent landmark such as a house or a bridge due north of the target, to give him an easy reference mark for future signals to his battery. He then gets into communication with his battery by wireless, signaling by a predetermined letter until he gets an answer in the shape of a letter made of strips of canvas and laid on the ground near the battery. Then he knows the battery has his signal, and when he is ready to observe, he gives the signal to fire and watches for the shell to strike.

He estimates the distance it strikes away from the target, which is usually the enemy's guns, and also the direction with regard to the mark which he has located due north from the target. Letters are used to designate given distances in yards, such as "Y" for 10 and "D" for 300 yards, so that he only signals letters and numbers for both distances and locations. The signal "D-3" would tell the gunner officer that the shot was 300 yd. away from the target and 90 deg. from the north, and as he has a map which is the duplicate of that carried by the pilot, he can see exactly where his shots have landed and proceed to correct his range before the next round. In the same way "2" would indicate 2 o'clock, or 60 deg. from north, and "8" would indicate 120 deg. from north on the other side of the north and south line (see Fig. 6).

These conditions are reproduced at the school by a field wireless set at a dummy battery and smoke puffs arranged to be set off at various distances and angles around the target, some distance away. Here the student signals his battery just the same as in war, receives his answer on the ground in white letters, and then goes to watch the effect of the shots, which are represented by smoke puffs. He locates his north and then gives the order to fire, and one of the puffs goes off, the battery man, who is an instructor, knowing exactly which one he sets off and its distance from the target. There are generally ten of these puffs set off, the student reporting each shot, the last usually being right on the target. As the instructor knows the location of each of these puffs, he knows just how accurate the reports of the student are and can mark him accordingly.



8

TO PILOT

AT HOME

(1) Do not lose this card or your graduation will be delayed.

(2) On being transferred from one Unit to another, show this card to the Officer Commanding the Unit you are leaving, who will fill in what you have passed, and will leave the others blank.

On arrival at your new Unit, show it again to the Officer Commanding your new Unit, and ask him to fill it in before you leave. If you fail to do this, or lose it, you are liable to be sent back to pass again.

ABROAD

On being posted to a Unit with the E.F., show the card to your Commanding Officer there. He will dispose of it as he thinks fit.

FIG. 4. PAGE 8 OF THE TRANSFER CARD

They also study observation of country from a miniature landscape which contains bridges, houses, trees, trenches and all the characteristics of the western front. This is studied from the top of a stand 100 ft. in the air, glasses being used to pick out the different points. These must be reported and maps drawn to see how accurately the student can do this kind of work, as it may form an important part of his work later on.

Before leaving the wireless squadron the student must be able to send eight words a minute and to receive twelve words a minute. He must also understand about letting down his aërial, or receiving and sending cable, the right distance for different stations and to manipulate his sending apparatus correctly.

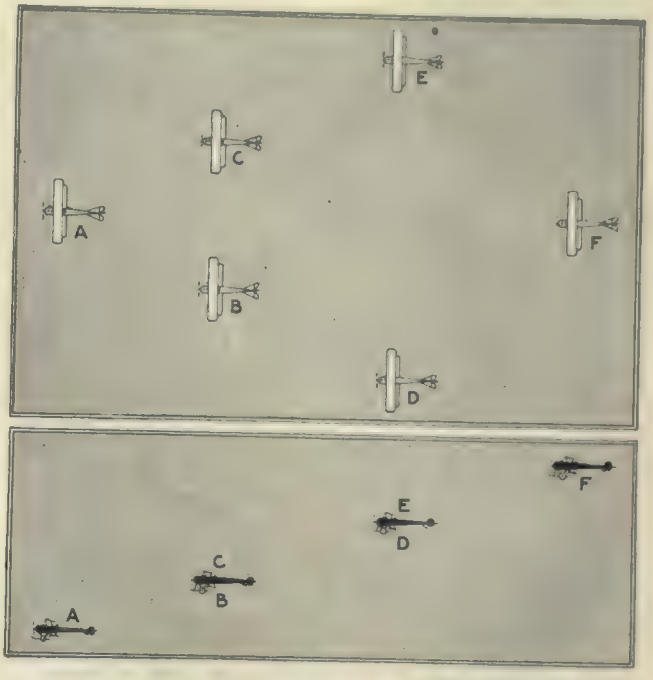


FIG. 5. SIX MACHINES IN FLIGHT FORMATION

The gunnery squad comes next and includes a study of the mechanisms of both the Lewis and Vickers machine guns, the timing of these guns to shoot through the propeller by means of what is known as the "constantinesco" gear, which is driven by the engine shaft and times the guns to shoot between the blades of the propeller. This has to be timed to shoot very accurately, as, while there is plenty of room between the blades of a two-bladed propeller at its full speed, a change in engine speed introduces a lag which spreads the shots over a wider range and must be allowed for in timing the gun.

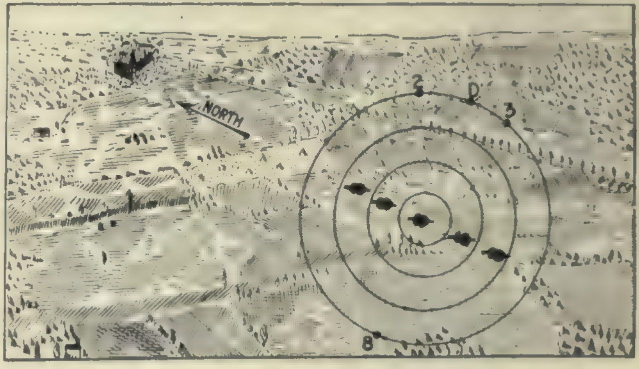


FIG. 6. GIVING GUNFIRE CORRECTION BY THE CLOCK CODE

This timing is done by fastening a disk of thin wood, usually a built-up or three-ply piece, on the end of the engine shaft in addition to the propeller. This shows exactly where every shot goes and allows correction in timing to be easily made. It is said to be a comparatively easy matter to get every shot within a space of 2 to 3 in. when the engine is running at normal speed. By so setting the gear that this comes midway between the blades, there is considerable leeway for engine-speed variation.

TARGETS ON THE GROUND

With the machine gun mounted on the airplane, shooting at silhouette targets on the ground is part of the course, the machine being flown low for that purpose. In this work the machine gun is usually operated by a second man, as in a reconnaissance or raiding machine. In most of the air fighting, however, the machine is a single seater, and the pilot operates the gun as well as the machine. In these cases the gun is usually fastened to the machine at the side, and is aimed by pointing the whole machine at the target, which is generally another machine. It is possible for an expert pilot to handle a movable gun in some cases, as he gives very little attention to his machine except in trick work, either attacking or eluding his enemy.

Another form of gun practice is at a target which is towed by another machine, but at a considerable distance behind it, much as is done in some forms of naval-target practice. This target is a piece of white cloth, perhaps 8 ft. square, held at the front by a stick which is weighted to keep it vertical and towed far behind an airplane. This represents an enemy plane fairly well and is attacked by other planes carrying machine guns, these machines being designated by black triangular flags flown from the rear outer wing struts, to warn other machines to keep out of range of gunfire when they are in action.

THE CAMERA GUN

For machine-gun practice at enemy airplanes, the camera gun is also used, this being almost a duplicate of the Lewis machine gun and fitting in the same mounting. The film passes behind a glass screen ruled with small black circles for locating the position of the picture with relation to the bore of the machine gun, and these circles show on the photograph itself whenever an exposure is made. The camera is aimed by means of very ingenious sights, the same as on the gun itself, and the location of the enemy airplane on the circles shows exactly where the machine or the pilot would have been hit had an actual shot been fired. This makes an indisputable record, and the photograph forms a part of the students' record in this squadron (see Fig. 7).

Having passed this section of the school, the cadet is assigned, at the discretion of the commanding officer, to go overseas for the final training on battle and scout machines before being sent to the front to win his spurs in action over the battle lines. The transfer card shows his studies and the record of them.

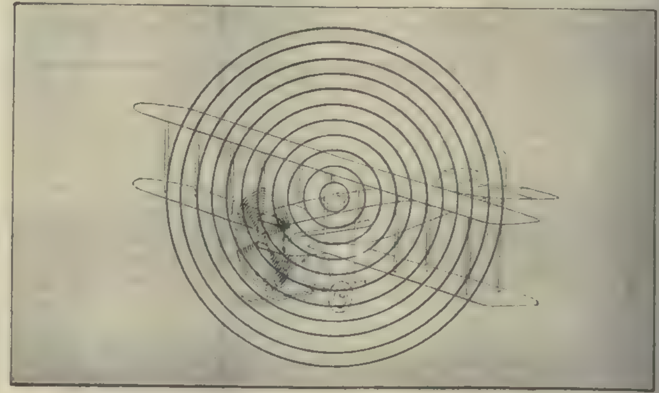


FIG. 7. WHAT THE CAMERA GUN SHOWS

We must not forget that the aviator is not merely the pilot who enables someone else to make the necessary observation or to fight off the enemy planes when this becomes necessary, but that in nearly all cases he is absolutely alone, thousands of feet in the air, and that he alone must guide his machine, operate his machine gun, send his wireless message, make his maps or take photographs, and that in most cases he is little more than a boy in years, yet with far greater responsibility and skill than most older men shoulder or acquire. The airplane is in its infancy, and it is to youth that we must look for its successful operation, for the present at least. It is to the intrepid daring of youth that we owe its development in the present war.

There are few serious accidents, but every provision is made for taking care of such as do occur. The ambulance, "hungry Lizzie," as the cadets call it, is always in readiness for an emergency call. It is shown below.

Practical Points in Flat-Gage Making

By HUGO F. PUSEP

SYNOPSIS — *The successive stages in the making of flat gages in quantities are here explained with details of operations required in annealing, shaping, milling, hardening, grinding and lapping. The use of the machine lap and its advantages are covered, and allowances are given for grinding to most effective limits for the final lapping process.*

A PRACTICALLY new industry has been created during the past two years, owing to the extraordinary demand for gages of all descriptions but more especially for the so-called "flat gages." It has been demonstrated beyond doubt, by all concerns engaged in producing war munitions in large quantities, that the flat gage is an indispensable tool for taking measurements of various characters during the manufacturing and inspection of different components of primers, fuse bodies, time fuses, rifle parts, etc.

Notwithstanding the facts that the initial cost of these gages is quite high and that their wear is rapid, owing to the constant use to which they are put, there is an ever growing demand for them at the present time. It is indeed difficult for the imagination to separate the flat gage from the quantity manufacturing of light interchangeable parts. No doubt, toolmakers throughout this country will become more familiar with the making of this type of measuring tool when the manufacturers of other products than strictly war munitions have generally adopted the flat gage in their various processes of manufacture.

The purpose of this article is to give a few practical points and suggestions gained from experience. In many instances the methods described have considerably lowered the cost of making these gages, more especially where quantities of gages were made of identically the same design.

Fig. 1 shows a group of flat gages of the kind most commonly used. There are so many varieties of flat gages that it would be almost impossible to tabulate them according to their different functions. Flat gages can be made for measuring any contour, internal or external, on cylinders or plane surfaces, also for depth of holes, recesses, counterbores, distances between shoulders, etc.

ANNEALING THE STOCK FOR GAGES

All stock from which the gages are to be made should be thoroughly annealed before machining. This is most important, as the majority of the steel for flat gages is cut from carbon-steel bars that have been rolled to shape. In order to remove stresses incidental to this rolling and also to make the structure of the steel more homogeneous and to soften the metal, it is wise not to overlook annealing. The saving in milling cutters alone will more than pay for annealing, not taking into consideration the risk of having intricate gages crack in hardening, which is more liable to occur with unannealed steel.

Considerable saving in time can be expected by planning the various machining operations so as to remove the greatest amount of stock in the shortest possible period. It is true in gagemaking as in manufacturing that the larger the order the more economical the production per unit. With the miller shaper and drilling machine, any ordinary gage can be machined to shape, although the bench lathe and sometimes the planer or the slotter will give good results.

One important fact to bear in mind in connection with gagework is that by doing all roughing-out operations in the most efficient manner a great saving is made possible at the beginning; and this will continue even up toward the end, when the more accurate and consequently slower finishing operations are performed.

As an example of what can be done, let us consider the group of gages in Fig. 1. A majority of these gages have small holes drilled at the bottom corners of the gaging surfaces in order to eliminate the objectionable sharp corners, which as all mechanics know, it is almost impossible to produce by either grinding or lapping. Now a majority of gagemakers would lay out these drill holes in each individual gage and, after center punching the locations, proceed to drill. Right here is where a considerable saving can be made. Instead of laying out each gage blank separately, the job should be done as follows:

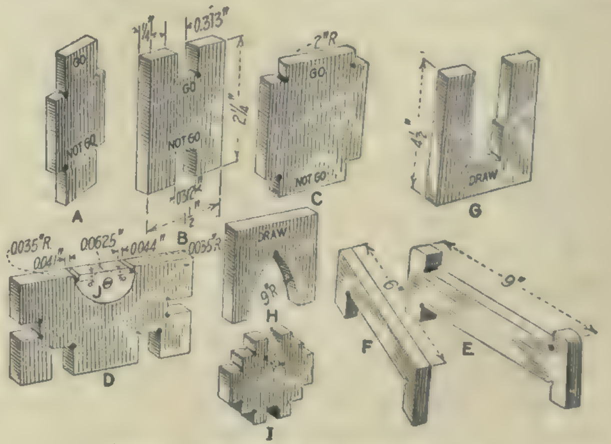


FIG. 1. GROUP OF FLAT GAGES

All drill holes are carefully laid out and drilled in one gage blank; then this blank is used as a drill jig for spotting all other blanks of the same order. Where gages are made in lots of one hundred or more, it will become quite clear how much this elimination of laying out will mean when the total production time is taken into consideration.

Another important point not to be lost sight of in machining to shape is to have all gage blanks on the same order very nearly identical as regards length, width and thickness; they do not by any means have to be to a 0.001-in. limit. Keeping the blanks to about the same size will facilitate to a marked extent all the operations that follow.

The gage *B*, Fig. 1, is a very common type of flat gage for measuring small cylindrical parts or the thickness of collars. Let us follow the various machining operations in their proper order as applied to this particular gage.

After the blanks have been cut from a stock bar of sufficiently large dimensions to allow for machining all over to the dimensions given and have been annealed as previously stated, the sides are finished in a shaper, bringing the thickness to ¼ in. plus allowance for grinding, if any. A pair of parallels high enough to keep the machined side of the gage blank just above the jaws in the shaper vise should be provided; and the shaper tool once set should not be disturbed, unless it is for the purpose of resharpening. In this manner the shaping operation will consist of repetition work throughout—namely, clamping a blank in the vise, running a cut across, removing the blank and inserting a new one, etc. After one side is machined, the shaper tool is set again for finishing the opposite side, and the same procedure is followed as before.

In this way the shaper work can be done in one-third faster time than would be the case if it were attempted to shape up both sides of the same gage blank, as is done in many good shops. The reason is obvious when the measuring and tool-setting times are considered separately for each gage blank. If an order called for a hundred gages, by the old method the time for measurements and tool setting would be a hundred times as great as for the first blank. With the repetition method, however, the time taken in tool setting and measurements will depend largely on how long a high-speed steel tool will stand up before regrinding becomes necessary. As a conservative estimate, regrinding will be required once for every twenty-five blanks, or eight times in a hundred finished blanks.

SHAPING TO WIDTH AND LENGTH

Having the blanks finished on the sides, the next step is to shape to the proper width. At this juncture as many blanks can be shaped at the same setting as the shaper vise will hold; and after finishing one edge on all blanks, they are reversed in the vise and finished on the opposite edge, bringing the width to 1½ in. A kink worth remembering when squaring the ends of the blanks is to clamp several blanks together with a parallel clamp, the blanks resting on a surface plate on their finished edges while the clamp is tightened. Then it is only necessary to square the blank next to the fixed vise jaw of the shaper in order to bring the rest of the blanks—held by the parallel clamp—square. After the blanks have been squared and the shaper vise tightened, the parallel clamp is removed. A cut is then run across the ends of the blanks, thus bringing them square with the finished edges. The final operation in the shaper consists of finishing to the 2¼-in. dimension, which is accomplished as previously explained in the case of the 1½-in. measurement, by holding the blanks to the capacity of the shaper vise.

The foregoing rather lengthy description is not intended as a lesson on how to run a shaper, but to bring out the principle of repetition and to show how it is possible to make a considerable saving in time without any extra effort on the part of the operator, except it be a little thinking in advance as to the best method of procedure. Thinking in advance is always good practice on any job.

The next machining operation on gage blanks after they have been shaped all over, as a rule, is drilling. Fig. 2 shows a drilling-machine table having two parallels clamped at right angles, with the drill ready for spotting the holes on all gage blanks through the one that has been already drilled. The sketch is self-explanatory, but it may be stated that the parallels are for the purpose of keeping the gage blanks in alignment.

MILLING THE GAGES

Having determined the amount of stock to leave for grinding, the gages are milled to the prescribed limit. Referring again to the gage B, Fig. 1, it becomes apparent that a straddle mill 0.300 in. in width would be the proper cutter to use, thus leaving about 0.012 in. for grinding, which in this particular gage is sufficient.

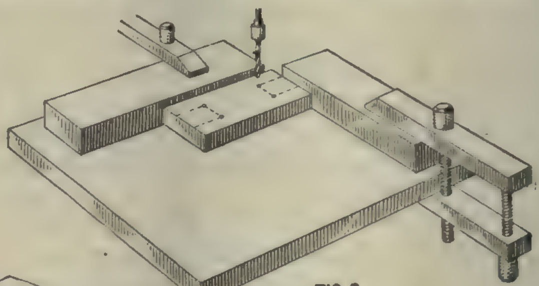


FIG. 2

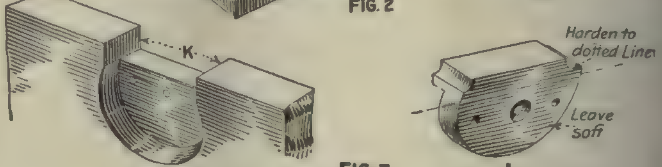


FIG. 3

FIGS. 2 AND 3. GAGE WORK
Fig. 2—Spotting through a drilled blank. Fig. 3—Gage only locally hardened

In milling the gage openings, the number of blanks held at one setting should be limited only by the capacity of the miller vise. By following this method and also selecting a cutter of the proper width for finishing the gage openings with one cut, wherever that is practicable, the milling time will be lowered considerably. Of course, in the case of very large gages, as E, F, G, Fig. 1, or where an irregular contour is to be milled, as at H, Fig. 1, the conditions might necessitate several cuts being taken or special methods being employed in milling, which can best be determined from the nature of the gages in question.

HARDENING AND GRINDING

Most flat gages are hardened all over, but there are exceptions where the hardness is to be only local. An example of this is given at D, Fig. 1. The inserted part J is held to the gage proper by two dowel pins and a flat-headed screw. An enlarged view of this part and a section of the gage where it fits are shown in Fig. 3, with the part J removed to show how it is seated in a counterbored recess and between the ground faces K. This design is very interesting, as it shows how a perfectly sharp corner in a flat gage is easily obtained by building in a separate section.

The gage D was hardened all over, but the part J was left soft, as indicated by the dotted line, in order that the dowel and screw holes could be transferred through the gage to the part J in assembling. Often it is advisable to draw a part of the gage, so as to eliminate the possibility of breakage in using. The gages *H* and *G*, Fig. 1, have been drawn to dark blue up to the dotted lines, after hardening. It is very desirable to have the gaging surfaces glass hard wherever possible, to stand the wear incident to continuous usage.

Grinding is really one of the important operations in gagemaking. On it depends the finish of the gages; and when the grinding is properly done, it will help the lapping considerably, both as regards the length of time taken and the quality of finish.

In the last year or so there have appeared on the market various makes of gage grinders, all having some good features and admirably adapted to this class of work; with these and a good surface grinder, most flat-gage work can be taken care of. All flat gages should be ground perfectly flat and parallel on their sides before any other grinding is done. This precaution is absolutely necessary, if satisfactory results are to be obtained in later operations on the gage grinder.

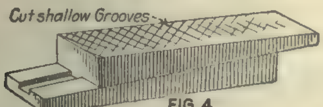


FIG. 4

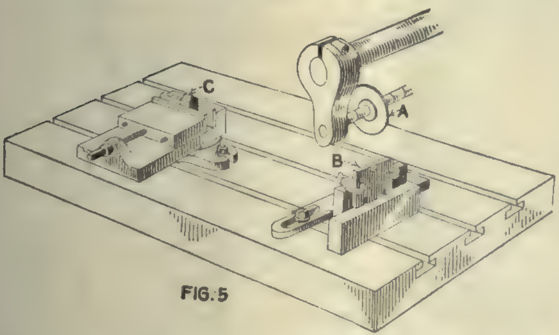


FIG. 5

FIGS. 4 AND 5. LAPPING KINKS
Fig. 4—Adjustable hand lap. Fig. 5—Lapping on the miller

The gage-grinder table should be tested frequently with a light, accurate surface plate having a small quantity of prussian blue rubbed on it. In this way any unevenness in the table surface will at once be noticed and can be corrected easily by scraping. Small hard-rubber pads should be placed between the gage and the clamps before tightening the latter, to prevent springing of the gage. Many a gage has been spoiled by improper clamping while grinding. Where only a fraction of a thousandth of an inch is left for lapping, it is an easy matter, if a gage is not clamped properly or where the gage-grinder table is not perfectly flat, to spring the gage so that when the clamp is removed, one side of the gage opening will be found oversize. As there is no "putting on" tool on the market yet, it would be a hard job to save a gage that had been ground oversize. Therefore, the watchword in gage grinding should always be: Grind only one gage at a time, and watch the clamping.

ALLOWANCES FOR LAPPING

Good judgment must be exercised as to how much to allow for lapping. It is hard to lay down rules as to the exact figure that would work in all cases; but for plain flat-gage work the lapping allowances in the accompanying table have given entire satisfaction.

Not enough stress can be laid on this final operation in gagemaking. The lapping should be done just right, because there is no other way of giving a gage its high finish and, what is most important of all, its long life. There was a feeling in many shops, when orders for flat gages first began to come in, that a good job of grinding was as good as lapping. Many a shop owner could not see why the specifications called for lapping, and he had to be shown that a properly lapped gage will retain its size three times as long as a gage that has been ground to size.

Flat gages are often honed to size with a dead-smooth oilstone or an oilstone pencil. By this method of finishing, a careful workman can do a very satisfactory job; but for a really first-class finish where the gage openings are expected to be perfectly parallel at all points, there is nothing that can excel the adjustable hand lap, which is shown in Fig. 4. It consists of two tapered pieces of cast iron held in alignment by an angular groove and a corresponding tongue, which should be a good fit. After being machined, the lapping sides of the two pieces are ground perfectly parallel on a surface grinder; and after shallow grooves have been cut on both lapping sides for the purpose of holding the abrasive, the device is ready for use.

GRINDING ALLOWANCES FOR LAPPING, IN INCHES

	From	To	From	To	From	To
Width of gage opening..	$\frac{1}{32}$	1	1	3	3	6
Allowance for lapping..	0.0002	0.0004	0.0004	0.0007	0.0007	0.001

Hand laps of this kind are easily made, and their life is indefinite, because they are adjustable and, when worn, can be ground parallel again. This type of hand lap has been used successfully for gages whose openings ranged from $\frac{1}{32}$ to 6 in. It is of course understood that a small lap has only a slight taper and a very shallow groove and tongue, whereas larger laps have deeper grooves and are often held by a setscrew extending through one side of the groove and, when tightened, binding the tongue in the groove, thus preserving the setting. Very small laps have no setscrews, but are usually held with a small parallel clamp.

MACHINE LAPPING

Very good results have been obtained with the circular lap on the miller. This is true especially of gages where the gage openings are comparatively narrow or where a radius or an angle is to be lapped, as in gages *D* and *I*, Fig. 1. The circular lap is a round cast-iron disk with a hole in the center bored to fit the miller arbor. The diameter of the lap depends largely on its thickness, but in practice I have found that from 3 to 6 in. diameter will answer all ordinary purposes. At times it is wise to make the lap to the maximum diameter, when a large number of gages are to be lapped, so that, instead of making a new lap in the middle of the work, the same lap can be re-dressed over and over again, till it actually becomes so small in diameter that the spacing collars on the cutter arbor interfere with the re-dressing operation.

On many lapping jobs it is absolutely necessary to make forming tools for preparing the circular lap. The finish forming of the lap and also the subsequent re-dressing should without exception be done on the miller while the lap is in position on the miller arbor, in order to have the lap run perfectly true. A poor lapping job will invariably result from a lap that runs out of true. The gages shown at *D* and *I*, Fig. 1, can be cited as examples where the circular lap has shown that for accuracy and saving in time it can hardly have an equal;

for both these jobs, special forming tools were made for finishing the lap. It must always be borne in mind, however, that before re-dressing the lap with a forming tool, an ordinary lathe tool, held in the miller vise, should be used to turn off sufficient stock from the periphery of the lap to remove all abrasive that has embedded itself in the lap, in order to preserve the expensive forming tool.

Lapping on the Miller

Fig. 5 shows a miller arranged for lapping; *A* is the circular lap, *B* the gage held to an angle plate with clamps resting on a parallel block; *C* is the forming tool held in the miller vise. The sketch is self-explanatory, and from the arrangement of the set-up it is obvious how conveniently the lapping job can be accomplished.

A circular lap of this kind cuts very fast, and it should never be crowded if good results are expected. An ear trumpet can be used effectively here, when feeding the lap to the job. The least scraping sound indicates that the lap is cutting, and it should be passed several times through the gage opening, then the gage wiped with clean waste and measured. Feed the lap only a fraction of a thousandth at a time.

Machine lapping is much more satisfactory in many instances than hand lapping, and for very narrow gage openings it is also much faster than grinding. When the gage opening is narrower than $\frac{3}{16}$ in., the circular lap is more economical than the grinder. As a case for comparison, I remember a hurry-up gage job that came into the shop one day. Everything seemed to go along smoothly up to the grinding of the $\frac{3}{32}$-in. gaging slots, and then the trouble began. What with grinding wheels breaking and the trouble in bell-mouthing, it took from 6 to 9 hours to grind one slot. As there were 40 gages in this order, each gage having two such slots, the expense of grinding alone would have amounted to a prohibitive figure. I suggested the circular lap; and although the stock that had been left for grinding was from 0.005 to 0.008 in., the gages were lapped to size in an average of 2¼ hours for each $\frac{3}{32}$-in. slot. This includes the time for dressing the lap as it became worn. Quite an improvement over the grinding methods! The lapping time would have been much shorter if only about 0.002 in. had been left for lapping.

In conclusion, I will make the following suggestions as regards machine lapping: Use a fine grade of emery flour for lapping; and leave just enough stock for lapping, so that the gage will clean up. If these and other points that have been dwelt upon under the head of machine lapping are adhered to, along with common care in all particulars, there is no reason why any gagemaker should dread a lapping job, as has been often the case with hand lapping.

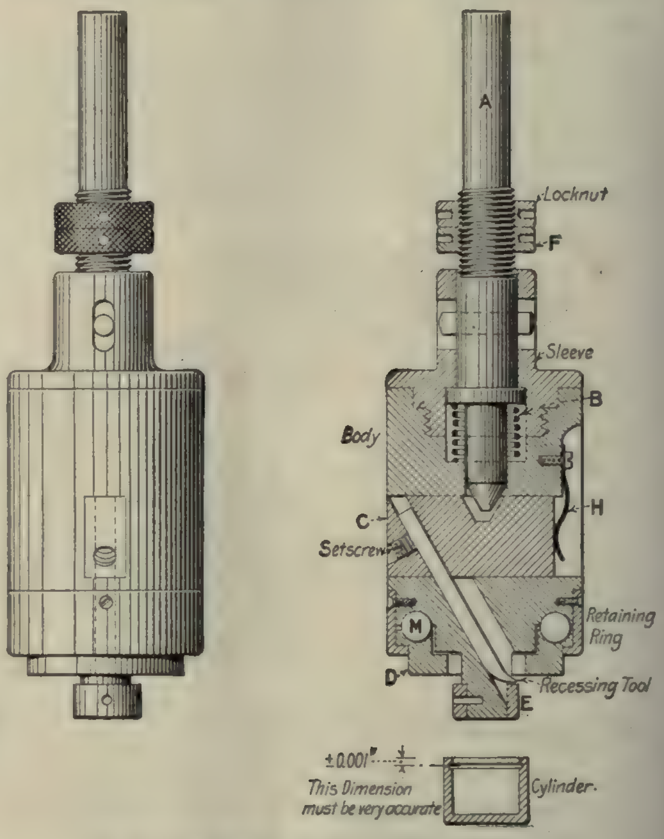
Recessing Tool

By William O. Banks

The machining of a recess in a small cylinder to very accurate limits has caused considerable trouble, so I have designed for the operation the tool shown in the drawing. This tool can be applied to any vertical drilling-machine chuck or to any automatic lathe.

The grinding bushing *E* enters the bore of the cylinder to be recessed, until the end of the cylinder comes in contact with the stop ring *D*, which rides on the balls *M*. Further movement of the tool causes the driving shaft *A* to press against the spring *B*, and the tapered end of the driving shaft then engages in a conical hole in the sliding toolholder *C*, causing the tool to move out and cut the recess.

The adjusting nut *F* limits the movement of the driving shaft, thus controlling the depth of the recess. The spring *H* returns the sliding toolholder to its original position, so that the tool can be withdrawn from the cylinder bore.



RECESSING TOOL FOR ACCURATE WORK

The Sine Bar

By Fred Henke

R. K. Rowell, page 254, Vol. 46, gives a method for making a sine bar. His method, he claims, is equally as good as mine. I think he has failed to see how much quicker my way is, as it does away with the button system. I stated in my article (page 1032, Vol. 45), that some toolmakers drill the holes larger and plug them after hardening the bar, then bore them out, using the button system. This is practically the same method as the one Mr. Rowell advocates. My main object, however, was to make an accurate sine bar in a simple way, without resorting to the button system to space the studs accurately.

Accurate Angles Without a Protractor—Erratum

In this article, on page 161, the second and fourth columns of Table II should read inches instead of minutes.

The Panoramic Sight

By

W. L. Olmstead

III. Machine Operations on Headpiece

SYNOPSIS—*In this article some of the machine operations for the headpiece group of the panoramic sight are described.*

THE first operation on the rotating head is boring and reaming the $1\frac{1}{2}$-in. hole *A*, Fig. 14, and threading and facing one end to relatively correct distance from the center of the bosses. The threading is done with a single-point tool, and a sizing tap is used for finishing to thread gage plug. The holding fixture for the lathe should be so made that the outside irregular shape of the rotating-head casting can be clamped into corresponding shapes cut in the holding fixture. The work when clamped in this manner will retain its shape upon release. Facing and threading the opposite side is done in the second operation. The work is held on a shank arbor similar to Fig. 15.

The adjustable finger support *A* is used to guard against undue strain on the work during the threading operation. It is bored to slide freely along the arbor shank. When the work has been screwed to the arbor, the finger is engaged and tightened with the screw at *B*.

Boring, reaming, threading and facing the large threaded hole *B*, Fig. 14, make up the third operation; *B* is the threaded hole into which the azimuth-circle threaded shank is screwed. In this operation the outside of the hub is turned to a uniform size, and in all later operations on the piece it is used for the locating point.

Operation 4 consists of drilling, reaming and counterboring for bearings and seats (Fig. 14), of the elevation worm. The threads are chased with a single-point tool, using an adjustable tap for sizing. This operation is positioned from the threads and face of the hole made in operation 3.

In operation 5, the throw-out plunger hole, Fig. 14, is bored, reamed and tapped. It is necessary to have this hole exactly on the center line and located for position from the hole bored in operation 4.

The milling cuts in the prism shield are taken in operation 6. The holding fixture, Fig. 16, is bolted to the miller table, and the vertical milling attachment is used. The locating points *B* are fitted to receive the finished outside diameter of the hub prepared in operation 3. The depth of the first roughing cut extends to the top of the rib *G*, Fig. 14, and the second roughing cut to the bottom of the shield opening. Standard end mills are used for the two roughing cuts. The milling cuts are then completed with one cut, using the forming cutter *A*, Fig. 16.

The scoring of the inside of the protecting shield is made in order to minimize the effect of light refraction, the metal surrounding the glass shield receiving a coat of dark-colored paint inside and out, before leaving the factory.

The dovetailed milling cuts for the german-silver index insert *D*, Fig. 14, are taken in operation 7. It is a circular cut of shallow depth into which the dovetailed german-silver insert is soldered. The rotating head is held on the special arbor, shown in Fig. 15, and the vertical milling attachment is used. In milling the curved seat for the insert, a standard mill end 0.1 in. in diameter with flutes $\frac{5}{16}$ in. long serves to remove the stock and finish all but the dovetailing, for which a small bevel cutter is used. When finished, the bottom of the cut comes very close to the top of the thread cut in operation. During the milling operation, a threaded plate should be temporarily screwed into the threaded opening, so as to avoid injury to the internal threads.

In operation 9, the rotating head, into which the german-silver segment has been soldered, is held on the special arbor, Fig. 15, and the outside surface of the segment is milled to size. In operation 10, the same holding arbor is used for cutting the graduated lines of the scale. The graduating can be done on the miller with the special dial apparatus to be described later.

The figures for the graduations on the index scale are engraved in operation 11, and the index line for the

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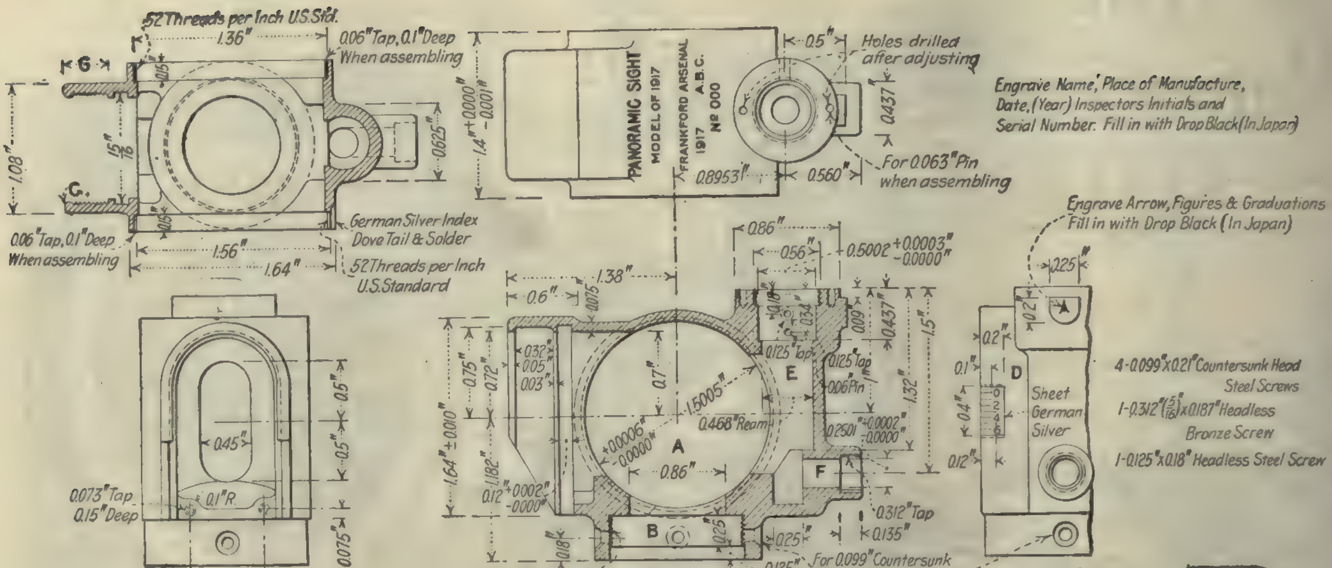

52 Threads per Inch U.S. Std.
1.36"
0.06" Tap, 0.1" Deep When assembling
G
1.08"
15/16"
0.05
0.625"
C
0.06" Tap, 0.1" Deep When assembling
German Silver Index Dove Tail & Solder
1.56"
1.64"
52 Threads per Inch U.S. Standard
1.4" +0.000" -0.001"
PANORAMIC SIGHT
MODEL OF 1917
FRANKFORD ARSENAL
1917 A.B.C.
Nº 000
0.8953"
0.5"
Holes drilled after adjusting
0.437"
0.560"
For 0.063" Pin when assembling
Engrave Name, Place of Manufacture, Date, (Year) Inspectors Initials and Serial Number. Fill in with Drop Black (In Japan)
Engrave Arrow, Figures & Graduations Fill in with Drop Black (In Japan)
0.5"
0.45"
0.5"
0.073" Tap 0.15" Deep
0.1" R
0.075"
0.625"
0.86"
0.56"
0.5002 +0.0003" -0.0000"
1.38"
0.6"
0.075
0.32"
0.05"
0.03"
0.75"
0.72"
0.7"
1.5005"
1.64" ± 0.010"
1.182"
+0.0006" -0.0000"
0.468" Ream
A
0.86"
0.12" +0.002" -0.000"
0.18
0.34
0.125" Tap
0.09
0.437"
1.5"
E
0.125" Tap
0.06" Pin
1.32"
0.2501" +0.0002" -0.0000"
F
B
0.25
0.18"
0.25"
0.312" Tap
0.135"
0.125"
For 0.099" Countersunk Head Screw
1.124" Tap 34 Threads per Inch U.S. Standard
1.125" Ream
1.374"
BRONZE CASTING
0.225"
0.2"
0.2"
0.1"
D
0.4"
Sheet German Silver
0.12"
4-0.099" x 0.21" Countersunk Head Steel Screws
1-0.312" (5/16") x 0.187" Headless Bronze Screw
1-0.125" x 0.18" Headless Steel Screw

FIG. 14 Rotating Head

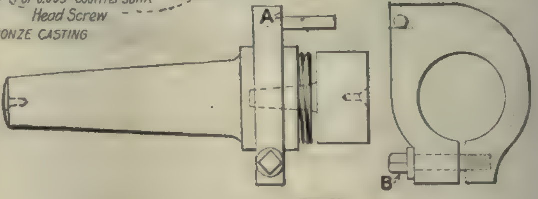


FIG. 15

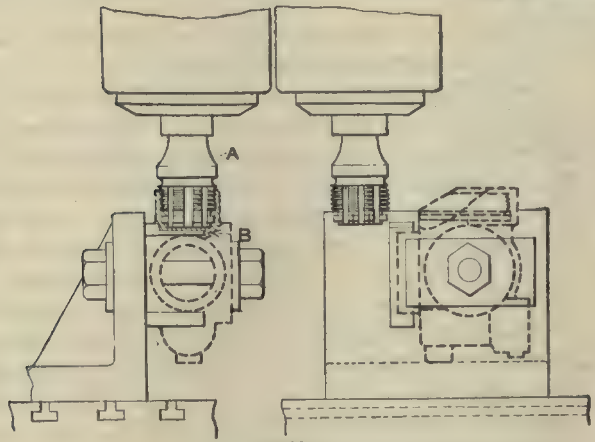


FIG. 16

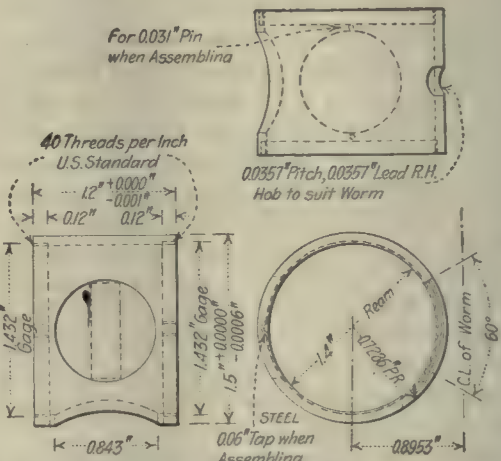

For 0.031" Pin when Assembling
0.0357" Pitch, 0.0357" Lead R.H. Hob to suit Worm
40 Threads per Inch U.S. Standard
1.2" +0.000" -0.001"
0.12"
0.12"
1.432" Gage
1.432" Gage
1.5" +0.0000" -0.0006"
0.843"
0.06" Tap when Assembling
STEEL
Ream
1.4"
0.7206" R
CL of Worm
60°
0.8953"

FIG. 17 Rotating Head Prism Holder

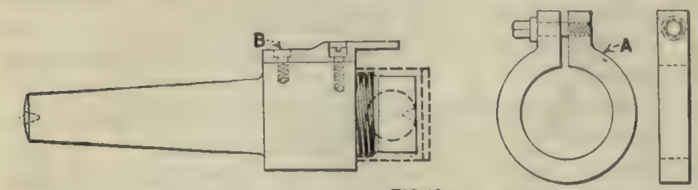


FIG. 18

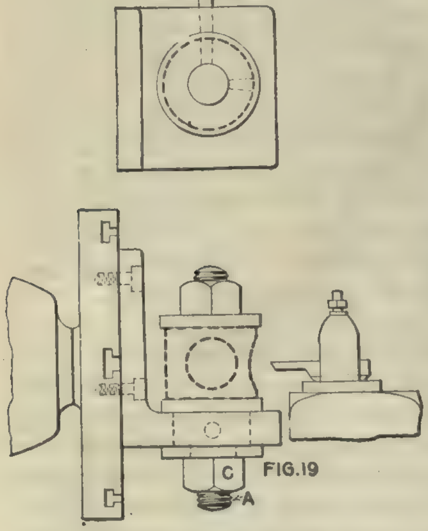


FIG. 19

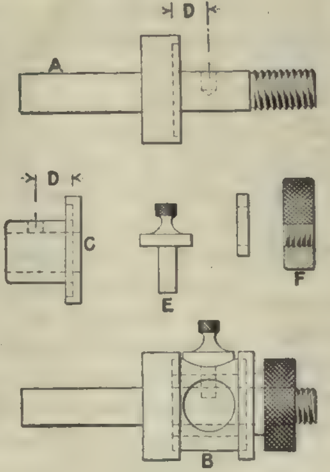


FIG. 20

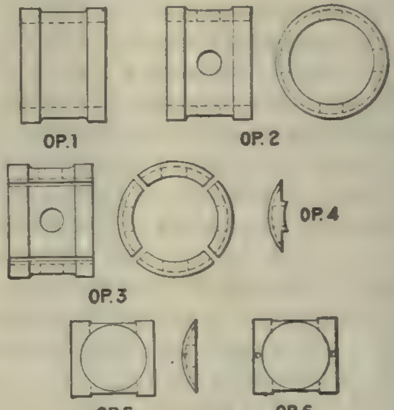
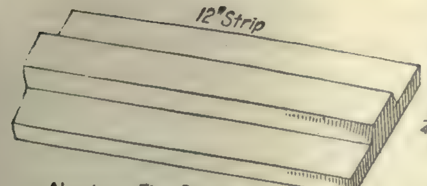


FIG. 21 Operations on the Front and Bottom Prism Support

FIGS. 14 TO 21. SOME OF THE DETAILS OF AND TOOLS FOR THE HEADPIECE GROUP



Aluminum Zinc Casting

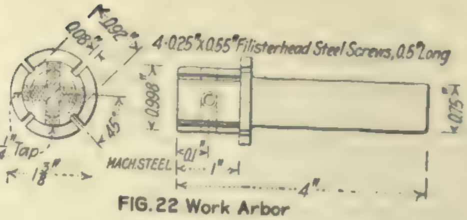


FIG. 22 Work Arbor

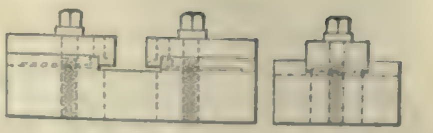


FIG. 23 Counterboring Fixture

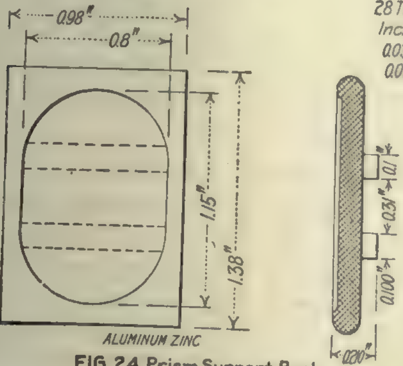


FIG. 24 Prism Support Back

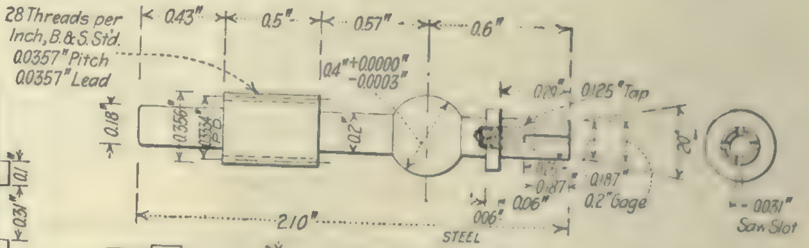


FIG. 25 Elevation Worm

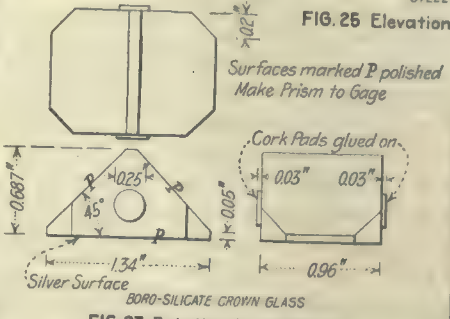


FIG. 27 Rotating Head Prism

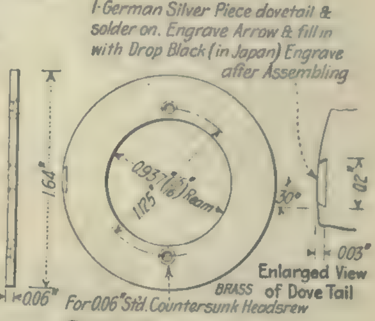

1-German Silver Piece dovetail & solder on. Engrave Arrow & fill in with Drop Black (in Japan) Engrave after Assembling
1.64"
0.937" (15/16) Ream
1.125"
30°
0.2"
0.03"
Enlarged View of Dove Tail
0.06"
BRASS
For 0.06" Std. Countersunk Headscrew

FIG. 28 Elevation Index

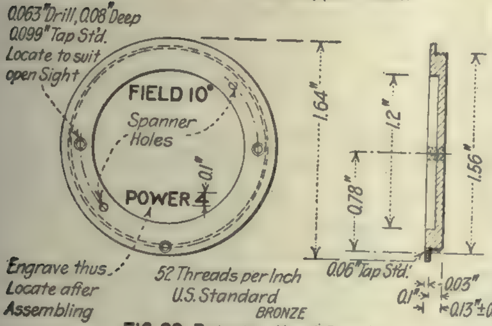


FIG. 26 Rotating Head Cover

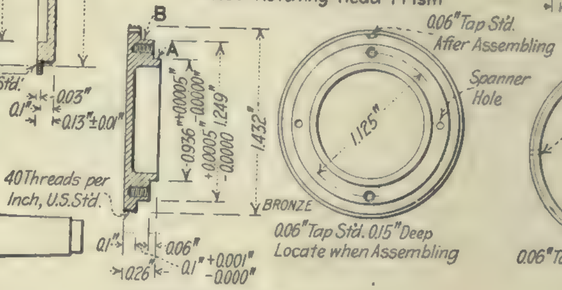


FIG. 29 Elevator Index Support

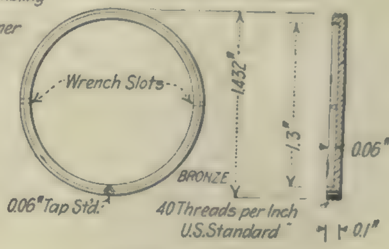


FIG. 30 Prism Holder Cover

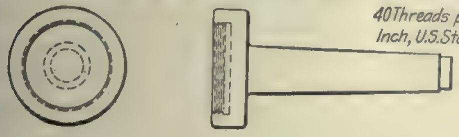


FIG. 31

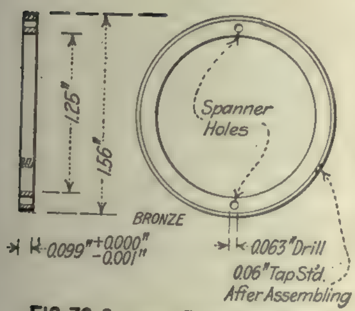


FIG. 32 Support Retaining Ring

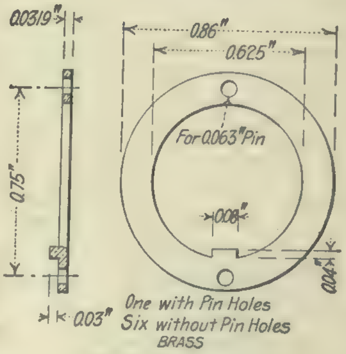


FIG. 33 Stop Rings

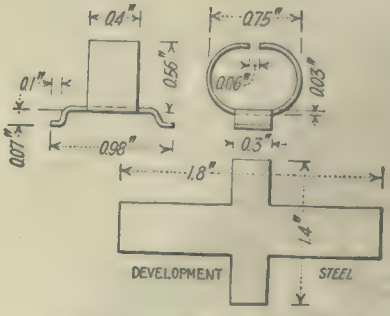


FIG. 34 Rotating Head-prism Spring

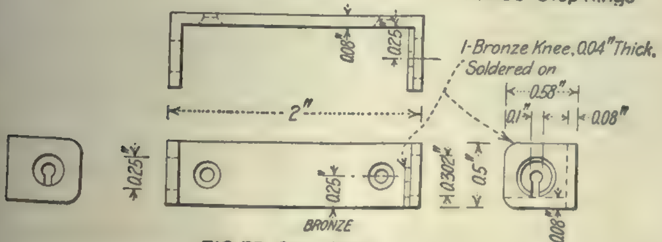


FIG. 35 Open Sight

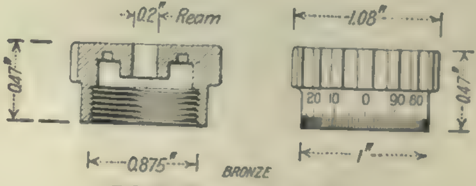


FIG. 36 Elevation Micrometer

FIGS. 22 TO 36. VARIOUS DETAILS IN CONSTRUCTION, AND TOOLS USED FOR THE HEADPIECE OF THE PANORAMIC SIGHT elevation micrometer head in operation 12. The figures on the graduated index scale are made by an engraving machine instead of by stamping. In operations 13 and 14, all other holes are jig drilled and countersunk.

Cold-drawn seamless tubing 1¾ in. in diameter, with ¼-in. thickness of wall, can be used for the prism holder, Fig. 17; or cold-rolled stock is satisfactory, if preferred. The work is chucked, bored, reamed, threaded, faced and roughed on the outside in the first operation. It is then screwed to the shank arbor, Fig. 18, which is threaded to receive the work that has been faced true during the first operation. The split collar *A* is clamped lightly on the work in contact with the projecting finger *B*, which takes part of the strain so that the thread-cutting operation cannot force the thin walls of the prism holder too tightly against the threads and shoulder of the arbor. In this second operation the opposite end is bored and threaded, and a second outside roughing cut is taken, leaving a few thousandths for grinding.

The third operation, that of boring the apertures, requires a special fixture. The angle plate, Fig. 19, is fitted with two locating pins in the base for attaching the fixture to the lathe faceplate, or false plate if preferred. The stud *A* is fitted to the angle plate so that it may be turned through the 90 deg. between apertures, each position being obtained by withdrawing the index pin *B*, loosening the binding nut *C* and turning the stud *A*, so that the pin *B* can be entered into the second index hole. After the apertures have been bored, the outside diameter is ground to the finished size.

Nicking and hobbing the worm segment make up the fourth operation. It is essential that the segment, when cut, shall be true with the outside diameter, or bearing, of the prism holder. The work, therefore, to insure accuracy, should be held on a special arbor similar to Fig. 20. The arbor *A* is faced and recessed to fit the outside diameter of the prism holder *B* and carries the faced and recessed sleeve *C*. The shaft *A* is a sliding fit in the sleeve *C*.

The dimension at *D* equals half the length of the prism holder *B*. At this point the locating pin hole into which the locating pin *E* enters is placed. The largest diameter of the pin *E* fits into the aperture in the work, thus bringing each hobbing operation uniform. The work is clamped securely in this position by the knurled nut *F* operating the clamping sleeve *C*. The indexing and hobbing of the work, the last operation, will be described in a succeeding article.

PRISM SUPPORTS

The front and bottom supports are made from $1\frac{7}{16}$-in. diameter brass rod. The first operation on the bottom prism support, Fig. 21, is to turn, face, drill and ream the piece with a 1-in. reamer. The outside is then recessed and turned to finished dimensions. In the second operation the piece is jig drilled for four ¼-in. holes equally spaced, as shown in Fig. 21.

In the third operation the piece is held on the work arbor, Fig. 22. The arbor fits into a milling machine index head chuck. Four cuts with a saw are taken, dividing the piece into four equal parts. Each part is then held on a shank arbor on the lathe and reduced to the required thickness. The end of the arbor is formed to accommodate the circular side of the work and is tapped for a fillister-head holding screw.

Counterboring the aperture is the fifth operation. The work is held in the fixture, Fig. 23, and a counterbore with a ¼-in. pilot is used.

The seventh operation is that of drilling the two small pin holes for locating the support in the prism holder. These holes are drilled in the bottom support, but not in the front support. The front and bottom supports are exactly alike with this exception.

The back prism support for the rotating head prism, Fig. 11, is an aluminum-zinc casting, 80 per cent. aluminum, 18 per cent. zinc, and 2 per cent. copper alloy. It is cast in strips 12 in. long. On one side, the tongues between which the rotating-head prism spring is held are milled to size, and the flat side, which rests against the prism, is milled and recessed.

ELEVATION WORMSHAFT

The elevation wormshaft, Fig. 25, during the first operation, is centered in each end and roughed out all over, except the diameter of the worm, which is turned to finish size. The worm is then milled to the finish size on a Pratt & Whitney thread miller, following which all other dimensions are machined to finish figures. The ball is turned with a single-point tool, using a standard circular turning attachment on the bench lathe. Forming tools have not proved satisfactory for the work, as it is essential that the surface of the ball shall be concentric with the worm and free from chatter marks or similar irregularities. The surface of the ball is turned to within 0.001 of the finish size and later, during the assembly operation, is lapped into its ball sockets with pumice and rotten stone.

The rotating-head mechanism is protected from dust and moisture by two side covers screwed into the head. One is called the rotating-head cover, Fig. 26, and is drilled and tapped for the open auxiliary sight, Fig. 35; the other, Fig. 29, is called the elevation-index support and is screwed into the index side of the rotating head. It is kept in place by a retaining ring, and its hub carries the elevation index, Fig. 28. There are also two side covers, Fig. 30, which hold the glass prism, Fig. 27, with its supports, in position in the prism holder. They are fitted so that they rest slightly under the flush line of each end of the prism holder, and each end of the prism holder bears against the faces of the rotating-head side covers. These covers, therefore, must be squared true with their threaded diameter.

The prism-holder covers, Fig. 30, are made from $1\frac{7}{16}$-in. brass rod. The recess is formed, the outside is turned, and the threads are chased with a single-point tool. A sizing die is used to bring the work to the thread gage, after which it is faced true and the wrench slots are sawed.

In Fig. 31 is shown the type of holder suitable for holding the covers during the later assembling operations, when extra facing operations are sometimes necessary.

Making the elevation-index support, Fig. 29, which also acts as a cover, is a screw-machine operation in which $1\frac{7}{16}$-in. diameter brass rod is used. The diameter *A* carries the elevation index. The diameter *B* fits into the support retaining ring, Fig. 32.

The stop rings, Fig. 33, are blanked and formed in the power press. The rotating-head prism spring is shown in Fig. 34.

Devices Used for Testing Typewriter Type—II

By FRANK A. STANLEY

SYNOPSIS—*In combination with a test for height, thickness and location of type characters a printing test is made for determining the quality of work which the type will produce when assembled eventually in the typewriter. The testing appliances are so constructed that each of the three characters on the type body may be printed independently or tested together, to assure uniformity in each type line and in the printing effect of the three combined. This establishes a high degree of accuracy in the case of each type itself and assures the faces of the three being in one true plane.*

THE method of fastening the type to their bars under a riveting machine is illustrated in Fig. 6. In putting the type on the bars a rivet is put in the ends—the two outside rivets—and then the type bar and type are put under a microscope to test the height of the center of the middle letter above the bottom of the type bar. This must be exactly 0.6 in.; and when this test is made, the normal center of the microscope crosshair reading is exactly that distance from the gaging surface against which the bottom of the type bar rests. In the case of the letter "a," which is 0.073 in. high, the crosshair of the microscope will show that the type must travel 0.0365 in. in each direction from both top and bottom, as indicated by the micrometer screw, to prove that the type is central up and down. This position established, the third rivet is put in the middle and riveted securely, thus fixing the type upon the working face at the end of the type bar.

This testing operation is shown in Fig. 7, where an inspector is shown traversing the type bar under the microscope by means of the micrometer spindle and noting the readings to see if the position is central, as required. A similar combination microscope and micrometer gage is shown at the right in Fig. 8, for testing the position centrally, up and down, of the characters on the type when this type is secured to the bars. At the left will be seen another form of gage used with a test indicator, which will be referred to a little later.

Here reference should be made to the operation in Fig. 9, which shows the method of grinding the top of the type to exact height from the bottom of the type bar. This is done with a cylinder end grinder with the type bar on a swinging table that carries the work past the wheel. The wheel is dressed off to leave a working edge flat for about ¼ in., and this working surface is kept the right distance in relation to the fixture on the work table by a micrometer adjustment at the rear of the wheel spindle to compensate for wear and dressing

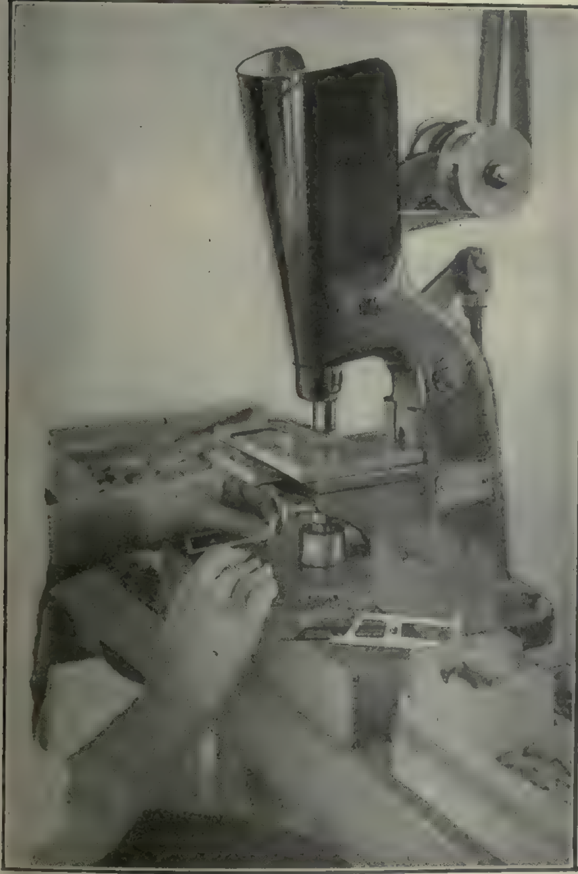


FIG. 6. RIVETING THE TYPE TO THE TYPE BARS

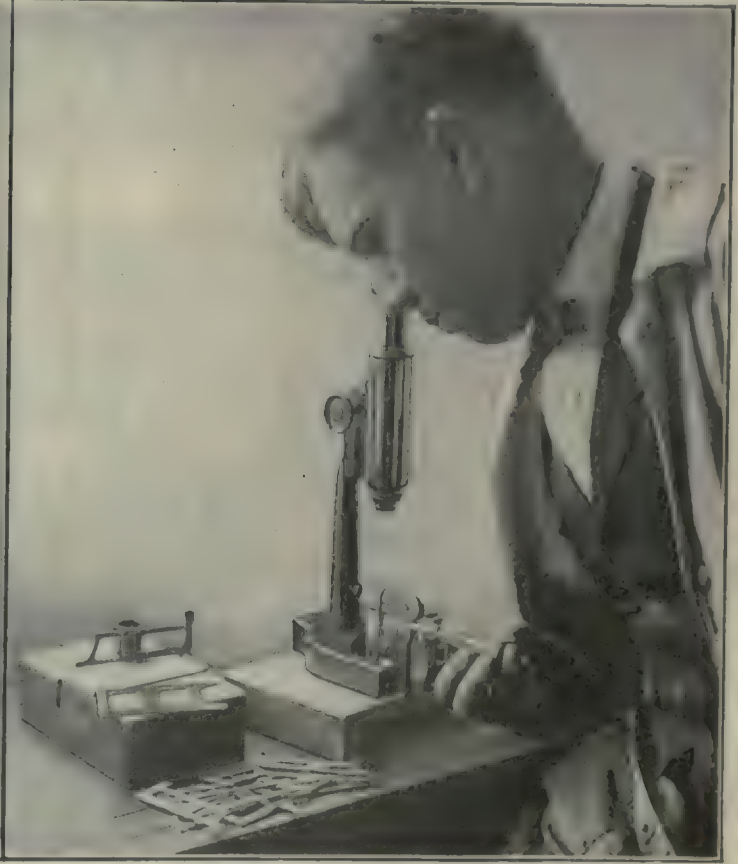


FIG. 7. INSPECTING LOCATION OF TYPE IN RELATION TO SHOULDERS

of the wheel. The work itself is held on the top of a fixture, with the bottom edge set squarely in contact with two locating stop pins by means of a spring-controlled clamp lying against the top edge of the type bar. This presses the bar always to the right and holds it in position for touching up the top end of the type proper. As the face of the wheel is always kept an exact distance from the locating stops on the work-holding fixture, the top of the type is ground off with the assurance that the type are the right height from the bottom of the type bar and that vertical alignment of the type in the guide on the typewriting machine will always be maintained.

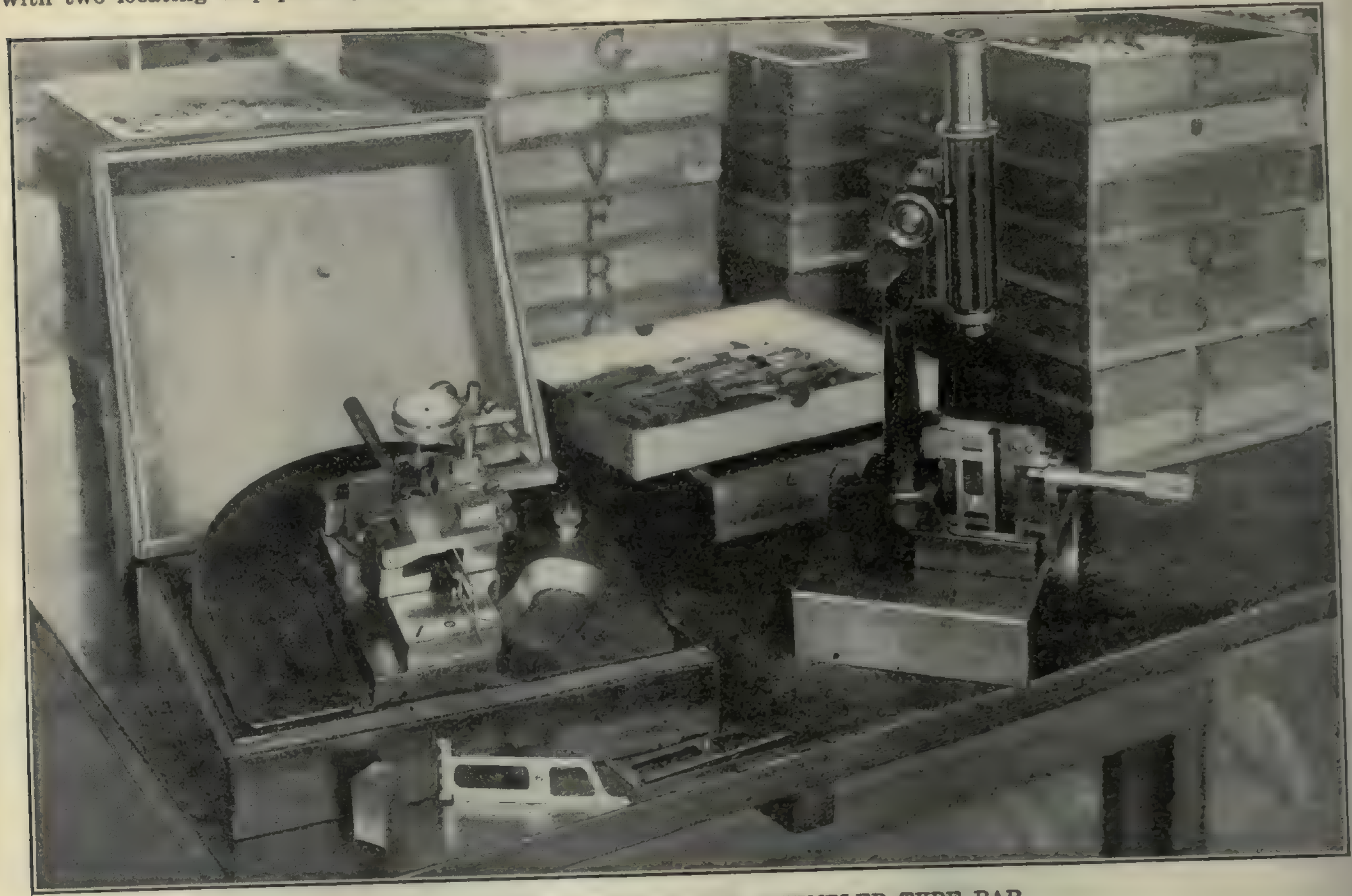


FIG. 8. TESTING DEVICES FOR ASSEMBLED TYPE BAR

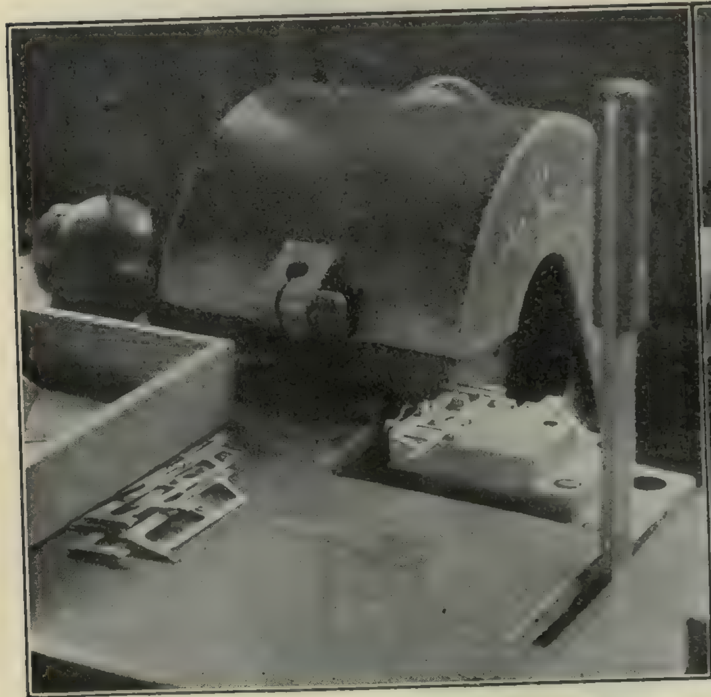


FIG. 9 GRINDING FIXTURE FOR FINISHING END OF TYPE ON TYPE BAR

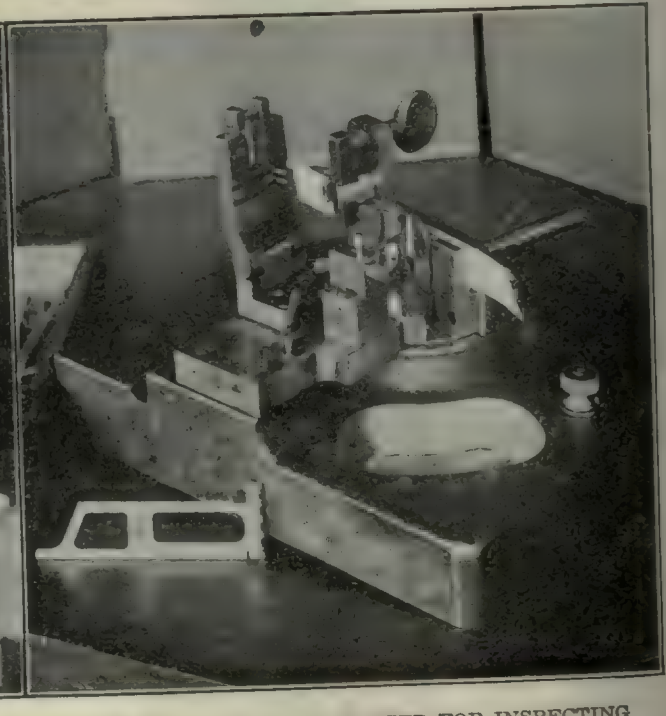


FIG. 10. TESTING DEVICE USED FOR INSPECTING THE ASSEMBLED TYPE BAR

Referring again to the gaging device at the left of the bench in Fig. 8—the same gage that is seen in open position in Fig. 10—it will be understood that this instrument is adapted for testing the height of the type from the bottom of the type bar, as just described in connection with the grinding operation in Fig. 9. It not only tests the height, but also provides for a printing test with a piece of carbon paper and a strip of white paper. For the dial gage test the bar is slid under the button of the gage, and the pointer shows at once whether the top of the type is the right height above the bottom of the type bar.

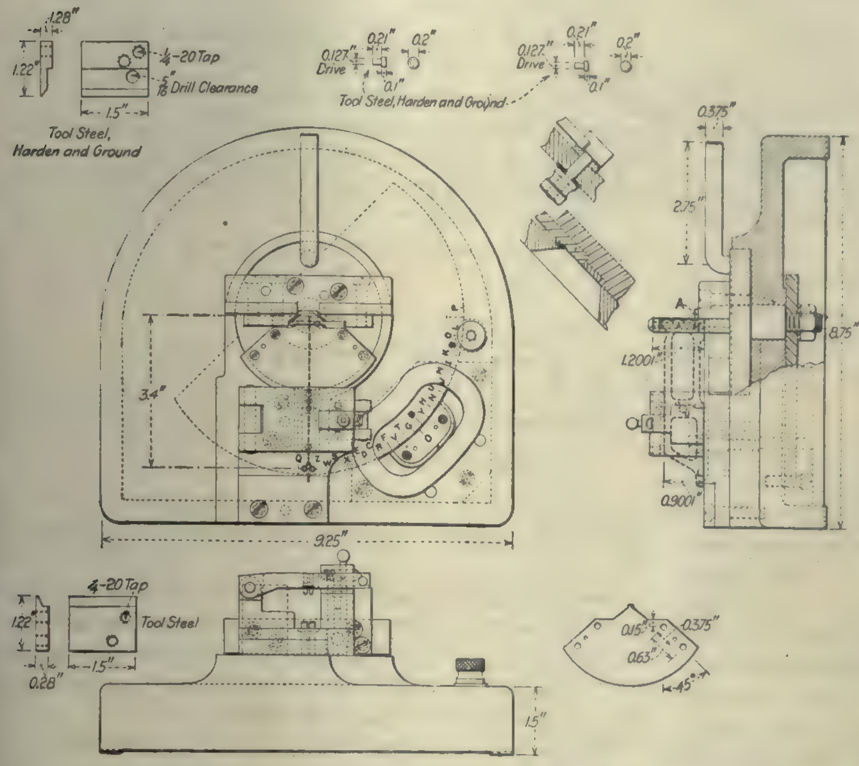


FIG. 11. LAPPING FIXTURE FOR TYPE BARS

The printing test is performed by sliding a sheet of white paper and a sheet of carbon into the back of the gage, as shown in Fig. 10, and then pressing the type bar forward with the fingers to see if the three characters are printed uniformly upon the white surface. The construction of this gage is interesting, and the general features will be understood upon inspection of Figs. 8 and 10. It will be seen that it has a swivel plate to allow the printing platen to be swung to any desired angle, according to which type is tested; and it is possible with the gage shown in Fig. 11 to lap the type characters slightly, if it is found that they do not print uniformly at the desired angle of setting. Thus this may be considered a lapping fixture.

The operation is accomplished by a perfectly square oil stone placed upon the guide at *A*, Fig. 11, where it can be held square to the surface and slipped back and forth to just touch up the faces of the type characters. This figure also shows the method of providing guiding pins in the top leaf of the fixture, as well as in the base, to form a guide for the type bars, and it also brings out certain other refinements in design and construction. The graduations for the angle of setting here are not expressed in degrees of arc, but rather designated by the letter to which the setting must be made when the corresponding type are to be inspected.

Referring again to Fig. 8, it will be seen that a master height gage or block is used in connection with the dial test gage as indicated, to establish a working point from which all tests are made. This gage can be slid under the indicator contact button and the dial then adjusted to bring the pointer to zero or any other convenient figure, so that when the work is slid into position it will be readily seen, in case there is any fluctuation in the needle, just how many thousandths it is above or below the original zero point. Turning now to Fig. 7, it will be seen that there is a master gage lying on the block at the left of the microscope base. This gage is of skeleton form to make it light and easy to handle, and it is used in setting the microscope or in testing the accuracy of its position at any time. As a matter of practice, this master gage is usually applied in the morning to test the setting of the microscope, before proceeding with the inspection of the work itself. The work is carried against a guide, which means that there is always more or less wear, however minute, in the hardened guiding surface here, so the micrometer, with its clamp, is adjusted to make sure that in the inspection of the type under the microscope with its crosshairs the original starting point is not off standard even by the smallest fractional part of an inch. It is interesting to mention that the actual wear in such a fixture, while negligible for a short length of time, is fairly constant through month after month. For example, it is found that, owing to the large number of type bars slid into this fixture every day, perhaps

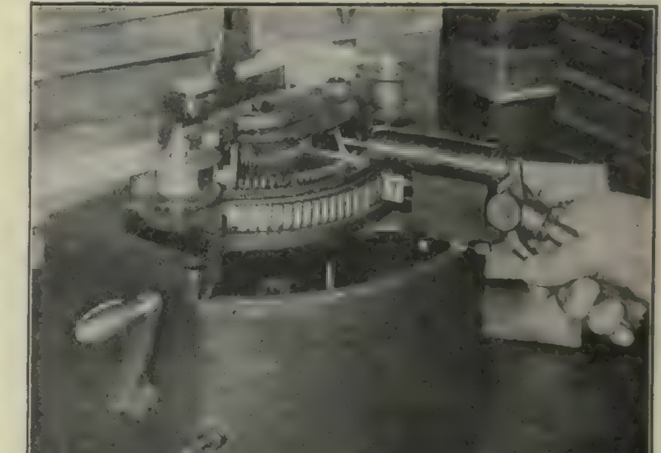


FIG. 13. FIXTURE FOR TESTING PRINTING TYPE READY FOR USE

several thousand, there is a wear of nearly one-half thousandth of an inch in the guiding surface in the course of a week. This wear, accumulating over a period of six months, would mean a total movement of five-thousandths of an inch on the micrometer to adjust for it. By making adjustment every Monday morning the change is unappreciable, because the micrometer is then reset to allow for this amount of wear.

The master gage, which really amounts to a setting gage for the micrometer under the microscope in Fig. 7, is shown more clearly by Fig. 12. As will be seen, it is made up of a piece of templet stock with a head 1.2 in. long. Across the base of this head portion is scribed a line exactly 0.6 in. from the working edge. When this is put into the holding fixture for adjustment of the device, it is moved until this setting line coincides exactly with the crosshairs in the microscope. The micrometer spindle clamp is then adjusted to bring the micrometer in correct position with its zero line in normal position.

Inspection gages of this character are of the utmost importance in modern manufacture; and to keep them up, some regular practice such as the use of checking and setting master gages at certain regular intervals is almost as important as the original gages themselves. There is no question that appreciable wear does appear in tools of this kind after some little service; and this wear is, as a matter of fact, almost in direct proportion to the length of time they are used. Negligible as it may be in a short period of time, each week or month of service adds to the wear. It is only by the regular application of a master gage as described that the effects of wear are minimized; in fact it may here be entirely disregarded, because of the compensation features due to adjustment of the measuring device on the instrument.

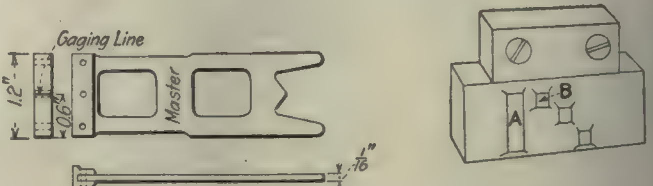
A Final Testing Gage

Fig. 13 illustrates a complete testing fixture for printing the different type on a slip of paper. This fixture corresponds in general construction to the complete typewriter itself.

As will be seen, it is built of a plate corresponding to the top plate of the typewriter, and each type bar may be slid into its own position at exactly the same angle that will be used in the typewriter and while so set may be pressed against the paper by means of the handle shown at the rear. A pair of regular ribbon spools are placed on the fixture, and the regular inked ribbon is used, so that the test of the type is under practically the same conditions in this respect as when assembled in the typewriter. The printing is done against a flat surface, and one, two or all three of the characters on each type can be printed at the same time. This is made possible by the design of the platen, or printing bar, as shown in Fig. 14. It consists of a steel block adapted to slide in the guide shown at the back of the fixture and having raised surfaces as indicated, to correspond to the full height of the type, as at *A*, or to the top, middle or lowest of the three characters, as at *B*. By simply sliding this block along by means of the handle at the rear, either of the printing surfaces is brought into position to back up the paper and ribbon for testing any one or all of three characters on the type.

This testing device, while very complete and serviceable for all the type used, finds a most important place in testing type ordered by mail by outside customers, say where a new style of type is wanted, as it makes it possible to test out the complete set of 28 type bars and type under the same conditions that exist in the typewriter itself.

It will be noticed that the operating handle and plunger, which latter is pressed against the heel of the type bar, are carried upon an arm which is centered under the center of the fan-shaped top plate and which rests upon the back of the circular base. This arm and head for the plunger carry another spring plunger with a roller that is adapted to engage with the semicircular indexing notches cut around the rear of the faceplate corresponding in position to the center line of the type bars themselves. The handle and plunger are thus indexed to any position by pulling to the right or left with the hand, and instantly take any desired location with the plunger on the regular center line.



FIGS. 12 AND 14. TESTING FIXTURES
Fig. 12—Master gage for setting micrometer spindle on microscope gage. Fig. 14—Platen for printing-test fixture

The system of testing fixtures and the methods of inspection discussed in connection with the foregoing text and illustrations indicate that the type and the type bars are pretty thoroughly checked up as to accuracy in character and quality of printing at every point. In the process of assembling the complete machine some further interesting steps are taken to assure accuracy in the work as appearing upon the typewritten sheet.

Running Keywayed Work in the Steadyrest

By George Rich

Regarding Mr. Gabriel's article on page 404, Vol. 46, on keywayed work in the steadyrest of a lathe, I notice that he does not explain why his 45-deg. bushing was made nor why it was necessary to put the keywayed piston in the steadyrest.

There are many ways in which keywayed shafts can be put in a steadyrest, as any first-class lathe hand will know.

A keyed shaft of any kind, running in a steadyrest with any kind of a split bushing, will never make a true job. There will always be that hack to the tool, no matter how minute, every time the keyway in the shaft or slot in the bushing leaves each jaw of the steadyrest.

There is only one way I know of to get absolutely true work of this kind, and that is to bore a collar or sleeve to fit tight on the steadyrest and set the job central. This method gives no trouble and does not require an undue amount of time as compared to other methods, especially if accuracy is desired.

IDEAS FROM PRACTICAL MEN

Press for Bending a Number of Plates Edgewise

By Joseph R. Sheppard

A concern engaged in the manufacture of automobile sideframes required a machine to make an edgewise bend on the plates *A*, Fig. 1, in order to save material when cutting out.

The idea was to take a number of plates from ⅛ to ¼ in. thick, 12 in. wide, forming a pile about 2 in. high, and make this edgewise bend before flanging. The steel was a low-carbon stock with 30 to 40 points carbon.

My part of the job was to design the bending press, shown in Fig. 2, to do the work. The pile of plates, heated at the end only, is securely clamped at *A*, Fig. 2. The horizontal ram is brought up against it so that the plates are held between the angle plate *B* and the crosshead *C*, which prevents the plates from buckling or upsetting on the upper edge. When making the bend with the punch *D*, the pressure is locked in the horizontal cylinder.

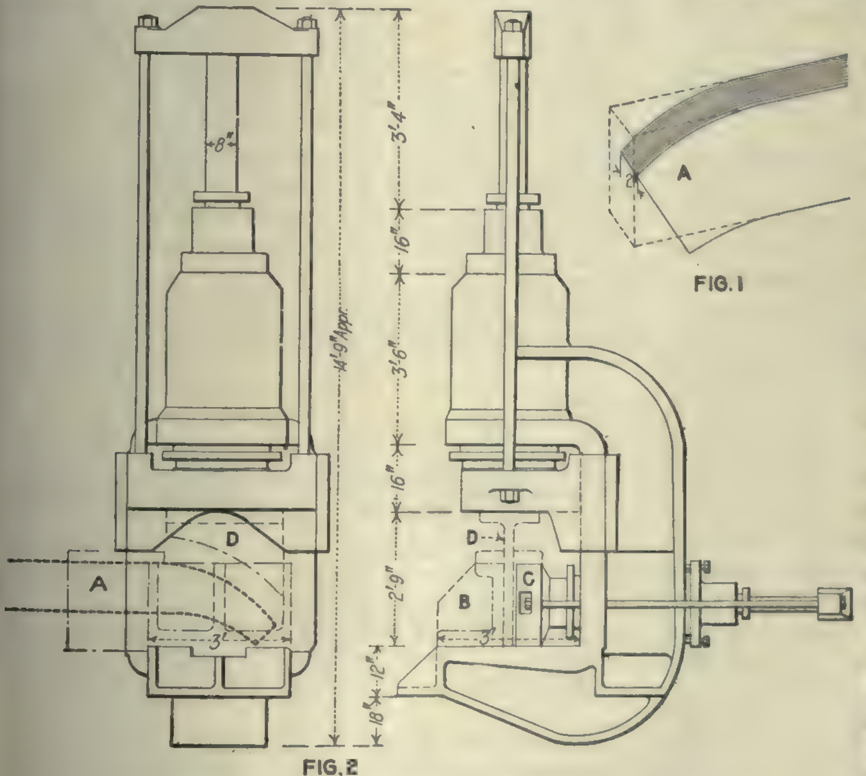


FIG. I

FIG. 2

FIGS. 1 AND 2. ONE PLATE AND THE PRESS FOR MAKING THE EDGEWISE BEND

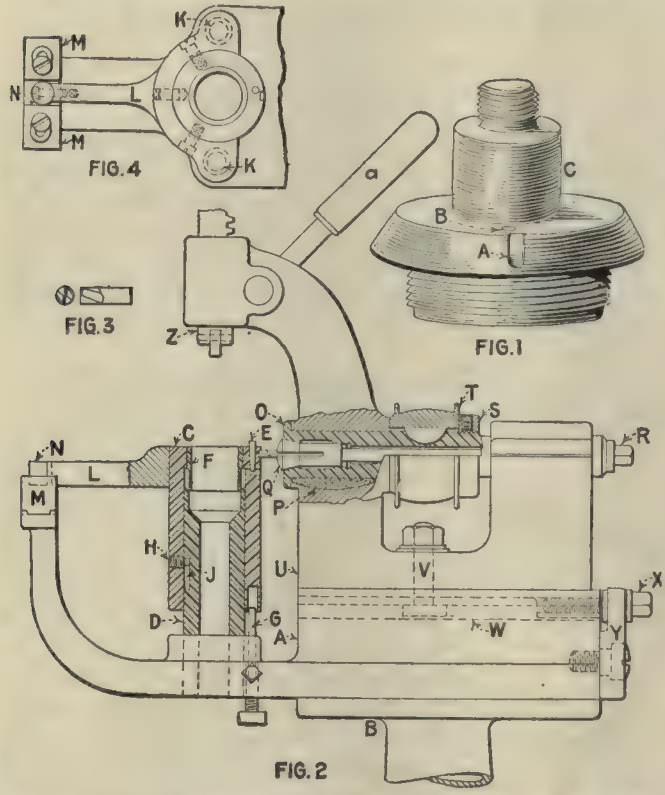
Key-Slot Milling Fixture for Type 80 Fuse

By Donald A. Baker

The machine about to be described was designed for the sole purpose of milling the key slot *A* in the type 80 fuse body, shown in Fig. 1. Its cost to build and set up was less than $300, and it replaced a machine costing upward of $2000. Production averaged about 1200 per day, good, bad and indifferent, for the old machine as against 5000 per day, 99 per cent. good, for the new machine.

Referring to Fig. 2, *A* is the base of the machine, of cast iron; *B* is the pedestal on which it is mounted; *C* is the work holder, which slides up and down on a hollow spindle *D*. Both of these are of hardened steel, ground and lapped on the working surfaces, special pains being taken to have them a nice sliding fit with one another when dry, no oil ever being used on the sliding surfaces. At *E* is the pin over which the work is located from the flash hole in the platform (see *B*, Fig. 1). The stem of the body *C* fits into the bushing *F*, Fig. 2. This is made about 0.002 in. larger than the high limit of the stem diameter. It should be particularly noticed that the bushing *F* extends down into the hollow spindle *D;* the purpose of this is to prevent any chips from getting in between *C* and *D* and causing them to stick. At *G* is an adjustable stop that controls the depth of the slot. It will be seen that *G* is well protected from any possibility of the chips collecting on it and interfering with the accuracy of the work. A screw *H* projects into the slot *J* and limits the upward movement of the work holder *C*. This work holder is held up by two coiled springs carried in spring pockets at the side (see *K*, Fig. 4). At *L*, Figs. 2 and 4, is shown an arm that is screwed and doweled to the work holder *C*. This arm extends out between two hardened-steel blocks *M*, and screwed to its end is a hardened cylinder *N*. The blocks *M* are slotted so that they can be adjusted. This is to take care of the angular relation of the hole *B* and the slot *A*, Fig. 1.

In Fig. 2 the spindle *O* of the machine is made of hardened steel and runs in scraped cast-iron bearings. Sight-feed oil cups are provided for keeping it properly lubricated. Also, a very important feature is a $\frac{3}{16}$ slot milled at the bottom of both bearings, as shown at *P*, which is filled with felt. This felt should be soft and loose rather than of the hard pressed variety. It acts as an oil retainer and safeguard, should the operator fail for any length of time to keep the sight-feed oiler working properly. The cutters, the design of which is shown by Fig. 3, are held in a special spring collet *Q*, Fig. 2. This is held from turning by a key, not shown, and tightened by the draw rod *R*. End play is taken up by the nut *S*, which holds the machine-steel pulley *T* (hardened, lapped inside and ground on the two faces) against the end bearing.



FIGS. 1 TO 4. TYPE 80 FUSE BODY AND MILLING FIXTURE

The spindle head, which slides on the base *A*, is held by the bolt *V* and in proper alignment by a feather on the bottom which fits in the upper part of the T-slot. Adjustment of the cutter for depth of slot is made by the screw *X* on the outer end of the spindle head. This screw has a bearing on the swinging latch *Y*, which is made to swing out of the way, in order to slide the head *U* back on the base *A* when changing cutters.

In operation the machine is used as follows: The body, stem end down, is placed in the work holder *C* with the left hand, locating it from the hole *B*, Fig. 1, over the pin *E*, Fig. 2. Next, the ram *Z*, which carries an equalizing arm (shape shown by dotted lines) is brought down by the hand lever *a*. The continued movement of the hand lever overcomes the tension of the springs and carries the work down onto the cutter, the depth being determined by the stop *G*. This finishes the piece so that bringing the hand lever back to place allows the body to be removed and another to be put in place ready for machining.

The cutter spindle, $1\frac{1}{8}$ in. at the large diameter inside the bearing, revolves at a speed of 6000 r.p.m. When the machine was first being tried out, using ordinary machine oil as a lubricant, the bearings after a run of 10 min. were too hot to bear the hand on, but did not heat enough to make the oil smoke, so they were allowed to run, after provision was made to keep them well supplied with oil. At the end of a day's run on production the bearings had cooled down until the hands could be kept on them, while after a few days the bearings ran comparatively cool. At no time have we experienced any trouble or had to shut down on account of them.

Splining the Bolt Slot in Military Rifles

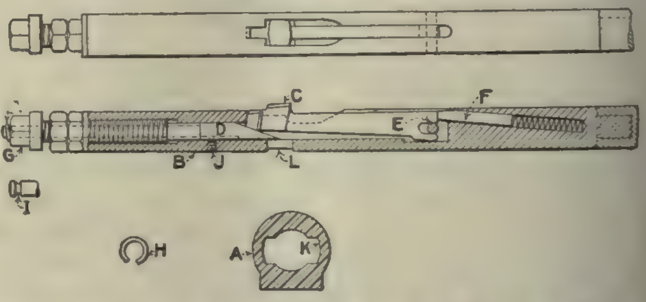
By Elam Whitney

The cross-section at *A* shows a splining, or slotting, operation that is common to the manufacture of the receiver of most military rifles. As the cutters for this work are often trouble makers and as the one illustrated was developed by experimenting, the writer offers it as a tool that will successfully perform the required operation. The work in this case is done in a spline miller.

The holder consists of the round bar *B*, in which is mounted the formed cutter *C* fed into the work by the wedge *D*. The cutter is located and retained by the pin *E* and the spring plunger *F*. The shank of *D* is a sliding fit in the collar headscrew *G* and is retained by the spring ring *H*, which snaps into the groove at *I*.

The threads on the screw are crossed, being both right and left hand, thus providing a simple means of locking the right- and left-hand nuts to the screw more positively than is usually the case. The wedge *D* is prevented from rotating by the pilot screw *J*. The cutter *C* is formed to the radius of the bolt lug, as seen in the illustration at *K*.

In operation, *B* is passed through the bolt hole in the receiver and connected to the ram of the machine, and the receiver is clamped to the fixture. At this stage the cutting edge at *C* is flush. At the end of the return stroke the feed screw is rotated slightly by the ratchet feed common to these machines and connected to the square head, thus pushing the wedge forward sufficiently to raise the cutter the amount of the feed for the next stroke.



SPLINING TOOL FOR MAKING BOLT SLOT IN RIFLES

When the cutter during several strokes has been raised enough to form the radius *K*, the stop nuts are in contact with the end of *B*. This position is shown in the illustration.

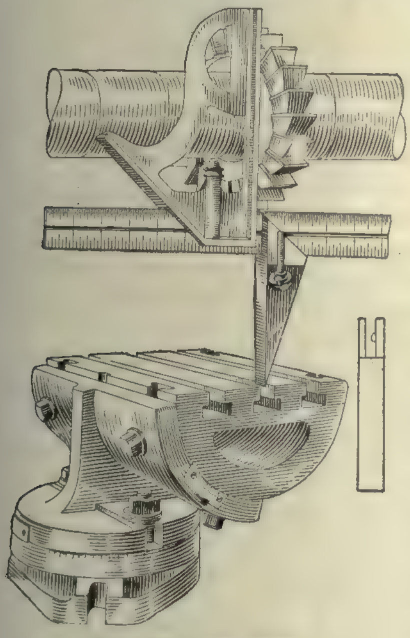
The hole *L* is provided for the removal of chips as well as for the insertion of a pin to remove the cutter.

The writer would be interested to know of other methods of performing this operation, which is one of the most difficult in the machining of parts for military rifles.

Setting Tool for Use with Milling Cutters

By A. Hansen

The illustration shows a small tool that I have found handy for setting milling cutters or lathe tools to center. It is easily made and is used on a combination square, as shown, by putting the head on any graduation and moving the small head to half the width of the cutter. The small head is made to slide on the scale of the combination square in the same manner that the regular head slides. It is square with the blade on the one side, but the other side tapers at an acute angle from the edge of the scale to the end where it comes to a sharp point. This facilitates setting the cutter either in relation to the slots of the milling machine, locating points of jigs or fixtures or with relation to any convenient finished or unfinished parts of the work.

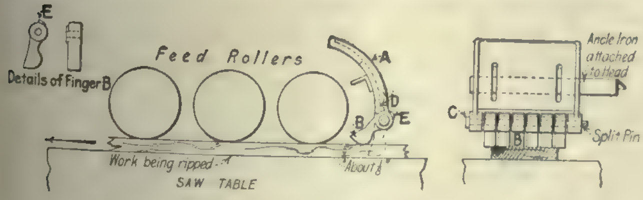


THE SETTING TOOL

Safety Guard for Self-Feed Rip-Saw

By R. A. Maxwell

The accompanying illustration shows a safety guard that was designed to be used on a self-feed rip-saw. These safety guards have been tested out for a considerable time and have been found very satisfactory. They can be installed at very low cost on any ordinary self-feed rip-saw and cost practically nothing for upkeep. The frame *A* and the fingers *B* are made of cast iron, while the fulcrum pin *C* is made of machinery steel; these constitute all the necessary parts.



SAFETY GUARD FOR RIP-SAW

In locating the safety guard on the rip-saw when the fingers *B* are in the vertical position, as shown by dotted lines, the lips should clear the top of the table by about ⅛ in. The work is fed in the direction of the arrow, the fingers *B* swinging on the fulcrum pin *C* so as to permit the work to pass to the saw.

The fingers are so designed that they tend to fall into the vertical position. Thus, if for any reason the saw should push the work away from it, the fingers will tighten on the work and prevent the backward movement. If the work has passed from under the fingers *B* and they have fallen into the vertical position, as shown by the dotted lines on the illustration, before the saw begins pushing the work back, then as soon as the backward movement caused by the saw brings the work into contact with the fingers *B*, the stop *E* on the fingers will bear against the stop *D* on the frame *A*, thereby preventing any further backward movement.

Business Men of the United States Call Great Patriotic War Convention

An emergency call has gone forth from the Chamber of Commerce of the United States to the business men of the country for a national convention to be held at Atlantic City, Sept. 17 to 21. The object of this convention will be to discuss ways and means, and to show to the world that American business is solidly united in backing the Government.

The Chamber of Commerce of the United States has gone on record as "against profit out of war," but it recognizes the fact that "business is conducted for profit and that without profit it cannot exist." Business men are willing to work on another basis so long as they can live; but they must have some plan clearly outlined, and the formulation of some such plan will be discussed at this meeting.

Without criticism of them it may be said that Government officials have been too busy creating armies, sending them to the front and furnishing them with supplies, to outline a policy along which business may proceed.

The meeting will be addressed by prominent speakers. The principal topic of discussion will be the duty that business owes the Government in war, and how business may render greater service in winning the war. The different phases considered will include price control, greater efficiency in transportation, protection of our forces and those dependent upon them at home, better education of the nation on the issues at stake in this war, ways and means by which business may readjust itself to the new conditions, food conservation, industrial relation and employment problems, foreign trade, and banking and credits in war time.

Of particular interest will be the question of readjustment after the war, course of prices, replacing our men in industry after their return, and our new responsibilities in international relations. These are all questions which are of vital interest to American manufacturers during the present crisis.

Every live business man who can do so should arrange to attend this convention, that each may gain all possible knowledge as to how he can best plan to be of greater service to a common cause.

The Metric-Equivalent Scheme

By F. A. HALSEY

Editor Emeritus, "American Machinist"; Commissioner, American Institute of Weights and Measures

THE opposition to the metric system has at least accomplished one object. The metric party have come to realize that the task of changing the set of sizes to which all manufactured things are made from those shown by the lines on English to those shown on metric scales cannot be ignored; and they now propose that we do not change them but continue to use existing sizes and measure them in millimeters. This idea, while not new, has been put forward with increasing frequency of late, and it has now become the official plan of the metric party.

In a recent newspaper interview the Secretary of the American Metric Association said: "Just as our Government experts have pointed out, whatever is manufactured must be exactly the same size or weight as before. It is merely a matter of a new term of expression."

I pointed out the absurdity of this plan in my article "The Anti-Metric Case," published in the *American Machinist*, page 139, Vol. 46, as follows:

> Draftsmen and mechanics will be required to use a set of sizes that are not given by the lines on the scales (that is, the metric scales) from which they are taken. That is to say, instead of taking from the scales the sizes shown by their lines, intermediate sizes are to be taken by estimation.

To make clear the meaning of the proposed plan there is nothing like actual cases and, as an illustration, I will select, first, standard screw threads, for which I give in Table I a few sizes expressed in both the old and the "new term of expression." It is to be noted in explanation that, the inch being larger than most pitches, we commonly express pitches as so many threads per inch, whereas, the millimeter being smaller than most pitches, metric pitches (in the few cases in which they are used) are expressed by giving the number of millimeters between threads. This transposition to conform to usage has been made in Table I. Can any shop man look at that table twice and believe that the "new term of expression" will ever be adopted?

Suppose we are to cut a screw of ten threads per inch, the lead screw of the lathe having four threads per inch. We see at once that the ratio of the change gears is $\frac{10}{4}$ or $2\frac{1}{2}$ to 1. Using the "new term of expression," the figures become $\frac{6.35}{2.54}$ and the ratio, which is obvious at a glance with the English system, requires calculation to find with the metric system. Worse yet, whatever threads we want, the index plate of the lathe will give the required gears for the English pitch, while no lathe in the world has an index plate reading for the "new term of expression," gears for all of which must be calculated. This is the way in which the metric system brings about "economy of time in calculations."

A Practical Example in Gear Cutting

Next, let us take up gear cutting. Here we have a similar difference of practice, which I am not mentioning to discuss, but to point it out. In the English system the diametral pitch is the number of teeth divided by the pitch diameter, while in the metric system the module is the diameter divided by the number of teeth. Making this transposition as before, the "new term of expression" for a few diametral pitches is given in Table II.

Charming, aren't they? In place of the simplest possible series of integral numbers we have a set of decimals which no one can remember, and three decimal places are necessary if the results are to be sufficiently accurate. Considering calculations again, with the English system the number of teeth is found by multiplying the pitch by the diameter, while with the metric system the number of teeth is found by dividing the diameter by the module, *both fractional in all cases.* Taking identical examples, we have

ENGLISH SYSTEM	METRIC SYSTEM
8 pitch × $6\frac{1}{2}$-in. diameter = 52 teeth	$\frac{\text{165.1 mm. diameter}}{\text{3.175 module}}$ = 52 teeth

To appreciate the point, the reader should make the actual division with pencil and paper. With both procedures the result is identically the same gear, and again we see how the adoption of the metric system will lead to "economy of time in calculations."

It is not, however, necessary to resort to argument. Why do not the metric party do as I have done—consult the practice of so-called metric countries? During the fifteen years in which I have been engaged on this subject, I have investigated the practice of weights and measures in substantially every civilized country on earth, and it is a simple fact that to whatever extent the metric system has been adopted, to that extent the sizes to which manufactured things are made have been changed; to whatever extent old sizes are used, old units are used in making them. Before the war, the receipt of German construction drawings was a common thing in the office of the *American Machinist*, and in those drawings English screw threads were always given in English inches for diameter and pitch.

Does some confirmed metricite rise up and tell us that he has been in a shop where he has seen this "new term of expression" used? Then, I reply that I have been in circuses where I have seen men walk on tight ropes, and others stand on their heads, but I never heard those practices recommended as improvements on more usual methods. Like the feats of an acrobat, the use of the "new term of expression" is a physical possibility to those having sufficient determination, but only those who are determined to use the metric system, regardless of common sense, will ever use it.

But, does the metric party mean what they say when they tell us that the adoption of the metric system does not involve a change of sizes? They do not. Present these tables of equivalent expressions to any one of them, and he will reply, as they have done over and over again: "But these expressions will be used during the transition period only. Once we have fully adopted the metric system, they will disappear."

This is the small circle in which they travel: When we show them that the change of sizes is impossible, they tell us we will not change them but use millimeter equivalents. When we show them that the millimeter equivalents are hopeless, they tell us we will not use them but change the sizes. The attempt to reason with such people is hopeless.

The metric-equivalent scheme is nothing but a pretext for getting us into the metric mire. The metric party should not be allowed to squirm out of it, but they should be held to it, for they have now made it their official plan. They have acknowledged our disclosures one after another, and have now retreated to this, which is their last ditch and the shallowest of all.

TABLE I. THE METRIC-EQUIVALENT SCHEME APPLIED TO SCREW THREADS

English Dimensions		Metric Equivalents	
Diameter, In.	Pitch Threads per In.	Diameter Mm.	Pitch, Mm.
¼	20	6.35	1.27
⅜	16	9.53	1.59
½	13	12.7	1.96
⅝	11	15.88	2.31
¾	10	19.05	2.54
⅞	9	22.23	2.82
1	8	25.4	3.17
1¼	7	31.75	3.63
1½	6	38.1	4.23
1¾	5	44.45	5.08
2	4½	50.8	5.64

But will the metric party reply to this showing of their ignorance of shop measurements? I wot not, for that is not their way. Their way is to ignore all such demonstrations and lie low, only to smilingly reappear later with the old threadbare claims that have been demolished again and again.

TABLE II. THE METRIC-EQUIVALENT SCHEME APPLIED TO GEAR TEETH

English Diametral Pitch	Metric Equivalent Module
4	6.350
5	5.080
6	4.233
7	3.628
8	3.175
9	2.822
10	2.540
11	2.309
12	2.117

The Time for Real Co-operation

This is the time for great forbearance, in the shop as well as out of it, and particularly in so far as it is likely to affect the production of our much needed munitions and other supplies. The tension of the times affects us all to some extent, even though we be not directly in the war zone or in the war atmosphere, and it is but natural that nerves are strung a little higher than usual.

For this very reason, we must realize that the other fellow is also under the same strain and remember that we probably annoy him as much as he does us. But the main thing to remember is that no personal feelings must be allowed to interfere in any way with the production of needed material—and that means about everything of a useful nature. Coöperation is needed as never before, and all must work together for the common good regardless of personal feelings or the desire to make records for one particular department. The total output is what counts, not the work of a single division of the shop.

This is not the time to stand on ceremony as to matters concerning personal pride or precedent. It is not the time to "let George do it"—there has been too much of that in the past—it is the time to do it yourself, to feel your own individual responsibility as never before.

When an order comes into the shop which seems to take away a little of your authority or personal glory, get busy on the order and find out about the other later. Remember, the manager is also keyed up beyond the normal nerve line, and he probably had no intention of offending you in any way. His sole thought was doubtless to get out the order and safeguard quality.

This is not the time to carry chips on your shoulder or to be looking for trouble. There is plenty of it without looking. But it is the time to see that nothing stands in the way of production; the time to prevent the possibility of personal differences which will reduce the output or the quality; the time to forget the personal pride or preference which may delay the game.

The Man Who Does Things

By Charles M. Horton

There's a call gone out to you, too,
You men in overalls,
Who can twist a nut or drive a pin—
The mightiest of calls.

A call to the man of mechanics,
To the man of the bench and tool,
A call to the Man Who Does Things
With his eye and a bit of rule.

A call to the man on engines,
From base to compression cup,
A call to the man who can set a valve,
To the man who can crank her up.

To the man who can pour out babbitt,
To the man who can weld a joint,
To the man who can head up a rivet,
To the man who can grind a point.

To the man who can cut a gear tooth,
To the man who can chip a lug,
To the man who can face a pipe flange,
To the man who can sink a plug.

To the man who can chuck a casting,
To the man who can chase a thread,
To the man who can run a planer,
And set one up on its bed.

There's a call gone out—a call, men!
A call from the Boss on High,
For men who can serve *behind* the men
Who fight in the fields—and die.

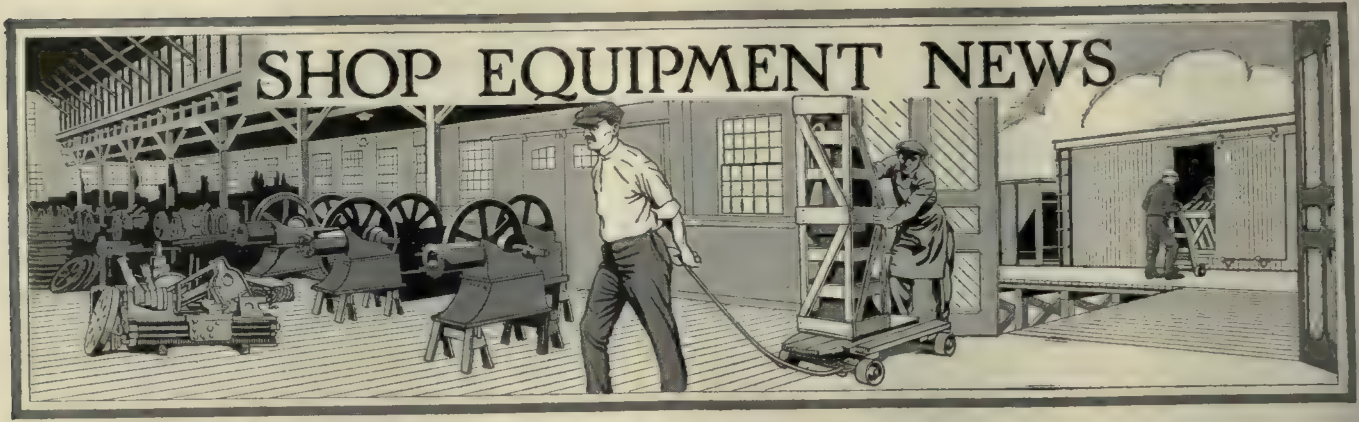
A call to the man of mechanics,
A call that is strident and true,
A call to the Man Who Does Things,
A call from the nation to you.

British Metal Imports

Imports of metals other than iron and steel in Great Britain for the five months ended May 31 are reported as follows, in gross tons:

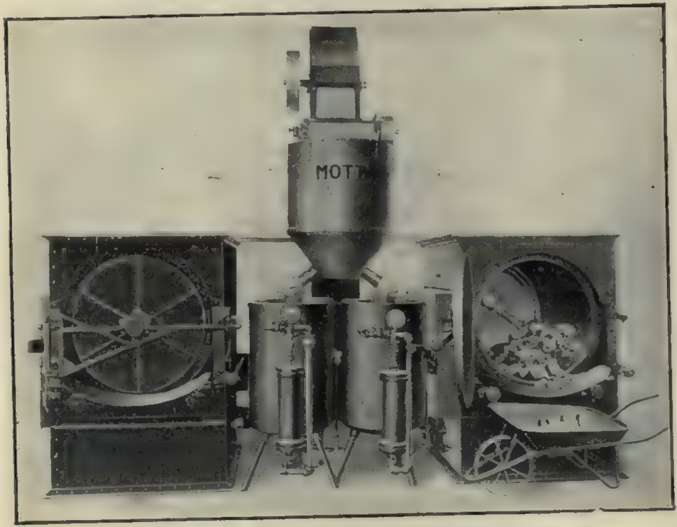
	1916	1917	Changes
Copper, metal	48,250	38,460	D. 9,790
Copper matte and precipitate	17,727	10,404	D. 7.323
Total copper	57,114	43,662	D. 13,452
Tin	15,172	12,847	D. 2,325
Lead	76,378	50,715	D. 25,663
Zinc	16,665	26,095	I. 10,030

Zinc is the only metal showing an increase this year. There were decreases of 23.6% in copper, 18.6% in tin and 33.6% in lead; an increase of 60.3% in zinc.



SHOP EQUIPMENT NEWS

Mott Sand Blast Machine



MOTT DOUBLE-BARREL SAND BLAST MACHINE

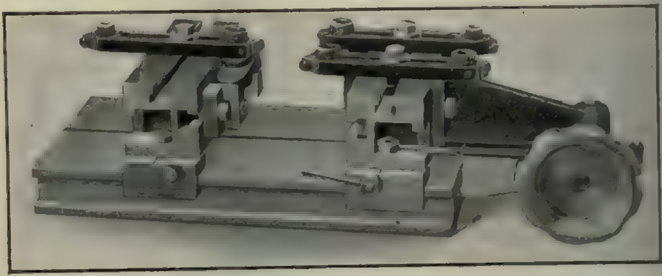
The machine here shown is equipped with a separate sand blast machine for each barrel. The abrasive material is elevated mechanically by a belt and bucket elevator and passed through a mechanically operated screen. This apparatus is claimed to be much superior to the older-model equipment, described in the *American Machinist*, Vol. 42, p. 1015, especially where a large amount of dirt is to be removed from the castings.

The Mott Sand Blast Manufacturing Co., Inc., of Brooklyn, N. Y., and Chicago, Ill., makes these machines in various sizes to meet the requirements of the large or small user.

Berggren & Pearson Universal Drill Jig

The universal drill jig illustrated is being marketed by the Berggren & Pearson Machine Co., Inc., 221-227 Canal St., New York City. It has been designed for the purpose of providing a jig that could be quickly and easily adjusted to various sizes and types of work coming within its range.

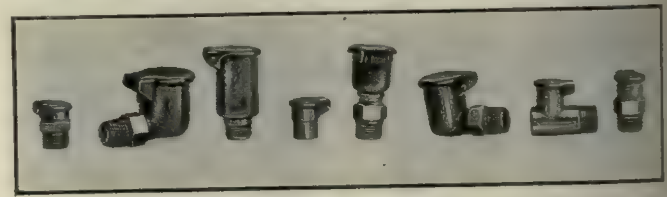
The device consists of a baseplate and two uprights that are machined with a number of T-slots, by means of which the bushing bars and stops for holding the parts to be machined are fastened. The bushing bars have a long slot in the middle in order to allow considerable adjustment and have a slot and screw at the end, by means of which the bushings may be locked firmly in place. One of the uprights has a detachable extension arm carrying a spur gear that meshes with a rack secured to the base. This feature not only allows small movements of the upright to be made, but permits the jig to be opened and closed quickly when this is necessary for the insertion and removal of the work.



UNIVERSAL DRILL JIG

Drill bushings are hardened and ground to size and are furnished regularly in sizes of from ⅛ to 1½ in. in diameter, but special sizes are made to order. Each jig is supplied with four bushing bars and eight bushings, the size of which may be selected by the customer. Spacing plates are furnished as an extra where particularly fine adjustments are necessary. The device is manufactured in five sizes, the largest of which will hold work up to 16 in. long between the jaws and 8 in. thick, it being possible to drill work of any length.

Gits Brothers' Oil Cups

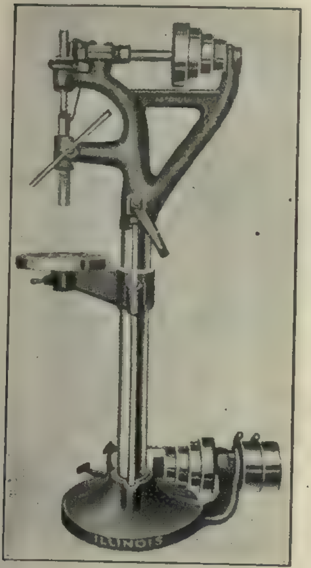


VARIOUS TYPES OF OIL CUPS

The Gits Brothers Manufacturing Co., 553-555 West Monroe St., Chicago, Ill., is now manufacturing a line of oil cups, some of which are shown in the illustration. In the manufacture of these cups all parts are brazed together, the advantage claimed being that the cups are as strong as cast cups, but can be manufactured and sold for a price considerably lower than the latter. They are made in a variety of shapes and sizes with shanks for a taper drive fit, pipe thread or straight thread.

Fourteen-Inch Drilling Machine

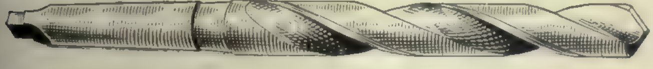
The W. W. Machine Works, Chicago, is manufacturing a 14-in. upright drilling machine especially designed to handle small and medium-sized work. The machine will drill to the center of a 15-in. circle, the spindle being equipped with a No. 2 Morse taper hole which will allow drills to be accommodated up to $\frac{3}{4}$ in. in diameter. The base is provided with ribs on the inside and is large and heavy. The stationary head is cast integral with the column. The spindle is provided with a ball thrust bearing on the lower end to take up pressure when drilling. The spindle driving gear is fitted with a double-headed key of large size sliding in the splineway of the spindle. The gear has a hub 3 in. long, running on a flanged bronze bushing. The height from the floor to the top of the cone pulley is 68 in., while the floor space covered is 20 x 30 in. The countershaft is mounted on the rear of the base and runs at 400 r.p.m. The belt shifter which is mounted on this countershaft is operated by a foot lever at the left of the machine.



UPRIGHT 14-IN. DRILLING MACHINE

Russ Forged Twist Drill

The Russ Forged Drill Co., Cleveland, Ohio, is now manufacturing a line of forged twist drills. These are made in a variety of styles and sizes and are sold under the trade name of "Drill-Far."



RUSS FORGED TWIST DRILL

"Resistal" Goggles

Strauss & Buegeleisen, 37 Warren St., New York City, are now marketing a line of goggles known by the trade name of "Resistal." The eyepieces of these goggles are made up of two layers of glass, between which is placed a layer of celluloid, all three being cemented together.

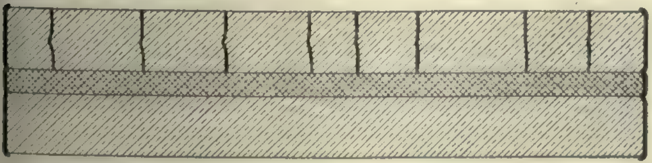


FIG. 1. CROSS-SECTION OF "RESISTAL" LENS

It is claimed that this combination produces a lens which is not easily broken and from which splinters will not fly in case it is struck hard enough to cause cracking. Lenses are made either flat or curved and either clear or colored. The firm will also supply the lenses in various forms for special purposes. Fig. 1 shows the cross-section of the lens, while Fig. 2 shows one style of the goggles.

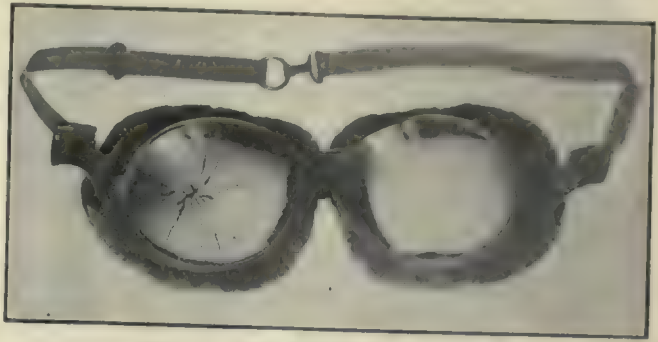
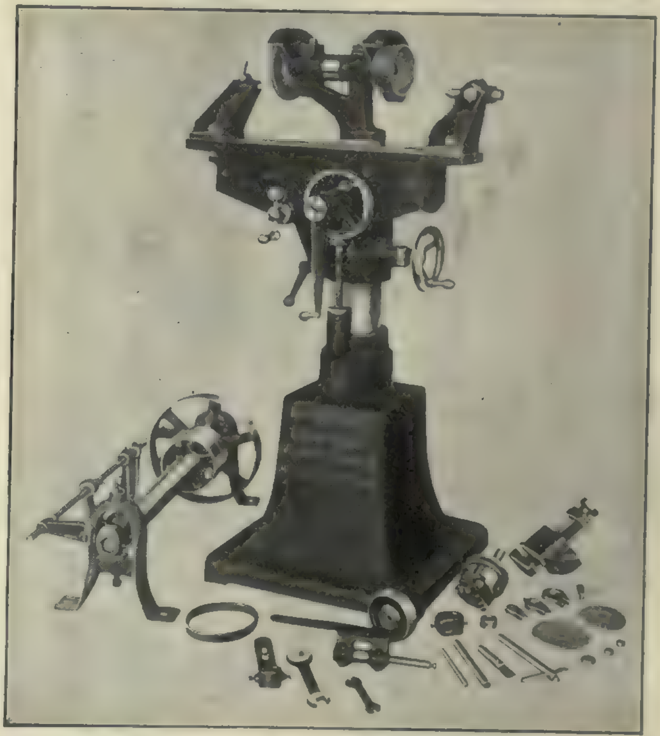


FIG. 2. ONE STYLE OF GOGGLES

Grand Rapids No. 1 Universal Grinder

The universal grinder illustrated has just been put on the market by the Grand Rapids Grinding Machine Co., Grand Rapids, Mich. This machine, which is called No. 1, is a companion machine to the No. 2 shown on page 570, Vol. 46.

The table swivels through full 360 deg. on the subtable and is provided with a graduated scale reading to $\frac{1}{16}$ in. taper per foot of length. The knee carrying the saddle, table and subtable swivels entirely around the main column. Transverse and elevating movements are accomplished by means of acme thread screws operating in bronze nuts, graduated dials indicating movements to 0.001 in. The spindle is of hammered crucible steel and runs in self-oiling bronze bearings that may be



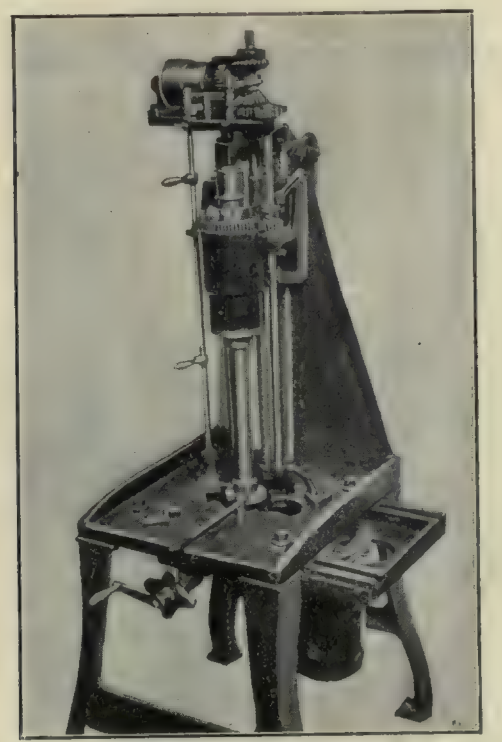
GRAND RAPIDS NO. 1 UNIVERSAL GRINDER

adjusted for either radial or end wear. A bronze bushing is also used on the loose pulley.

The column, spindles and other parts are ground to size; and the machine is regularly supplied with a chuck, universal vise, internal-grinding attachments and a complete set of wrenches, dogs, grinding wheels, etc. The saddle, table, subtable, headstock and tailstock and all attachments are duplicates of those used on the No. 2 machine.

Hy-Grade Gasoline Engine Cylinder Grinder

To provide a machine for grinding engine cylinders, the Hy-Grade Machine Co., 5606 Curtis Ave., Cleveland, Ohio, is now marketing the grinder illustrated. The upright frame and lower surface of the table are cast integral, and the vertical ways and bottom surface are scraped to insure proper alignment. The cylinder block is mounted on a plate that may be moved to bring the different bores into proper position, the ways on which this plate moves extending the full length of the machine.



CYLINDER GRINDER

Height, 6 ft.; travel of spindle head, 22 in.; length of grinding spindle, 16 in.; size of movable plate for supporting work, 16 x 22 x 2½ in.; working space under machine, 18 x 22 in.; floor space, 28 x 32 inches

A movable head carries the spindle, which is driven by a belt extending back through the ways. The spindle is traversed by a screw driven through bevel gears and a clutch that is operated by adjustable stops. Eccentricity of the head is controlled by a worm or screw fitted with a graduated dial. The spindle head is equipped with adjustable bronze bearings, while the spindle is carried on double-row ball and adjustable bronze bearings that are provided with oil retainers. These retainers prevent the oil from working out and collecting and carrying the grinding dust to the bearings.

Universal Electric Drills and Grinders

The illustrations show two new electric portable tools that are the product of the Universal Electric Co., 9 Oliver St., Newark, N. J. In Fig. 1 is seen an electric breast drill that is manufactured in ⅜-, ½- and ¾-in. sizes, the two latter being made in both single- and two-speed types. The weight of the machines has been kept as low as possible by making parts of Acieral metal when feasible. The two smaller sizes are equipped with Jacobs drill chucks, while the larger size is provided with a quick-release Morse taper socket.

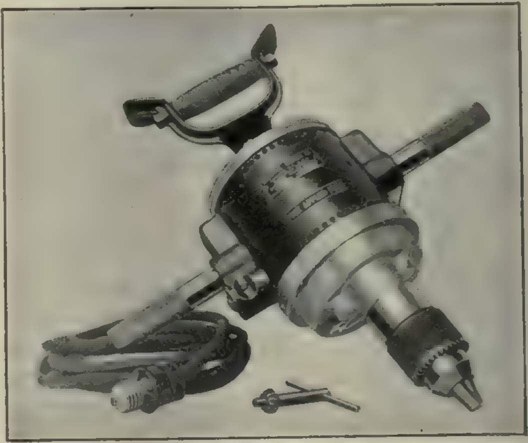


FIG. 1. ELECTRIC PRESS DRILL

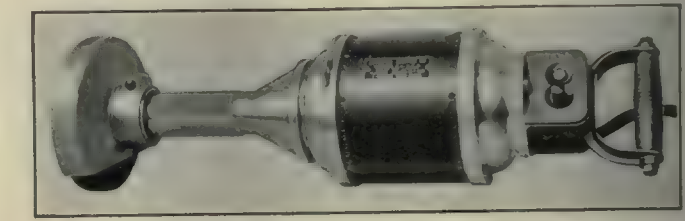


FIG. 2. PORTABLE ELECTRIC GRINDER

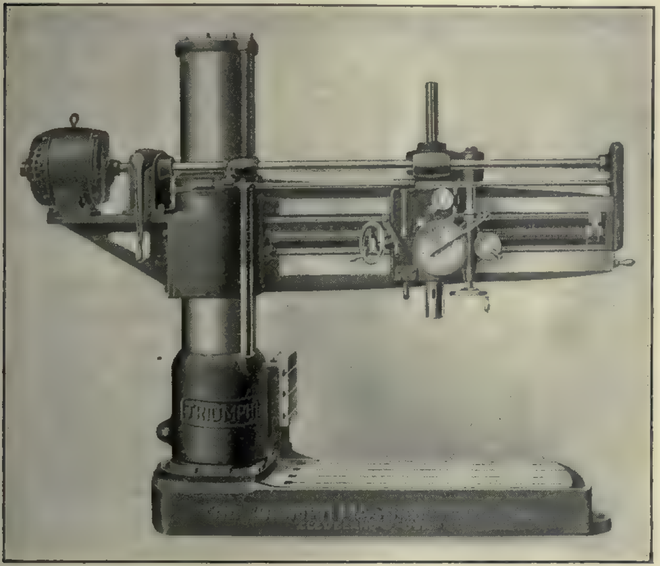
Fig. 2 shows the motor-driven surface grinder, which is a ½-hp. machine with a speed of 3575 r.p.m. The motor bearings are of the SKF ball type, while the wheel bearing is of bronze, adjustable for wear. The grinding wheel measures 6 x ½ in. and is protected by a guard. Acieral metal is used in this machine also, and the weight of the complete grinder is 31 lb. The switch is placed in a convenient manner so that it may be operated by the thumb without letting go of the handle.

Triumph Motor-Driven Radial Drilling Machine

The motor-driven radial drilling machine illustrated is one of the latest to make its appearance on the market. As will be seen, the motor is mounted directly on the rear of the arm and drives the shaft direct. The motor gives 21 speeds in either direction, and the control is located on the spindle head within easy reach of the operator.

The column is made in two sections, the outer sleeve moving about the inner portion, which is attached to the base. Both ends of the outer sleeve are provided with roller bearings to insure ease of operation. Two push buttons on the spindle head serve to operate the raising and lowering mechanism for the arm, an automatic mechanism being provided which disengages the elevating mechanism before the limit of travel has been reached in either direction. Three gibs support the spindle head on the arm, and power-driven rapid traverse is one of the features. The spindle is of high-carbon crucible steel and runs in phosphor-bronze bearings, the thrust being taken by a ball bearing. The rack is inlaid in the sleeve. A worm and wormwheel drive is used, and an oil bath furnishes lubrication.

Another feature of the machine is that when a predetermined depth has been reached the feed is automatically thrown out and the spindle is returned to the upper position. The three-speed gear box is mounted in front of the motor. All gears are of steel submerged in an oil bath and are idle when the normal running speed is being used. Four feeds are provided. The base is ribbed throughout and has an oil gutter around the edge to prevent the waste of cutting compound. A lubricant-circulation system is provided as an extra. The Triumph Machine Tool Co., 1276 East 55th St., Cleveland, Ohio, is the manufacturer.



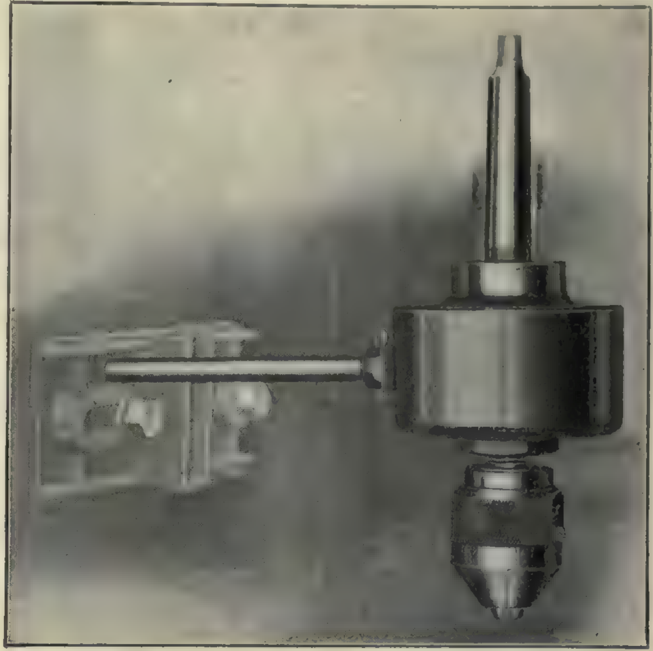
TRIUMPH 6-FT. RADIAL DRILLING MACHINE

Height of base, 9 in.; size of base-working surface, 4 ft. by 6 ft. 8 in.; vertical adjustment of arm, 4 ft.; travel of head, 4 ft. 2 in.; minimum distance spindle to base, 8½ in.; maximum distance spindle to base, 6 ft. 2 in.; minimum distance column to spindle, 24 in.; diameter of column, 18 in.; height, 10 ft. 4 in.; motor horsepower, 5; spindle speeds, twenty-one, 15 to 260 r.p.m.; vertical spindle traverse, 19½ in.; weight, 16,500 lb.; feeds, four, 6, 9, 15 and 24 thousandths per revolution

Bicknell-Thomas Tapping Attachment

The illustration shows a reversing tapping attachment that is made for the drilling machine and is now being marketed by the Bicknell-Thomas Co., Greenfield, Mass. It is built in two styles, positive and friction drive. The friction mechanism is automatically adjusted by the amount of pressure that the operator puts on the drill spindle while tapping, thus making a very sensitive drive.

The attachment shown is equipped with a plain chuck, but the positive-driven attachment may be equipped with a friction chuck if so desired. The friction-drive device is built in one size for work with taps from $\frac{3}{32}$ to ¼ in. in diameter and is made with either a No. 1 or a No. 2 Morse taper shank. The positive-driven attachment is built in two sizes, with capacities of from $\frac{3}{16}$ to ⅜ in. and $\frac{5}{16}$ to ¾ in., the former being supplied with either a No. 1 or a No. 2 Morse taper shank, while the latter may be had with a No. 3 or a No. 4 taper shank.

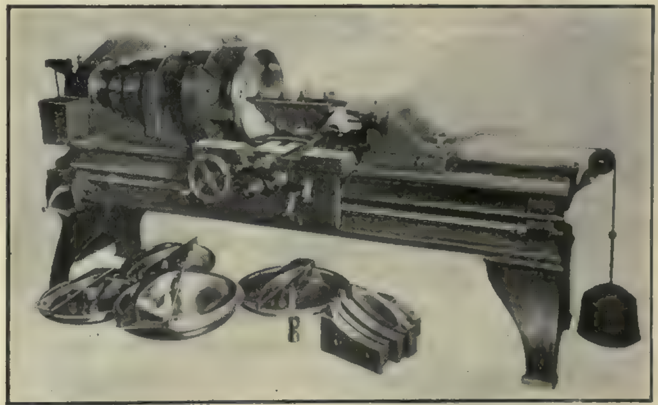


BICKNELL-THOMAS TAPPING ATTACHMENT

Concave Turning Lathe

The lathe shown in the illustration is made by the Luster-Jordan Co., Franklin Ave. and Washington St., Norristown, Penn., being designed especially for turning the inside of air-flask heads for torpedoes. It may also be used for other concave turning work.

A special form of tool-feeding attachment is necessary on account of the fact that the curve of the inside surface is not the same at all points, there being from two to five distinct curves. For turning some curves it has been necessary to connect the toolpost screw with the carriage feed, so that one feed is thrown out and the other is thrown in without interrupting. This has been accomplished by splitting the screw operating the toolpost and connecting with the clutch on the carriage.



CONCAVE TURNING LATHE

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Hotel Powhatan, Washington, D. C., Aug. 25, 1917—The huge airplane appropriation has been made available, and contracts have been placed for training machines in large quantities; airplane engines of well-known types are either being manufactured or shops are preparing to manufacture them in large numbers. Such concerns as the Nordyke & Marmon Co., of Indianapolis, are getting ready to build a thousand engines, and with their experience in high-grade gasoline-engine work, there is no question as to quality of product.

All this is very gratifying; but when we realize how many parts there are to the modern airplane, the multitude of turnbuckles, struts and fuselage fittings and similar parts, and know the crude methods used by most builders of airplanes because of the small quantities previously made, we begin to wonder if all the available plants are being utilized in this work. There is a tendency in some quarters, not necessarily in Washington by any means, to act on the assumption that cost is not to be considered in any of this emergency production. But while we all agree that the actual dollars and cents spent matter very little as compared with ending the war quickly, we must remember that cost is largely a matter of time required for the work, and that if we can reduce the cost we also reduce the time required to turn out the product.

This is particularly true of airplane fittings, which are now being cut out, shaped up and fitted by hand when they could be done by machine in much less time and at much less cost. If the number of pieces is small, cast-iron dies can be used for bending to shape just as successfully as they are used for drop-forging in many places. One particular fitting that I have in mind is said to cost $37 each by hand methods. It ought to be made for not over $2.50 by using even cast-iron dies for bending. This method would also increase the output, which should appeal to those who do not seem to count cost in any particular.

FAILURE TO USE STANDARD PRODUCTS

There is also another point that seems to be entirely overlooked by some of the men responsible for ordering, or specifying, the materials wanted. This is the fact that every change from the regular product of a manufacturer means delay in getting out the material and an added cost that may seem all out of proportion to the changes made. In too many cases, the men who do the specifying seem to have no conception of the manufacturing problem and do not realize how much even a small change upsets the manufacturing schedule. No machine manufacturer, for example, who wanted a lot of monkey wrenches in a hurry, would think of asking the maker to change the shape of the handle a trifle to conform with his particular notion of what a handle should be. Even if this particular shape of handle should be better, should have been carefully and scientifically measured from a plaster cast of someone's hand, he knows that the regular handle will do the work, that the average man who uses it will never know the difference and, most of all, that to make the special shape of handle will require new fixtures and tools, will delay deliveries and add materially to the cost.

This is not a specific instance, but is typical of a number of orders which are being placed or on which manufacturers of standard instruments are being asked to bid. Until those who place orders learn to accept standard instruments and equipment that will work satisfactorily, even if not ideal in all respects, there is bound to be disappointment in deliveries, and prices are sure to be much higher than necessary.

Coupled with this feature is the ever present question of inspection—a question that bothers even experienced manufacturers and that is doubly troublesome when the inspector is a man who knows little or nothing of the product, but who has to be guided by a set of rules laid down by someone else equally ignorant of the actual requirements necessary to secure proper functioning. Probably nothing adds more to both delay and cost than arbitrary and unnecessary rigidity in inspection. The main difficulty is so to draw specifications and so to inspect that essentials shall be carefully watched and nonessentials shall be inspected only in accordance with their bearing on the piece as a whole. No one who is not utterly unscrupulous wants an inspector to pass anything that will not function perfectly, anything that can possibly cost the life of a soldier or in any way affect or delay the final victory. But it is just as disastrous to delay production by rejecting parts that will perform their work perfectly, even if they do not appear absolutely perfect in nonessential particulars. There have been many cases where rifles and other munitions have been rejected—when they were badly needed across the water—because of defects which did not and could not affect their working in any way.

Contracts are being let for ship accessories, such as compasses and other instruments. Here again the question of deliveries is all important. On this account the matter of price is not being considered as the sole deciding factor, but rather the date of delivery coupled with the reputation of the builder and his habits in meeting delivery dates. These instrument contracts run into more money than one not familiar with the instruments would imagine. They are required both for the new naval vessels, which count up to larger numbers than we might think, and also for the new commercial fleet that is building in various parts of the country. Firms who can supply anything for vessels of either type should get themselves on record to this effect. Then, whether they are called upon or not, they will know that they have done their part and cannot be blamed in any way.

EXEMPTIONS OF MEN

The exemption of men in vital industries is a real problem, even where extreme intelligence is displayed by the exemption board, which is not always the case. Not that all men can be exempted in any industry, as some of the places in any shop can be filled by men beyond the military age or by women; but in some cases, one in particular being an industry that is vital to the building of airplane engines, there should be some definite assurance as to the men really necessary being exempted. But do not imagine that exemption boards have an easy time. I recently heard of a case where an employer asked for the exemption of an unskilled man who had been in his employ only 17 days.

In many cases men who were really needed in industry have enlisted so as to be able to choose the branch of service they desired rather than be drafted later—men who would have been of greater value in industry than in the ranks, but who get no assurance from any source that they would be exempted. In such cases it would seem possible for closer coöperation between the military and the Government branches responsible for the production of vital supplies. We should surely be able to profit by the mistakes of our allies, who are vainly regretting the loss of many skilled mechanics in the early days of the war.

BALLING UP THE INSPECTION OF GAGES

It will be remembered that the Bureau of Standards was selected to be the central headquarters for the inspection of munition gages and secured the necessary appropriation from Congress to carry on this work, being aided by the War Department in so doing. Preparations were duly made, many instruments installed and a force organized to handle the work. But the gages do not come in to be measured. This would indicate either that they are not being made or that they are being sent elsewhere to be inspected and passed. As a matter of fact, the latter is exactly what is happening, and an attempt is evidently being made to establish an inspection headquarters at the Frankford arsenal either in addition to or in place of the one in Washington.

This is only one of the many samples of duplication of effort which are to be found in bureaucratic circles at present and for which no special individual is to be blamed. It is rather the result of the system that has grown up undisturbed in times of peace, when no one had much occasion to pay any attention to it. The only consolation is that it is at least no worse than that which exists, or which did exist at the beginning of the war, in other countries. Great Britain has cleaned house to large extent and is now purchasing and manufacturing war supplies from a centralized bureau and on a business basis, this being done by men who know a particular job by virtue of actual business training rather than by accident of seniority in service.

As examples of the duplication, it is only necessary to see what has happened in the matter of rifles and of artillery. Each of these is placed in charge of a separate officer, presumably chosen for his knowledge in his particular field, which is of course perfectly right and proper. But instead of creating a central gaging and inspection board for all munitions, each branch begins to build up its own organization, each working in its own way and taking no heed of the work or methods of the other. Comment as to the wisdom of such a course is unnecessary.

Suppose any large plant making a number of different articles had a separate gaging department and inspection force for each branch of the work. Different types of fixtures and gages would be used, and the number of men necessary would be very much larger than if this work were all combined into one department. No business man would think of running separate departments in cases of this kind. It is matters of such nature which cannot fail to impress every thoughtful man who appreciates the necessity of rapid and efficient production in the present crisis, with the necessity of placing all matters of production in the hands of engineers and managers who are especially trained in this line, as only in this way can we hope to attain the mark we have set for ourselves. To quote Frank A. Scott, head of the new War Munitions Board, in a recent interview in the Philadelphia *Public Ledger:*

> Only a part of modern war is fought on the battlefield. An important part is fought in the mines and workshops; in the harvest fields and shipyards. Efficiency and economy in producing and distributing the Government's requirements are as necessary to success as courage and intelligence in battle. The slacker at home is as contemptible a figure as the coward in the presence of the enemy. The luxuries of peace must give way to the necessities of war.
>
> We must standardize, economize and then produce, produce, produce. This country has the three great necessities for making modern war—men, metal and machinery. We must make them all available now. Until we can claim the victory, "Speed" must be our watchword.
>
> Artillery, ammunition, aircraft manufactured today may save the lives of countless American soldiers. If we love our country, if we love our sons, now is our chance to express it in action. Days saved now in the production of war needs will mean lives saved hereafter when our troops take the field. Profit making must now yield to patriotism; extravagance to economy; selfishness to service. We must now apply to war needs all those vast material and human resources which have made possible the notable achievements of our country in time of peace. War and its sacrifices may be made to yield us a more efficient and a nobler national life.

The appeal for service as against selfishness is just as important now as that profit making must yield to patriotism. The sinking of desire to maintain personal prestige at the cost of efficiency is much needed at this particular time.

PROSPECTS OF THE NEW SHIPS

The prospect of securing ships according to the more rational schedules laid down seems to be reassuring. While none of the new fleet is yet actually in commission, the hulls and machinery are progressing satisfactorily; and there is every indication that there will be no delay in furnishing equipment. In fact, more equipment is offered in some lines than can be utilized as yet.

The inspection methods followed in selecting timber allow the use of pieces which, while perfectly good for this work, might easily be rejected by arbitrary inspection rules. With the various curved shapes, it frequently happens that a defect in one part of a large piece will be cut away when it comes to shaping. Such pieces are passed when the templets or drawing show clearly that the defect will be entirely cut away in sawing to shape, and a great waste is saved in this way.

Chronometers present quite a problem. As I have pointed out previously, almost none are made in this country which pass a satisfactory test at the Naval Observatory. Many chronometers will probably come from England; but in case of necessity high-grade watches will be used, so that there will be no delay from that score.

Perhaps the most hopeful sign of the times is that we are learning, to some extent at least, the necessity and value of coöperation. This is shown in connection with supplying cars to railways that need them most in order to haul either troops or supplies. It also eliminates to a large extent the duplication of train service, which was an obvious inefficiency of the competitive idea. The War Industries Board reports that it has greatly increased the possibilities of securing both artillery and field guns in large quantities at an early date, which is indeed good news. This very evidently means that the men in charge of these guns have been able to decide what they wanted much more rapidly than has been the case with the rifle. They probably have had practical experience enough to realize that perfection is unattainable, and they avoid letting nonessentials delay the output week after week.

THE AVIATION SITUATION

Three of the large training fields for aviators are already in operation, although not with a full equipment of machines. These are, however, being shipped direct from the factories, which are increasing production in almost every case. Then, too, some of our boys are being trained on the Canadian fields by a reciprocal arrangement by which the Canadian students will train on our Southern fields when the weather at Camp Borden, Deseronto and Toronto becomes too cold for comfort in teaching the young birdmen the many duties of the army aviator. It is difficult to realize that practically all the daring feats we read of are accomplished by men under 25 years of age, yet this is the case.

The aviation program is perhaps the most hopeful of any, and presumably because it is in charge of men who are thoroughly trained in manufacturing by modern methods and in large quantities. The only fly in this ointment seems to be the delay in securing instruments that were countermanded after being originally ordered to go with the machines. This is not vital, however, but is one of the unnecessary annoyances that seem to be entirely without excuse.

We are already building European models of aircraft engines which have proved particularly successful, as well as some of our own, and the new standardized "Liberty" engine has been developed in record time. In addition to this, we are receiving the benefit of the studies of a mission of technical experts who have been in Europe for several weeks gathering information of various kinds for the use of both the Government and the various manufacturers of aircraft and aircraft parts.

It is also stated that the Committee of Supplies, under Julius Rosenwald, who should certainly understand buying in large quantities, has done splendid work in advising the Government department responsible for clothing and similar supplies, on how to adapt itself to commercial conditions so that clothing manufacturers who did not specialize in uniforms could utilize their plants in this work. This is another case of accepting commercial standards instead of demanding special models and specifications when it is not necessary to do so.

FRED H. COLVIN.

Activities of the Engineering Council

Subsequent to the organization meeting held on June 27, 1917, the Engineering Council has held two other meetings, one on July 13 and the other on July 26. It has considered many matters of interest to engineers in general.

There have been appointed the following standing committees: (1) On public affairs, C. W. Baker, G. F. Swain, S. J. Jennings and E. W. Rice, Jr.; (2) on rules, J. P. Channing, Clemens Herschel, N. A. Carle and D. S. Jacobus; (3) on finance, B. B. Thayer, I. E. Moultrop, Calvert Townley and Alex. C. Humphreys.

Many matters coming before the council, both from the several founder societies and from the council's predecessor, the Joint Conference Committee of National Engineering Societies, have been considered and referred to appropriate standing committees for investigation and report.

The council has also created a War Inventions Committee, comprising H. W. Buck, A. M. Greene, Jr., and E. B. Kirkby, to coöperate with the Naval Advisory Board and other departments at Washington, if desired, in the promulgation to engineers of war problems now before the Government and for which there are opportunities for solution by means of inventions. It also created a committee consisting of George J. Foran, E. B. Sturgis, A. S. McAllister and A. D. Flinn, which is to collect and compile such information regarding engineers of the country as will enable the committee to coöperate with the different departments of the Federal Government on request and to assist in supplying the Government's need for engineering services.

Iron-Ore Shipments

Shipments of iron ore from Lake Superior in June were 9,639,991 tons, an increase of 132,415 tons over last year. For the season to July 1 shipments were, in gross tons:

Port:	1916	1917	Decrease
Escanaba	2,602,824	2,205,297	397,527
Marquette	1,154,140	625,949	528,191
Ashland	2,204,263	1,909,268	294,995
Superior	3,878,915	3,526,082	352,833
Duluth	6,325,990	5,128,894	1,197,096
Two Harbors	3,449,435	2,739,645	709,790
Total	19,615,567	16,135,135	3,480,432

The decrease this year was due to the late opening of navigation on the Lakes.

Condensed Clipping-Index of Equipment

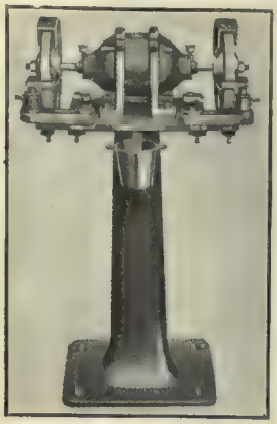
Clip, paste on 3 x 5-in. cards and file as desired

GRINDING AND BUFFING STAND (JOHNSON)

United States Electrical Manufacturing Co., Los Angeles, Calif.

"American Machinist," Aug. 23, 1917

Height to center of spindle, 38 in.; length of spindle over all, No. 1 frame, 24 in.; No. 2 frame, 25 in.; diameter of arbor at wheels, ⅝ in.; guards for wheels, 10 x 1½ in.; maximum floor space, 14 x 18 in. Has one-, two- or three-phase alternating-current motors, as ordered, and runs 1800 and 3600 revolutions per minute

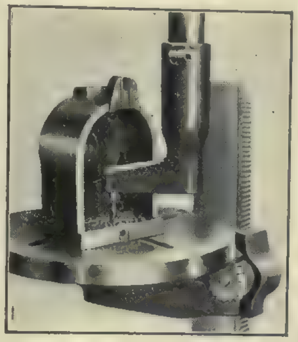


DRILLING ATTACHMENT, OFFSET

H. E. Harris Engineering Co., Bridgeport, Conn.

"American Machinist," Aug. 23, 1917

Designed for drilling and milling operations where the use of an ordinary drilling machine is impossible. It is used especially for drilling, facing or counterboring operations. Eight sizes regularly manufactured, but special types will be made up if required. Attachment is gear driven throughout, and the spindle is equipped with a ball thrust bearing

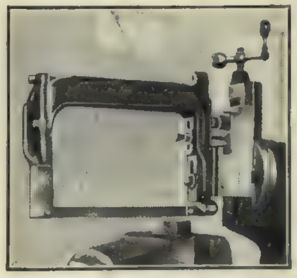


SAW ATTACHMENT FOR SHAPERS

J. A. Moller, P. O. Box 242, New Rochelle, N. Y.

"American Machinist," Aug. 23, 1917

Designed for accomplishing hacksawing operations on the shaper in connection with the manufacture of dies, gages, fixtures, tools, etc. The advantages claimed are the positive control of the saw and the permissible clamping of the stock at any desired angle. Screws at forward end serve to tighten the saw, which is relieved on the return stroke. Distance from cutting edge of blade to under side of saw frame is 9 inches

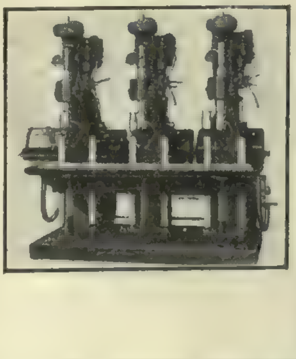


DRILLING MACHINE, ALL-GEARED GANG

The Barnes Drill Co., 830 Chestnut St., Rockford, Ill.

"American Machinist," Aug. 23, 1917

Capacity, up to 2-in. high-speed drills in steel; center of spindle to face of column, 11 in.; maximum distance table to spindle nose, with No. 4 taper 33¾ in., with No. 5 taper 32 in.; spindle travel, 14 in.; diameter spindle sleeve, 3⅛ in.; diameter spindle nose, 3 1/16 in.; width of 8-pitch steel rack on spindle sleeve, 1⅛ in.; ratio of back gearing, 4 to 1; vertical travel of table, 23 in.; distance from floor to table, 42 in.; distance center to center of spindles, 28 in.; height of machine, 85½ in.; weight, three-spindle machine 7832 lb.; two-spindle machine 5300 pounds

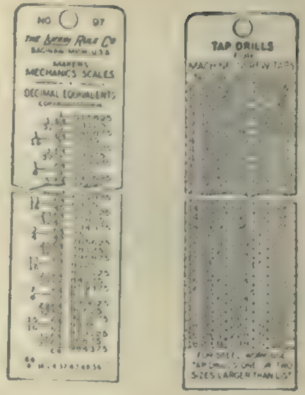


REFERENCE TABLE FOR MECHANICS

Lufkin Rule Co., Saginaw, Mich.

"American Machinist," Aug. 23, 1917

On one side are given machine-screw tap sizes, each followed by the tap-drill size number, its decimal equivalent, the body-drill size number and its decimal equivalent. On the reverse side are the decimal equivalents of fractions of an inch, and at the lower end is an inch graduated in sixty-fourths. A hole is provided at the top in order that the device may be hung up. Is made of flexible steel and measures 1⅞ x 6¾ inches



CRANE, TRAVELING

Champion Crane Co., Cleveland, Ohio

"American Machinist," Aug. 23, 1917

These cranes are designed with a view of accessibility and interchangeability and are provided with a safety device to prevent overhoisting. All shafting is of forged steel, and the gears are cut from 40-point carbon steel. The hook swivels on chrome-nickel steel balls. A mechanical load brake of the Weston multiple-disk type is supplied in addition to the dynamic brake. A foot brake is also provided for stopping the crane on the runway

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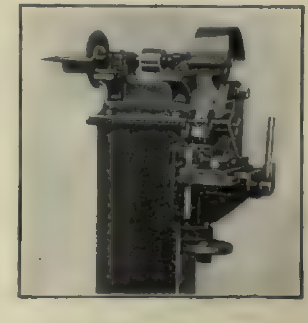
GRINDER, NAIL-DIE

Sleeper & Hartley, Inc., Worcester, Mass.

"American Machinist," Aug. 23, 1917

Designed specially for grinding nail dies. Spindle is double ended, carrying two wheels, one being used for squaring the dies while the other, having a V-shaped edge, serves for grinding the pointing dies. The table carries a support designed to receive the holders in which the dies are mounted for grinding and is adjustable vertically and laterally by means of handwheels. Die holder may be rotated in the support in order that the die may be located in any one of three grinding positions. The floor space occupied is 16 x 22 in. and the weight 350 pounds

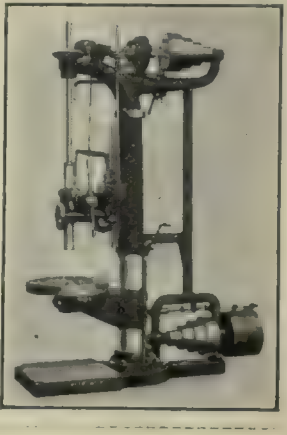


DRILLING MACHINE

Silver Manufacturing Co., Salem, Ohio

"American Machinist," Aug. 23, 1917

Maximum distance spindle to base, 48 in.; maximum distance spindle to table, 31 in.; distance from column to spindle, 12⅞ in.; travel of table on column, 16 in.; travel of head on column, 22¼ in.; diameter of table, 21¼ in.; diameter of column, 6⅝ in.; diameter of spindle, 1⅝ in.; diameter of sleeve, 2⅞ in.; feed of spindle, 9¼ in.; Morse taper hole in spindle, No. 4; ratio of bevel gears, $2^2/_{11}$ to 1; ratio of back gears, 3¾ to 1; size of drive pulleys, 4½ x 12 in.; face of cone steps, 3⅛ in.; spindle speeds, eight, 14 to 315 r.p.m.; feeds, six, 0.0056 to 0.031 in. per revolution; floor space, 22 x 62½ in.; weight, 1650 pounds



Patent Applied For

Personals

H. G. Seltzer is now assistant sales manager for T. A. Willson & Co., Inc., Reading, Pennsylvania.

S. E. Vance has been appointed Washington district manager of Warren Webster & Co. The office is located at 301 Southern Building, 15th and H Sts., N. W., Washington, D. C.

J. T. Plummer, formerly district manager for the Haines Stellite Co., in Cleveland, has been transferred to Kokomo and assigned the State of Indiana and southwestern Ohio.

Harvey B. Wheeler has been appointed supervising engineer of the National X-Ray Reflector Co., Chicago, Ill., and will maintain offices at 120 West 11th St., Kansas City, Missouri.

John B. Nickalas, formerly secretary of the Union Foundry and Machine Co., is now connected with the machinery sales department of Somers, Fitler & Todd Co., Pittsburgh, Pennsylvania.

George De A. Babcock, production manager for the H. H. Franklin Manufacturing Co., Syracuse, N. Y., has been commissioned a major in the supply division of the ordnance section of the United States Army.

H. A. Richmond has been elected managing director and treasurer of the General Abrasive Co., Niagara Falls, New York.

Oliver J. Abell has been elected a director of the American High Speed Chain Co., Indianapolis, Indiana.

Business Items

The Davis-Bournonville Co. has removed its Detroit office from 88 Adams Ave. West to 427 Grand River Avenue.

The Framingham Machine Works, Framingham, Mass., has been reëquipped with machinery appliances for the production of gray-iron castings and the galvanizing of metal goods. The company will henceforth be known as the Framingham Foundries.

Russell, Holbrook & Henderson, Inc., has recently been incorporated and will continue the machine-tool business formerly carried on by Lewis Russell, 30 Church St., New York City. The officers are Lewis Russell, president; C. H. Holbrook, vice president; Lucien G. Henderson, secretary and treasurer.

The Abell-Howe Co. has recently been incorporated to provide for the expansion of the sales and engineering business started some months ago by Oliver J. Abell, at 566 Washington Boulevard, Chicago. Oliver J. Abell is president and treasurer, Glenn G. Howe is vice president, and C. E. Kane is secretary.

The Haines Stellite Co. has discontinued its Cleveland office. The Pittsburgh office has been assigned Cleveland and the eastern section of Ohio, while the Detroit office has been assigned the northwestern section of Ohio west of Cleveland.

The Parker Manufacturing Co., 410 Kerr Building, Detroit, Mich., elected the following directors at a recent stockholders' meeting: Gorham C. Parker, David J. Rice, Howard K. Chambers, Charles D. Bennett and Kenneth P. Albridge. The officers of the company are Gorham C. Parker, president and treasurer; David J. Rice, vice president, and Howard K. Chambers, secretary. The company, which has recently been incorporated, manufactures drill chucks and arbors.

Obituary

F. R. Boynton, tool-designing engineer of the General Vehicle Co., Inc., Long Island City, died suddenly at his home in Brooklyn on Wednesday, Aug. 15.

Major Henry Souther, a pioneer in the field of automobile standardization, and senior officer of the Aircraft Engineering Division of the United States Army Air Service, died at Fortress Monroe hospital on Aug. 5, following an operation. Major Souther was a prominent and active member of the Society of Automotive Engineers, having been its president in 1911, and the first chairman of its standards committee. His policy was essentially one of advancing his industry by bringing to a standard many diversified questions of materials and parts. Major Souther was born in Boston in 1865. After graduating from the Massachusetts Institute of Technology, he was employed by the Pennsylvania Steel Co., later becoming identified with bicycle production in a consulting capacity. He was for some time state chemist of Connecticut and for many years conducted at Hartford a chemical and physical testing laboratory. The first of the White-Souther alternate-stress testing machines was installed in this laboratory, where also elaborate mechanical tests of many kinds were conducted. Early last year, Major Souther assumed duties with the Government and was recently put in charge of Langley Field at Hampton, Va., this detail including the conduct of the experimental work on engines. He was shortly to have been promoted to a lieutenant colonelcy.

Trade Catalogs

Plain and Swivel Milling Vises. The Moback Tool and Machine Manufacturing Co., 330 Atlantic Ave., Boston, Mass. Circular. Illustrated.

Emery Wheel Grinders, Polishing Machines, etc. Challenge Machine Co., Inc., Philadelphia, Penn. Catalog. Pp. 16; 8½ x 11 in.; illustrated.

Lathe, Drill and Planer Chucks, Vises. The Skinner Chuck Co., New Britain, Conn. Catalog and Price List No. 30. Pp. 72; 4 x 7 in.; illustrated.

Edison Storage Batteries for Industrial Transportation. Edison Storage Battery Co., Orange, N. J. Bulletin No. 600. Pp. 32; 6 x 9 in.; illustrated.

Improved American Model Brinell Hardness Testing Machine. Scientific Materials Co., 711-719 Forbes St., Pittsburgh, Penn. Pamphlet. Pp. 12; 6 x 9 in.; illustrated. This also shows special depth-measuring gage with which machine is equipped.

New Publications

Compressed Air—By Elmo G. Harris. One hundred and ninety-two pages; 36 illustrations; 5 charts; 19 tables. Published by the McGraw-Hill Book Co., Inc., New York City. Price $2.

The first edition of this book was presented to the public five years ago. This, the second edition, has been prepared with the view to eliminate all errors and ambiguities and to add matter of value where possible without burdening the text with illustrations and descriptive matter of only temporary value, it being the author's opinion that current practice in the general form of machines and their details can best be studied in trade circulars, of which there are many very creditable productions, illustrating and describing a great variety of machines. The present work is divided into eleven chapters, which embrace formulas for work, measurement of air, friction in air pipes, other air compressors, special applications of compressed air, the airlift pump, receivers and storage of compressed air, fans, centrifugal or turbo air compressors, rotary blowers and examples and exercises. The work is a mathematical treatise throughout, the author making use of the calculus where necessary. No attempt has been made to adapt this book to the use of the self-made mechanic except by the insertion of more complete tables than usually accompany such works. Some 46 formulas are derived throughout the book. These are all indexed in the front of the volume, where they may be readily referred to. A chapter on centrifugal fans and turbine compressors has been added to this edition, which gives a clear concise presentation of the theory underlying such machines.

The tables on compressed air are a very important part of the book, many of them being the original work of the author. Another feature is Appendix B on the design of logarithmic computing charts. Appendix C gives the results of an extensive series of experiments made at the Missouri School of Mines to determine the laws of friction of air in pipes under three inches in diameter. Special effort has been made to give examples of practical matter to illustrate some of the important points in the use of compressed air, and to bring out principles and facts not usually appreciated, making the book as a whole a very complete theoretical compendium on compressed air, which should be well received by the mechanical-engineering profession in general.

Forthcoming Meetings

The twelfth annual exhibit of foundry and machine-shop equipment and supplies will be held under the auspices of the American Foundrymen's Association in the Mechanics Building, Boston, Mass., from Sept. 25 to 28, 1917. The officers of the exhibit committee are: President, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; vice president, Benjamin D. Fuller, Westinghouse Electric and Manufacturing Co., Cleveland, Ohio; secretary and treasurer, A. O. Backert, 12th and Chestnut Sts., Cleveland, Ohio; manager of the department of exhibits, C. E. Hoyt, 123 West Madison St., Chicago, Illinois.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

The American and Canadian engineers and architects of Norwegian birth and descent will hold an informal congress and reunion at the Chicago Norske Klub, Logan Square, Chicago, Ill., Sept. 27 to 29, 1917.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

The annual congress of purchasing agents, under the auspices of the national association, will be held at Pittsburgh, Oct. 9 to 11. The program includes business sessions for the mornings and visitation and inspection of industrial works during the afternoons. Special features are: Tour of Pittsburgh's principal business districts by automobile during the late afternoon of the first day, and cabaret dinner in the evening, to be held at one of the country clubs. The banquet will be held at the Convention Hotel the evening of the second day, Oct. 10, with speakers of national prominence in attendance.

All purchasing agents as well as others interested are welcome and expected to attend and participate in the activities of the convention. Special arrangements are planned for the entertainment of the ladies.

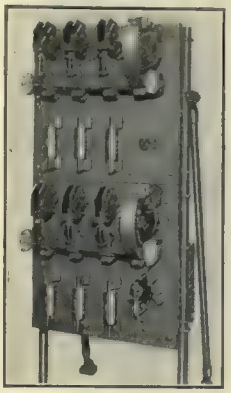
American and Canadian engineers and architects of Norwegian birth or descent will hold an informal congress at the Chicago Norske Klub, Chicago, Ill., Sept. 27 to 29. Correspondence should be addressed to Joachim G. Giaver, Railway Exchange Building, Chicago.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

CONTROLLER, OVEN-HEAT

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.

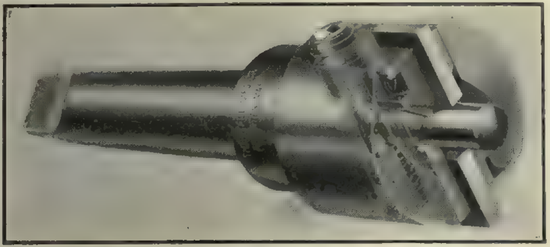


"American Machinist," Aug. 16, 1917

Used for controlling the heat of electrically operated drying or enameling ovens, either push-button or thermostatic control being employed. The thermostat is of the pressure-gage type, the pressure being produced by the expansion of mercury or a gas in a steel capillary tube. Magnetically operated switches are used throughout

COUNTERBORE, END MILL, HOLLOW MILL AND BORING TOOL

Hall Manufacturing Co., Abington, Mass.

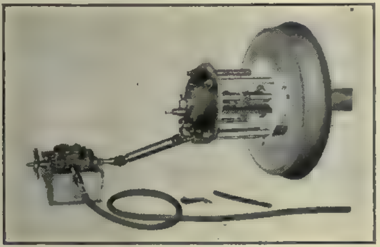


"American Machinist," Aug. 16, 1917

This tool is adjustable and universal and can be used for counterboring, end milling, hollow milling, boring, facing, spot facing, etc. Made in various sizes, each of which has a wide range of adjustment. Blades are ground on all four edges and clamped by movable jaws operated by right- and left-hand screws. Blades may be shaped for irregular work

JOURNAL-TRUING MACHINE (PEARCE)

W. C. Dunn, 26 Hulbert Block, Cincinnati, Ohio

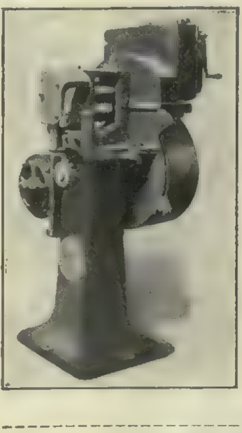


"American Machinist," Aug. 16, 1917

Built primarily for truing car journals, but can be used for other similar types of work. Will handle journals from 3½ x 7 to 6 x 11 in. Fastened to journal by a scroll chuck and held in proper position by a center. Feed mechanism is automatic, being contained in the case at the end. Power is furnished by a standard electric or air motor

WIRE POINTER, MOTOR-DRIVEN

Morgan Construction Co., Worcester, Mass.

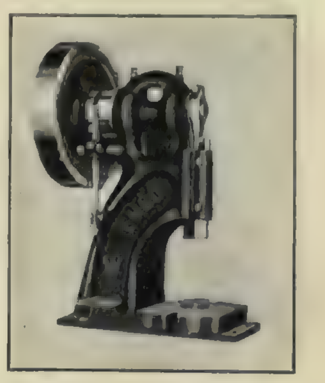


"American Machinist," Aug. 16, 1917

These machines are now arranged with an electric motor mounted on the frame. The wire-pointing mechanism consists of a pair of rolls revolving so as to feed the material toward the operator. A number of grooves are provided to take care of various sizes of wire, the cross-sections of these grooves diminishing around the circumference so that the end of the wire is reduced to a tapering form, allowing it to be threaded into the drawing die

PRESS, BENCH TYPE PUNCH (EMCO W)

Enterprise Machinery Co., 32 South Clinton St., Chicago, Ill.

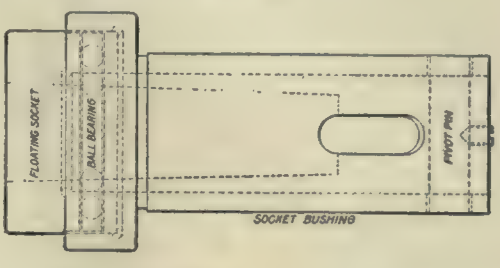


"American Machinist," Aug. 16, 1917

Total weight of press, 120 lb.; weight of flywheel, 30 lb.; size of flywheel, 11 x 2 in.; stroke, ¾ in.; adjustment of stroke, ½ in.; hole in bed, round, 2 in.; slide to bed, stroke up, adjustment down, 5 in.; distance center of ram to frame (throat), 3½ in.; size of bottom of ram, 1⅜ in.; size of bed, front to back, 6½ in.; size of bed, right to left, 8½ in.; bench space required, 11 x 16 in.; height over all, 21 in.; speed, 300 r.p.m.; hole in ram for punch, ⅝ in.; capacity, maximum, soft iron, ¾ x $\frac{1}{16}$ inch

REAMER HOLDER, FLOATING (SHERMAN)

Victor Tool Co., Waynesboro, Penn.



"American Machinist," Aug. 16, 1917

A floating reamer holder for use in turret or automatic lathes and on vertical or horizontal boring mills. A ball thrust bearing is used, and turning is prevented by a pin at the rear as indicated. Made in standard sizes with either taper or straight shanks. Special sizes made to order if desired

PIPE-THREADING ATTACHMENT

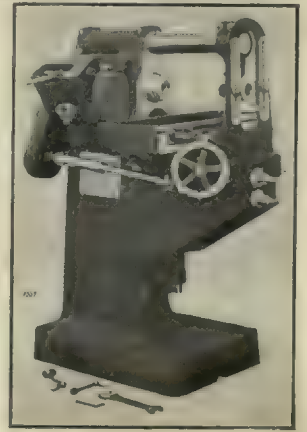
Curtis & Curtis, Bridgeport, Conn.

"American Machinist," Aug. 23, 1917

Designed with the idea of providing a pipe-threading attachment for engine lathes for use in shops where the cost of a regular pipe-threading machine would not be warranted. Pipe is held on carriage while the die is carried on the spindle. For lathes of any make or size from 14- to 24-in. swing and will handle pipe in sizes of from 1 to 4 in. inclusive

MILLER, 12-IN. PLAIN

Cincinnati Milling Machine Co., Cincinnati, Ohio



"American Machinist," Aug. 16, 1917

Working surface of table, 8 x 20 in.; longitudinal power feed, 12 in.; cross-adjustment with braces, 3½ in.; without braces, 6 in.; vertical adjustment, 10½ in.; maximum distance center of spindle to table, 12¼ in.; diameter overhanging arm, 3¼ in.; diameter front spindle bearing, 2$\frac{13}{16}$ in.; hole through spindle, $\frac{13}{16}$ in.; spindle speeds, twelve, 30 to 600 r.p.m.; feeds, four, 0.011 to 0.032 in. per revolution; rapid table movement, 2⅜ in. per turn of handwheel; floor space, 40 x 48 in.; weight, 1650 pounds

Patent Applied For

WEEKLY PRICE GUIDE O

IRON AND STEEL

PIG IRON—Qutations were current as follows at the points and dates indicated:

	Aug. 24. 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$47.00	$47.00	$14.00
No. 2X Northern Foundry, Buffalo.....	53.00	53.00	19.75
No. 2 Northern Foundry, Chicago......	55.00	55.00	18.00
*Bessemer, Pittsburgh	53.95	55.95	21.95
*Basic, Pittsburgh	52.95	53.95	18.95
No. 2X, Philadelphia..............	53.00	53.00	19.50
*No. 2, Valley......................	53.95	53.00	18.25
No. 2, Southern Cincinnati...........	49.90	49.90	16.90
Basic, Eastern Pennsylvania..........	50.00	50.00	19.75

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.

STEEL SHAPES—The following base prices in cents per pound are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Aug. 24, 1917	One Month Ago	One Year Ago	Aug. 24, 1917	One Year Ago	Aug. 24, 1917	One Year Ago
Structural shapes ...	5.25	5.25	3.25	4.50	3.25	5.00	3.10
Soft steel bars......	5.00	5.00	3.30	5.00	3.30	4.50	3.10
Soft steel bar shapes.	5.00	5.00	3.25	4.50	3.25	4.50	3.10
Plates, ¼ to 1 in. thick	9.00	9.00	4.00	8.00	4.00	9.00@10	3.50

BAR IRON—Prices in cents per pound at the places named are as follows:

	Aug. 24, 1917	One Year Ago
Pittsburgh, mill	4.75	2.60
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Aug. 24, 1917	One Month Ago	One Year Ago	Aug. 24, 1917	One Year Ago	Aug. 24, 1917	One Year Ago
*No. 28 black......	8.50	10.50	10.50	3.65	9.00	3.20	10.00	3.20
*No. 26 black......	8.45	10.40	10.40	3.55	8.90	3.10	9.90	3.10
*Nos. 22 and 24 black	8.40	10.35	10.35	3.50	8.85	3.05	9.85	3.05
Nos. 18 and 20 black	8.35	10.30	10.30	4.45	9.20	3.70	9.80	3.00
No. 16 blue annealed.	8.60	10.20	10.20	4.45	9.20	3.70	10.20	3.60
No. 14 blue annealed.	8.60	10.10	10.10	4.35	9.10	3.60	10.10	3.50
No. 12 blue annealed.	8.55	10.05	10.05	4.30	9.05	3.55	10.05	3.45
No. 10 blue annealed.	9.50	10.00	10.00	4.25	9.00	3.50	10.00	3.40
*No. 28 galvanized...	10.25	13.00	13.00	5.00	10.75	4.70	11.50	4.75
*No. 26 galvanized ..	9.95	12.70	12.70	4.70	19.45	4.40	11.20	4.40
No. 24 galvanized...	9.80	12.55	12.55	4.55	10.30	4.25	11.05	4.30

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring fair-sized lots, the following quotations hold:

	Aug. 24, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	40%	45%
Cleveland	40%	45%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—This material per 100 lb. sells as follows:

	Aug. 24, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	13.30	6.30
Chicago	12.50	5.50

In coils an advance of 50c. usually is charged.
Note—Stock scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in fair-sized lots:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

*Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Aug. 24, 1917	Cleveland Aug. 24, 1917	Chicago Aug. 24, 1917
Tire	5.00	5.00	4.50
Toe calk	5.00	5.50	4.75
Openhearth spring steel...	7.00	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Ordinary carbon tool steel, base price	14.00	13.00	15.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	42%	15½%	¾ to 1½.....	33%	17%
½	46%	31½%			
LAP WELD					
2	42%	15½%	2	26%	12%
2½ to 6.....	45%	31½%	2½ to 6.....	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	38%	20½%	¾ to 1½.....	33%	18%
½	43%	30½%			
¾ to 1½.....	47%	34½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4.....	43%	31½%	2¼ to 4......	29%	17%
4½ to 6.....	42%	30½%	4½ to [illegible]......	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	29%	15%	38.8%	24.8%
3½ to 6 in. steel lap welded	26%	7%	36%	21%	42.8%	27.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound:

	Aug. 24, 1917	One Month Ago	One Year Ago
Copper, electrolytic (carload lots).....	27.00	24.00	28.00
Tin	62.00	62.50	38.87½
Lead	11.00	10.00	6.50
Spelter	8.50	8.50	9.50
ST. LOUIS			
Lead	10.75	11.75	5.87½
Spelter	8.25	8.25	9.50

At the places named, the following prices in cents per pound prevail:

	New York			Cleveland		Chicago	
	Aug. 24, 1917	One Month Ago	One Year Ago	Aug. 24, 1917	One Year Ago	Aug. 24, 1917	One Year Ago
Copper sheets, base.	36.00–40.00	42.00	37.50	38.00	38.50	37.50	38.00
Copper wire (carload lots)	38.50	39.50	32.00	38.00	33.00	40.50	33.50
Brass pipe, base...	43.00–45.00	47.50	46.50	46.00	45.00	38.00	45.00
Brass sheets	40.00	39.12½	44.50	36.00	42.00	40.50	39.00
Solder ½ and ½ (case lots)	39.25	39.50	24.62½	39.50	24.75	39.25	24.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Aug. 24, 1917	One Year Ago
Mill	$42.00	$42.00
New York	38.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Aug. 24, 1917	One Year Ago	Aug. 24, 1917	One Year Ago
New York	21.00	17.00	21.50	18.00
Cleveland	23.00	16.75	23.25	17.50
Chicago	22.50	17.00	23.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound for spot delivery, duty paid:

	Aug. 24, 1917	One Year Ago
New York	15.00	13.50
Cleveland	17.50	14.50
Chicago	16.50	13.50

木村商事合名會社

How Japan Turned Its Gardens Into Foundries

可鍛（鋼鐵）鑄造專門 關西鑄鐵所

By "Hi" Sibley

SYNOPSIS — *The war has been a remarkable stimulus to Japanese mechanical industries. This article tells how the demand for castings wherewith to build machines resulted in the creation of numberless backyard foundries in Japan.*

THREE or four years ago, if the traveler speeding north from Tokyo happened to glance out of the car window at the little village of Kawaguchimachi, he would have seen a number of grass panniers of vegetables on the station platform. There being vegetables awaiting shipment on scores of other station platforms throughout this farming district, he would have thought no more of it. But if the same traveler passed through this village today, he would notice these same baskets filled with gray-iron castings. And thereby hangs the interesting story of Kawaguchimachi.

Geographically, the location is no more suited to foundry work than to truck gardening, but it so happens that the native loam of this section is admirably adapted to the molding of castings, and before the war two or three foundries grew there much as mushrooms would spring up in the propitious soil. These foundries were doing a desultory business; came the European War with its subsequent embargo on metal exports by the warring nations, and the foundry trade in Japan began to boom. The old foundries of Kawaguchimachi flourished, expanded; their owners began to make money slowly, and then they became rich. Other inhabitants of the village regarded them wistfully—why could they not become rich, too?

Surely there were greater profits in sowing molten metal in their garden patches and reaping a harvest of door hinges, flatirons and ferrules than laboriously raising green onions and rice. A crop of garden truck only twice a year, but a crop of hardware every day! And so the little foundries sprang up, literally, in the backyards of Kawaguchimachi.

Papa-san put aside his rake and hoe; he invested his savings, and what more he could borrow, in a second-hand boiler, which he reconstructed into a cupola; he installed a crude blower, he cleared his garden patch and erected a light shed over the whole. All over the village one sees these new foundries, many of them as yet unstained by the soot and grime of the smoking molds. Then our enterprising foundryman got the older foundries to farm some of their overflow to him—small pieces—and with his native aptness he set to work at his new trade.

The entire family helps him with enthusiasm. He has taken in all his relatives who are not busy elsewhere, for most concerns in Japan are family affairs, and even his children take a hand. Young Hashimoto is learning to make molds, while little daughter Oukisan clatters back and forth gleefully with her arms full of patterns and tools. And even mama-san, with all her household duties, finds time to make the cores.

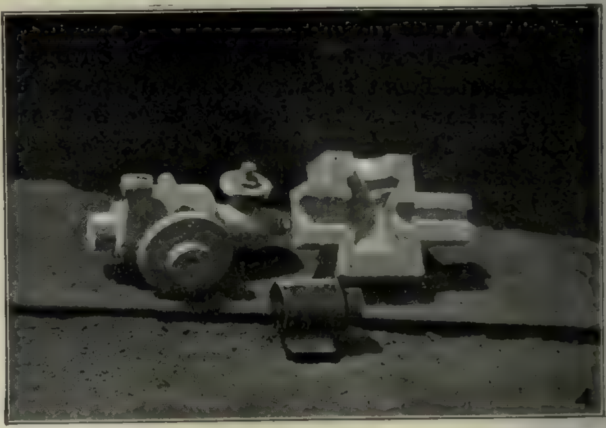
But Kawaguchimachi is typical of the foundry situation all over Japan since the war began. In Osaka, the industrial center, it is a hundred-fold as impressive. New foundries have sprung up everywhere, and the old ones have doubled and quadrupled their capacities. Some of those in congested sections have spread out into adjacent buildings, oozing out of their natural limits like rising batter. One in particular that the writer visited is the Kwansai Iron Foundry, which had exhausted its original space and percolated through to the yard. As soon as this had been roofed over, it spread still farther, until now it is a series of honeycombs in the neighboring buildings. Stepping into it, the visitor is not impressed, but after the proprietor leads him through one little cubby-hole of a molding room into another—some of them only large enough for four molders—and learns that two hundred molders in all are employed, he gets a pretty fair idea of what the war boom has meant to the foundry business.

In this cluttered-up condition the Kwansai foundry was working at a disadvantage. The proprietor admitted it and was very apologetic, but explained that orders had come upon him in such an avalanche that he had no time to think of moving into new quarters. Every Japanese manufacturer regards the American visitor as an authority on the most efficient factory methods, and the proprietor of the Kwansai was no exception. He asked innumerable questions, down to the minutest detail of foundry work. "How are cores made in America, and how are the flasks constructed, and what is the best design for such-and-such a gate?" Of course, all this through an interpreter. He was particularly interested in chills, as he had never heard of them, and wanted to know if they could be applied to any of his work.

The Kwansai Iron Foundry is only one of hundreds of foundries in Osaka. New modern buildings may be seen in the course of erection at all the older plants. Castings as large as some of the heaviest in this country are made at these establishments, and in general, modern methods are employed. One sees a fair number of molding machines in use, though exhaust mills and sandblast apparatus are relatively rare. Labor is so cheap that the cost of a few extra hands is almost negligible. The quality of castings produced is generally very high, for molding is one of the oldest, if not the very oldest, metal trades in Japan. And the Japanese molder is an interesting figure. Invariably, he is attired in a cotton or drill tunic with the name or trademark of his employer inscribed on the back in huge Japanese characters. Trousers are of the same material and very close-fitting, and he wears straw sandals or goes about barefooted. One would think that the sandals would be hampering, held on the foot as they are by a cord between the toes, but the workman seems to get about in them without the slightest inconvenience. At work he squats on the floor rather than stoops or kneels, and builds up the mold with a deft and fascinating skill. When pouring, he is always stripped to the waist, and in hot weather usually wears only a breechclout. In skill he may be the equal of the Western molder, but in efficiency he is noticeably inferior. A pattern that he has been working on for some time he will handle with remarkable speed, but give him a new one that requires a different twist from what he has been accustomed to, and it will take him some time to figure out its geometry, and the chances are that he will make many puttering mistakes before he adopts, or is patiently shown, the proper method. This is true in all other lines of work done by the ordinary Japanese mechanic. In patternmaking he excels; that is, as far as finish goes. The Japanese are traditionally very fine carpenters and cabinet makers, and in working with any sort of wood he is thoroughly at home. He does not always grasp the scientific principles of a pattern, particularly the intricate ones, but he will copy a model or a blueprint faithfully. In turn, these models or drawings must be absolutely accurate, for the patternmaker is likely to copy the most flagrant errors.

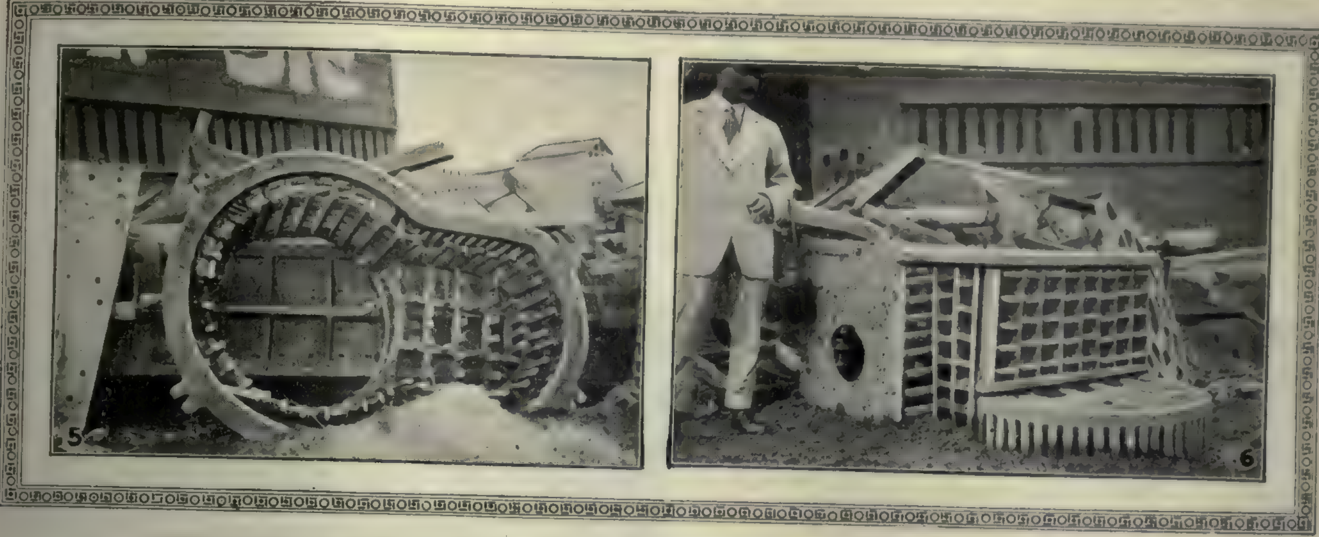
The pattern shops are usually equipped with power tools similar to ours, frequently American-made tools, in the most modern plants. Here will be a hand-saw, rip-saw and woodworker's boring machine. Much of the planing is done by hand, and compatible with his custom of doing things just the opposite of Western methods, he draws his plane toward him, likewise the saw, for both light and heavy work. On small pieces he will brace his feet against the wood—literally stand on

FIGS. 1 AND 2. MAIN STREET OF KAWAGUCHIMACHI AND YARD OF ONE OF ITS FOUNDRIES



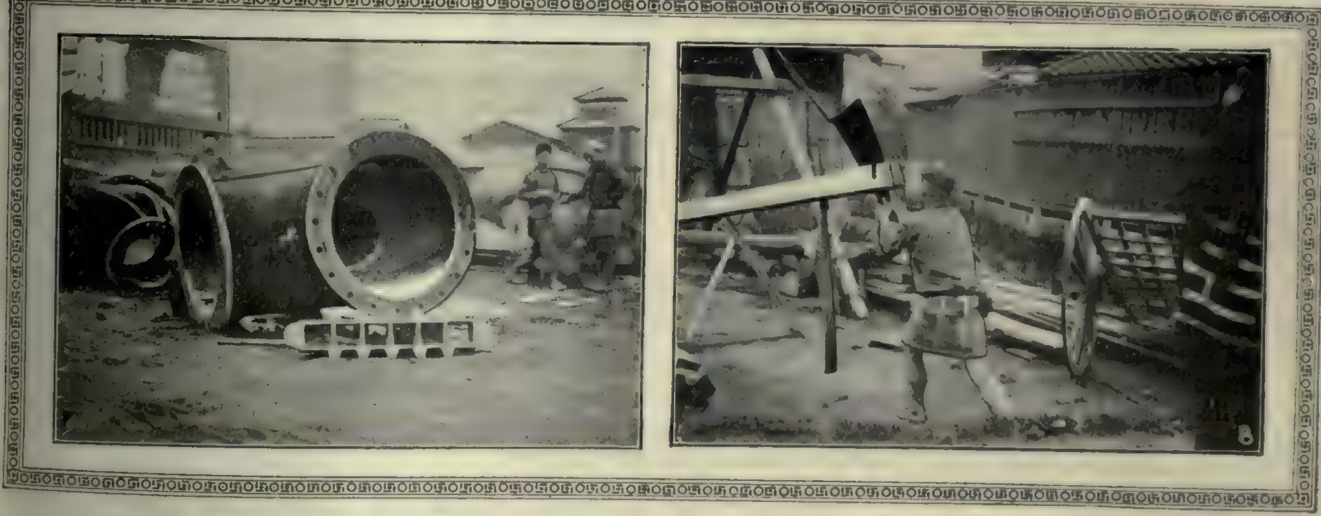
FIGS. 3 AND 4. SAND IS PACKED IN STRAW SACKS FOR SHIPMENT. SOME PATTERNS OF THE BETTER CLASS

it—and pull up on the double-edged saw instead of pushing on the cutting stroke. Most of the patterns are made of a clean white wood called "hinoki" which is similar to our cork pine. Sometimes a coarser wood known as "sugi," or cedar, is used for heavier patterns.



FIGS. 5 AND 6. CAST-IRON FLASKS ARE IN COMMON USE FOR LARGE WORK IN JAPAN

The pig-iron situation is a serious one. Many foundries have been obliged to reject orders because of shortage of material. It is even rumored that several rich concerns put up and equipped large new plants only to discover when they were finished that there was no material with which to work. Even one of the largest shipyards was forced to cut down a building program of from eighteen to twelve ships on this account. Many foundries will not accept orders unless the customer brings the pig iron with him, and dealers are selling it piecemeal, in five- and ten-pound lumps, like so much sugar. The value of this precious metal is evident from the fact that Japanese papers reported the theft of 4000 tons from the seaport of Kure last May.



FIGS. 7 AND 8. A LARGE CAST ELBOW AND A JAPANESE PATTERNMAKER USING A "PULL" SAW

A pig-iron dealer in Osaka, proprietor of the "Kimura Shoji Gemei Kaisha," is authority for the statement that the five mines in the Orient have a total output of 600,000 tons under favorable conditions, but that recently two or three of them were disabled by accidents at the smelteries, and that one in particular was forced to cut down its annual production of 120,000 tons to one-half that amount on account of shortage of coal. And coal has advanced tremendously, although operators on the Island of Kyushu succeeded in increasing their March yield to 900,000 tons, which is 200,000 more than was produced the preceding month.

Suspension of imports from India has had much to do with the shortage of iron. In May the visible stock in Osaka was less than 6000 tons, but the bulk of it had been contracted for, so that only 1200 tons was available for fresh dealings, and doubtless this has all been bought at this writing. At that time dealers were asking 195 yen, or $97.50, per ton. Recently, mine owners in British Columbia sought to interest Japanese buyers in iron ores, but transpacific freight is prohibitive. A pig-iron dealer in Osaka showed the writer a contract for 2000 tons of Alabama No. 3 iron for delivery June, 1917, to January, 1918. The price was 165.65 yen, approximately $83, per ton f.o.b. Seattle, and the ocean freight from that point was to be about $31, so it can be seen that the Japanese foundryman is paying what in this country would be considered fancy prices for his raw material.

Old Combination Lathe and Slotter

By W. L. Olmstead

The illustration presented in Fig. 1 shows a corner in one of the many small jobbing shops found along the waterfront of New York. This particular shop is not as young as it used to be, but is as spry as ever when the occasion demands. Under the guiding hand of Charlie it can make the younger and classier shops step lively to keep the pace. Charlie is the superintendent and foreman.

Perhaps 20 years ago, the machine shown in Fig. 1 was built. Up to that time the big lathe of the shop was a 48-in. swing plain engine lathe, which answered the purpose for all the ordinary jobs of marine work except the larger sizes of propeller wheels. The machine work on a propeller is practically confined to boring, facing and slotting the keyway in one setting. Occasionally, both ends of the propeller hub have to be faced. In this case, after facing one side, the wheel is reversed on the faceplate.

Small propeller wheels, under 4 ft. in diameter, were bored and faced on the 48-in. lathe, but the keyway slotting required another type of machine. The lathe was accordingly sacrificed on the altar of necessity and became a part of the combination shown in Figs. 1 and 2, the former being a general view of the machine. The foundation timbers are 24 in. deep by 12 in. wide. The cross-timber thickness is 6 in. The heavy metal parts are the lathe headstock, which carries the faceplate, and the auxiliary bed *A*, which carries the cross-slide and slotting attachment. The headstock is bolted to the frame, which is built of heavy reinforced timber. The auxiliary bed is secured to the timber foundation with the bolts *B*.

When the propeller wheel is ready to be machined, it is swung into place on the faceplate with the aid of an overhead runway carrying a block and falls. It is temporarily held against the faceplate by a rod that passes through the cored hole of the propeller. The end of the rod is threaded and enters into a hole tapped into a false plug in the spindle. A strap is placed across the outer face of the propeller hub, and the bolt is tightened. Four adjusting screw-holders, like *D*, Figs. 1 and 2, are attached to the faceplate, and the propeller is shifted until it runs true. Four clamping rods *C* are clamped against the propeller blades and tightened. The rod and strap are then removed from the hub.

The work, ready for boring, is shown in Fig. 1. The propeller-blade holes are bored taper. The cross-slide *E* is arranged so that the desired taper can be obtained. The movement of the bedplate is controlled by the horizontal worm *W*. The circular base of the cross-slide is fitted to the bedplate, and the taper adjustment is obtained with two screws *F*, one on each side of the slide.

The cross-slide with the toolposts removed is shown in Fig. 2. In this illustration the slotting bar may be seen in position. The bar and its gearing are mounted on a separate bedplate fitted to the ways of the auxiliary bed. The longitudinal movement is controlled by a worm manipulated from the same side. The geared mechanism is driven by an overhead pulley. The stroke is 20 inches.

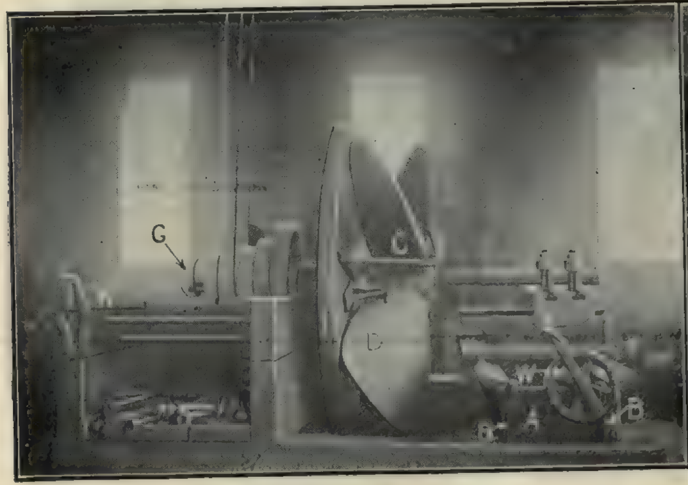


FIG. 1. BORING THE PROPELLER-BLADE HOLE

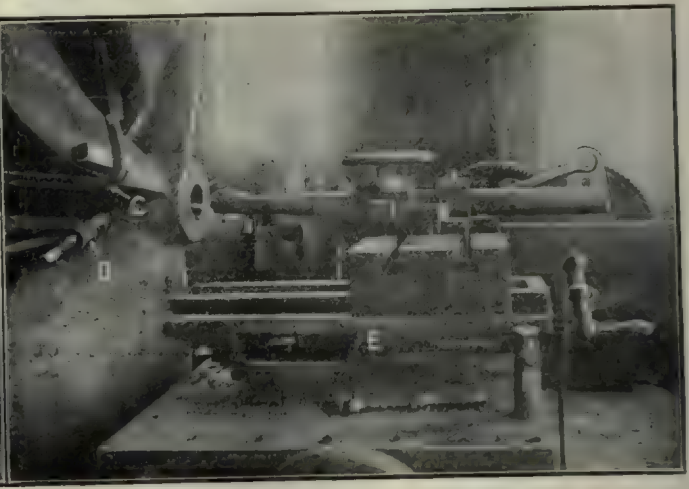


FIG. 2. THE SLOTTING OPERATION

Automatic feed is applied to the cross-slide for boring. The cam *G*, Fig. 1, depresses the lever *K* at each revolution of the spindle. One end of this lever is connected with an overhead rod, the end of which is bent to the shape of a bell crank. The rod passes over the machine, and the opposite end is bent in a similar manner. To this end is attached the connecting chain that operates the ratchet feed for the cross-slide. The ratchet lever *H* is shown in Fig. 2 with the chain detached.

Most of the medium-size propeller wheels have four blades; the smaller sizes have three, and the propellers for launches and small boats have only two. Four-bladed propeller wheels from 4 ft. in diameter to 8 ft. 6 in. in diameter are bored and slotted with this machine. Propeller wheels 4 ft. in diameter weigh from 350 to 400 lb. The diameter of the wheel shown in Fig. 2 is 6 ft. 4 in., and the weight is in the vicinity of 1600 pounds.

The diameter of the faceplate is 6 ft. The swing is 8 ft. 6 in. Occasionally, machine tools unexpectedly live through much more severe tests than can be anticipated by the maker. This lathe survived a hot fire several years ago—not, however, without bearing scars. The intense heat caused a number of severe fractures to appear in the faceplate. The trouble was overcome by shrinking a welded steel band to the outside diameter of the faceplate, as shown at *I*, Fig. 1. The allowance for shrinkage was ¾ inch.

Design and Use of Twisted Spur Gears

By L. D. HAYES
Assistant Professor of Machine Design, Sibley College, Cornell University

SYNOPSIS—*In this article the author makes a plea for a more careful use of names as applied to twisted spur gears and helical gears.*

THE ever increasing use of gears for high-speed transmission of power has led to various schemes to lessen their noise and vibration. One of the most successful is the use of twisted spur gears, and it is to this type that the present article is devoted. The author is well aware that some excellent articles bearing upon this subject have been published within the last few years. It seems rather unfortunate that the writers should have found it necessary to express themselves so largely in terms of a particular method of cutting, in which they are known to be interested. This fact, therefore, tends to offset the arguments that they have, in the main, presented with great accuracy. Inquiries that have come from men interested in the use of twisted spur gears indicate the need of some more general information concerning the best commercial practice, which may lead to a standardization of design and consequent facility of manufacture.

The twisted gear is the limiting case of the stepped gear, developed to improve the smoothness of operation of gears having cast teeth. Each gear may be considered as cut into a series of extremely thin slices, by uniformly spaced planes perpendicular to its axis, and each of these slices rotated about its axis a very slight but uniform amount beyond the last preceding slice. In the same way the mating gear must be considered cut into slices exactly equal to these in thickness, and the rotations of equal amounts, but of the opposite hand. Each mating pair of slices will operate in every way as a pair of ordinary spur gears, but each succeeding pair will be in a different phase of action from the preceding or following pairs. If the angle of rotation between the two pairs of end slices is equal to the pitch angle of the gears, there will be one pair of slices in each possible phase of action for these teeth.

METHOD OF ACTION

The action of all gear teeth is pure rolling, and therefore smoothest, only as the contact point is passing the line of the shaft centers. The smoothness of action continually decreases as the point of contact is farther from the line of centers in either direction (this is especially noticeable when the point of contact is approaching the line of centers), and the amount of sliding between the teeth correspondingly increases. In twisted gears there is always one pair of slices in contact on the line of centers, and a considerable proportion of the others near that line, which gives the whole pair of gears a uniform smoothness of action very desirable as compared to that of ordinary spur gears, where the phase of action is the same on the entire width of the teeth, and varying continually from the smoothest condition with the contact on the line of centers to the worst when one tooth is leaving contact and the next is just commencing action. There is an added advantage to twisted gears having involute teeth, which, while incidental, is of considerable importance.

It is a well-known characteristic of involute teeth that the center distances of a pair of gears may be varied without in any way altering the angular velocity ratio. In the case of ordinary spur gears the amount of this variation of center distance is limited by the necessity of keeping the angle of action of any tooth at least equal to the pitch angle. With twisted gears every phase of the action is always present at some point along the width of the tooth, and therefore the angle of action may be reduced to any value greater than zero without interrupting the continuity of the tooth action. This permits a change of center distance for a pair of gears nearly equal to the full height of their teeth. There is introduced, however, a large amount of backlash.

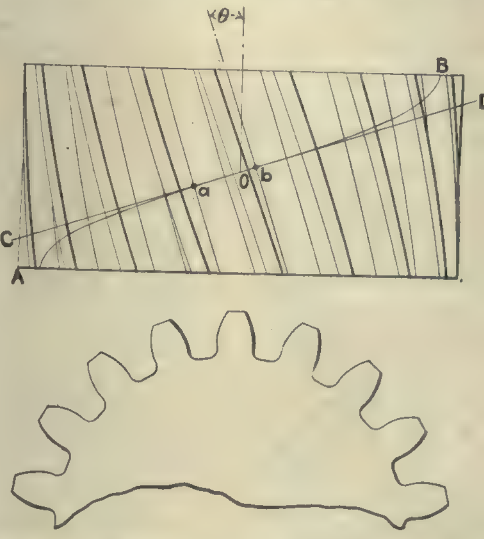


DIAGRAM ILLUSTRATING THE DESIGN OF TWISTED SPUR GEARS

Of course, these sections of the twisted gears which we have called "slices" have no finite thickness, and each element of what would have been the tooth of the ordinary spur gear now slopes at a uniform angle and forms a true helix around the axis of the gear. This is the single disadvantage of twisted gears. It causes the pressure between the mating teeth to have a component parallel to the axis of the gears, which tends to force them along their respective shafts in opposite directions and also increases the necessary normal pressure between the teeth of the gears. The magnitude of this undesirable component increases with the slope, or helix angle, of the teeth. This disadvantage is partly overcome by "herringbone" gears, on which the teeth on one half of the width of the face of each gear are twisted to the opposite hand from the other half.

While the tendency to slide the gears along their respective shafts is now balanced, there is still the excess normal pressure and consequent increase of friction and reduction in efficiency. For this reason this angle should be kept as small as possible and still maintain a total rotation between the two ends of a tooth at least equal to the pitch angle, without introducing an excessive width of face for the gear. With the reversal of twist in the herringbone type, either the helix angle or the width of face must be increased in order to maintain the proper total twist between each of the end sections and the middle section. This doubles the number of teeth in contact and increases the smoothness of the action. The continuity of the tooth action in the herringbone type may be maintained without increasing the width of face, if the teeth are staggered so that on one half the teeth are placed opposite the spaces of the other half. A gear of this kind gives no smoother action than a simple twisted gear, but the endwise thrust is balanced. It is usually desirable to retain the full width of face on each side of the gear for the sake of the greater smoothness of action. It has been contended by some makers of herringbone gears that staggering the teeth is advantageous on gears having full-width faces. This claim cannot be sustained, as every phase of tooth action is occurring simultaneously on each side, whether the teeth are placed symmetrically or staggered. During the process of twisting, the form of the teeth in the several sections or "slices" remained unchanged; but as shown in the illustration, the actual thickness of the teeth and width of the spaces, measured along the line AB perpendicular to the pitch elements of the teeth, have been decreased. This perpendicular line is helical in form and called the normal helix. The distance ab, measured on the normal helix between the pitch points of two adjacent teeth, is called the normal pitch. The angle θ, through which the pitch element of a tooth has been twisted out of parallel with the axis of the gears, is called the angle of cut. The relation between these is such that the normal pitch is equal to the circular pitch of the gear multiplied by the cosine of the angle of cut. The corresponding diametral pitch (equal π divided by the normal pitch) varies inversely as the cosine of the angle of cut.

In order to learn something of the possibility of being able to secure an agreement as to a standard, statements have been obtained from 10 prominent concerns that are engaged in the manufacture of the herringbone type of twisted gears, giving their practice, which information is contained in the table herewith. The names of these concerns have been omitted in conformity with the wishes of some of them. It will be seen that, while there is a very considerable range of angles covered, most of them lie between 20 and 35 deg. Concerns Nos. 1 and 5, which use smaller angles, do so on gears of very large pitch cut by the use of templets, as in the third of the methods described. On the other hand, the high angle of 45 deg. used by concerns Nos. 2 and 4 is on gears designed to carry light loads at high speeds.

Concern	Tooth Form	Angle of Cut
1	20 deg. involute	23 deg., hobbed; as small as possible, planed
2	20 deg. involute	Up to 45 deg., small gears; around 30 deg., large gears
3	Not stated	21 to 23 deg.
4	Not stated	45 deg., low tooth pressures; 23 deg., higher pressures
5	Not stated	17 deg., never exceeds 23 deg., below 17 deg. or wider faces
6	20 deg. involute	About 30 deg.
7	15 deg. involute	30 deg.
8	20 deg. involute	30 deg.
9	Not stated	26 to 31 deg.
10	Not stated	23 deg.

The size of the spaces on any gear is increased as the diameter is decreased. Their form may be said to be a function of the radius of curvature of the pitch line of the gear. On a twisted gear the curvature is measured on the normal pitch, and its radius is equal to that of the normal helix AB, which is also equal to the radius of curvature at the extremity of the minor axis of the ellipse, cut from the pitch cylinder by a plane passed through the line CD, tangent to the normal helix at O. The minor axis of this ellipse is equal in length to the pitch diameter of the gear. The major axis is equal to the pitch diameter of the gear divided by the cosine of the angle of cut. The radius of curvature is equal to the square of one-half the major axis divided by one-half the minor axis, or equal to the pitch radius of the gear divided by the square of the cosine of the angle of cut. The form of the tooth and space in a normal section will be the same as that of a spur gear of this radius, the circular pitch of which is equal to the normal pitch of the twisted gear.

There are at least five different methods that are used for cutting the teeth of twisted gears:

1. A milling cutter shaped to the form of the normal space between the teeth may be used in connection with the usual "spiral attachment" for a miller. This method can never cut a theoretically correct tooth form, as the teeth of the cutter revolving in a plane cannot follow the helical motion of the space being cut, and will interfere on the sides as they enter and leave the cut.

2. A planer tool shaped to the form of the normal space may be used, the tool and blank being geared for the desired angle of rotation with each stroke of the tool. Usually it is the blank that is rotated, because of the relative ease by which the motion may be secured, but the size of the gear that may be cut in this manner is limited by inertia. If the tool is properly backed off to follow the helical space, the accuracy of the tooth produced should be equal to that of the form of the tool.

3. The teeth may be cut with a planer tool the point of which cuts along an element of the tooth. The position of the tool for each stroke must be determined by a guide, or templet, the form of which is copied upon the tooth of the gear. This method is especially applicable to gears of large pitch. There is required the same relative rotation between the blank and the tool with each stroke as in the preceding method. Because of the inertia of large gears cut in this way, machines have been devised which give to the cutting tool an approximate helical motion while the gear remains stationary, except as indexed after each tooth is completed.

4. The tooth outlines may be generated by planing with a cutter having the form of a small pinion of the same pitch. The teeth on the cutter have the same helix angle as the gear to be cut, but of the opposite hand. The cutter rotates on its axis with each stroke so that the teeth follow in the helical spaces, while both gear and cutter rotate continuously at their proper

speed ratio. This method is peculiarly adapted to the cutting of internal twisted gears.

5. They may be cut with a hob having a linear pitch equal to the circular pitch of the gear. If the diameter of the hob is so taken that the helix angle of the hob is equal to the angle of cut of the gear, it will generate a theoretically correct tooth on the gear, as the teeth of the hob and gear will then operate together like those of a worm and flat-faced wormwheel.

Whichever of these methods is used, either the cost of production may be greatly reduced or the accuracy increased by the adoption of a standard angle of cut on all twisted gears of any particular pitch. For the last three of these methods this standard angle of cut might be made the same for all pitches, but it would not be adaptable to the first two methods unless it is feasible to vary the diameter of the gear from that of the corresponding plain spur gear. Since the form of the cutting tool in either of the first two methods is derived from the normal pitch of the gear, if standard tools are to be usable, it is necessary that the angle of cut be selected to make the normal pitch also a standard pitch. For example, if it is desired to cut a 10-pitch twisted gear, the angle of cut may be taken 33 deg., 33 min., when the normal diametral pitch equals $\frac{10}{\cos 33\text{ deg. }33\text{ min.}} = \frac{10}{0.8333} = 12$. If the addendum is proportioned for a 12 pitch, standard 12-pitch cutters may be used to this gear. For this reason very little choice as to the angle of cut is permitted on gears cut by these methods.

There is a tendency on the part of shopmen to apply the term "spiral gears" to each of these types indiscriminately, with the apparent expectation that the listener or reader will understand therefrom the exact type of gear that is meant. The form of individual gears of the two types may be identical, but in operation they are wholly different, both in the theory of their design and in their relative positions in the machine. In twisted spur gears the shafts are parallel, and they act in all essentials like a pair of ordinary spur gears, giving the same angular velocity ratio between the two shafts. In the case of helical gears the shafts are nonparallel and nonintersecting, the action of the teeth resembling closely the screwlike action between a worm and a wormwheel. Their angular velocity ratio is independent of their relative pitch diameters and wholly dependent upon the ratio of the numbers of teeth on the two gears. It is probable that the failure to understand the difference in the action of these two types of gears is responsible for some inconsistencies that have developed in the practice of the various shops now making gears of either type. In any case it would be helpful if the word "spiral" could be eliminated.

Standard planing and milling cutters of any pitch may be used to cut at any desired angle, provided it is feasible to vary the pitch diameter of the gear. Had this been done in the foregoing example, the circular pitch of the gear would have been changed and would not have corresponded to any standard diametral pitch. For example, if it were desired to cut a pair of twisted gears having 18 and 37 teeth respectively of 10 pitch cut at an angle of 23 deg., a cutter of $\frac{10}{\cos 23\text{ deg.}} = \frac{10}{0.9205} = 10.86$ pitch would be required. For most shops the 10-pitch cutter would be the nearest commercial size. Used at an angle of 23 deg., this would cut teeth of $10 \times 0.9205 = 9.205$ diametral pitch and would require blanks $\frac{18}{9.205} = 1.955$ in. and $\frac{37}{9.205} = 4.018$ in. respectively in pitch diameter. As previously stated, the form of the spaces will be the same as on a gear whose diameters are $\frac{1.955}{\cos^2 23\text{ deg.}} = \frac{1.955}{(0.9205)^2} = 2.307$ in. and $\frac{4.018}{(0.9205)^2} = 4.742$ in. respectively.

Gears of those sizes would have $2.307 \times 10 = 23.07$ and $4.742 \times 10 = 47.42$ teeth. The standard milling or planing cutters suited to cutting straight spur gears of 23 and 47 teeth would be of the proper form to cut 18 and 37 teeth on the required twisted gears. The addendum and depth of cut would be proportioned from the normal diametral pitch, making the outside diameters of the blanks 1.955 in. + $\frac{2\text{ in.}}{10} = 2.155$ in and 4.018 in. + $\frac{2\text{ in.}}{10} = 4.218$ in. respectively. The third of the foregoing methods offers, perhaps, the least saving from standardization of the angle of cut. Unless the entire machine is to be limited to this single angle, the only apparent saving would be in the number of guides, or templets, necessary to cut all numbers of teeth of any given pitch. It is usual for one templet to be made to serve for a considerable range in numbers of teeth, as is the case with the standard milling and planing cutters; and the teeth produced only fairly approximate the theoretical outline. In each of the last two methods, the teeth are generated to a theoretically correct outline by a single cutter, without regard to the numbers of teeth to be produced upon the blanks, provided only that the cutter is designed for the particular angle of cut required. These cutters are relatively expensive to produce, and the standardization of the angle of cut would reduce the necessary stock cutters to one for each pitch. The makers of the machines that use the pinion-shaped cutters have practically adopted a 30-deg. angle of cut for the cutters and guides for use in their machines and make them for other angles only as requested.

On hobbing machines it is customary to set over the axis of the hob to correct for the difference between the required angle of cut and that for which the hob was designed. This results in interference between the teeth of the hob and the surfaces of the teeth being produced, just as in the case of teeth produced with a milling cutter, and a consequently imperfect tooth outline. The cutting of correct teeth for angles of cut other than those angles for which cutters are already in stock not only involves the cost of making new and expensive cutters, but also materially increases the time needed for delivery, which in many cases is the deciding factor between getting correctly formed gears and those with tooth outlines only approximate.

So far as the author has been able to learn, no systematic experiments have been made to determine the most desirable angle of cut under any of the conditions shown in the accompanying table. There is an undoubted loss in mechanical efficiency as the angle is increased while, on the other hand, the quietness of running is increased, due to bringing into simultaneous action a larger number of teeth. A series of careful tests upon gears otherwise identical in design and method of manufacture should demonstrate either which is the best angle to use, or that there is a very considerable range of angles which may be used with practically equal satisfaction.

FEASIBILITY OF A STANDARD ANGLE

To the author it appears highly probable that the latter condition would be found to exist, and that this range would include most, if not all, of the angles now commonly used. If this were shown to be true, it would prove conclusively the entire feasibility from the commercial standpoint of the adoption of a standard angle. Assuming that similar tests upon gears of finer pitches for high-speed work might be shown to operate best with a greater angle of cut than that for the usual conditions, their manufacture as "specials," after the adoption of a standard, could not make them more expensive than they now are, while the adoption of a secondary "standard" might easily bring a corresponding reduction in their cost.

It may be contended by some that the angle of cut must be determined by the load carried by the gear. A glance at Fig. 1 will make it clear that the length of each element of the tooth is increased by the twisting in the same ratio only as the thickness has been decreased, while as a cantilever resisting bending, the strength of any section of the tooth has decreased in proportion to the square of its thickness. In his interesting article on "The Design of Cut Herringbone Gears," which appeared in the *American Machinist*, Vol. 43, pp. 901 and 941, W. C. Bates has shown that this loss of resisting strength is counterbalanced by the better distribution of the load on the tooth. In a straight-tooth spur gear the load is liable to be concentrated upon the point of the tooth of the driven gear at the beginning of contact, and upon the point of the driving gear as contact ceases. In the twisted or herringbone gear, with all phases of contact occurring simultaneously, the resultant pressure on the tooth acts steadily at a point somewhere near the pitch line, thus greatly reducing the maximum bending moment sustained by the tooth. A still greater gain is made by the change from shock to gradually applied loading.

THE MODIFIED LEWIS FORMULA

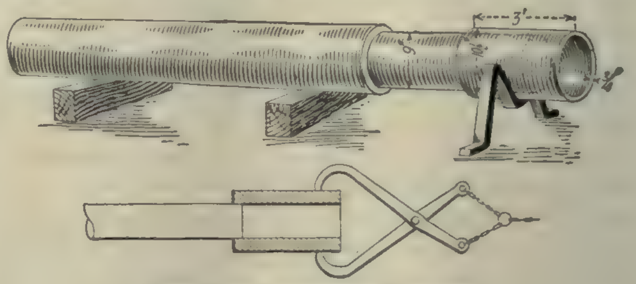
Mr. Bates has found a modification of Lewis' formula for spur gears to give satisfactory results. One would be inclined to check up some of the approximations in Mr. Bates' analysis by some more rigid calculations, had it not been so strikingly demonstrated by Rear-Admiral George W. Melville and John H. Macalpine (*Engineering*, London, for Sept. 17, 1909, and May 5 to June 16, 1916) in their work upon "floating frames" that concentration of loading, and consequent stresses, resulting from even slight inaccuracies of shaft alignments are many times more serious than any that could possibly result from very liberal approximating in their design.

Their theoretical estimates of a large gain in the power which could be transmitted by any given set of gears, if the alignment of the shafts was sustained, was confirmed in their experimental tests when a reduction gear, originally designed to carry 2500 hp., carried a load of 6000 hp. when fitted with a "floating frame." Until provision is regularly made for the continual maintenance of an extremely accurate alignment, any further refinement in the computing of tooth stresses would appear to be wrongly directed effort.

Shrinking on a Large Sleeve

BY M. JACKER

I recently had to shrink a large bush on a long shaft. The job was an odd one in this shop, so I got all kinds of valuable information regarding it while I was preparing to do the work. The foreman said he thought it best to leave the bore in the bush about $\frac{1}{64}$ in. smaller. I settled this dispute by getting out my "American Machinist Handbook" and, turning to page 231, found that about 0.005 in. was sufficient for a 9-in. bush.



HOW THE WORK WAS HELD

If the bush of cast steel were made $\frac{1}{32}$ in. smaller than the shaft, it no doubt would be so strained beyond its elastic limit that its grip would be greatly reduced.

A bush of this size and weight could be nicely slipped over a shaft when in a vertical position, but the shaft being too long, we proceeded as shown. The shaft was supported upon two timbers and the bush supported a $\frac{1}{2}$ x 3-in. bent iron securely fastened to the floor, after the bush was lined up. We then heated it just a little hotter than mother's flat iron and shoved it home.

Do not attempt to put a bush of this size and weight over a shaft without some means of guiding it on parallel with the shaft, for it is almost sure to catch.

First-Aid Boxes for British Factories

The British Home Office will shortly issue an order on factory and workshop welfare in the metalworking industries, as follows: In every factory employing 25 or more persons, first-aid boxes or cupboards must be provided in the proportion of one to each 150 persons. The equipment of the boxes is standardized, and they are under the control of a responsible person who is always available.

Wherever 500 or more persons are employed, a separate ambulance room must be provided. Where both sexes are employed, provisions must be made for treating the sexes in separate rooms.

The Panama Canal Forge Shops

BY FRANK A. STANLEY

SYNOPSIS—*The arrangement of the forge shop is given in the equipment layout, which, together with the list in the table, forms a good guide to those having similar work in charge. The open-sided buildings, closed with louvers when necessary, present a distinctive feature of tropical construction.*

THE forge shop of the Panama Canal at Balboa is in building No. 2 of the group of permanent shops. This structure houses not only the forge plant, but the copper, tin and pipe shops also. The building is 359 ft. long and 89 ft. in width, the main portion, or high section, of the structure being 60 ft. wide with a lean-to on the side, 29 ft. in width. In general, the closure of the building is very similar to that of the machine shops described in earlier articles. The main portion of this building is served by a 25-ton electrically operated overhead traveling crane, the runways for which extend out of the building at each end, the same as in the case of the machine shop. In addition to this crane there are numerous jib cranes that handle work for various hammers and other machines throughout the plant.

A general layout of the forge shop is shown in Fig. 1. This gives the location of all the equipment, which is listed in the accompanying table. The steam-hammer equipment is located in the northern half of the shop. These hammers range in various sizes up to 2700 lb. capacity. The smaller sizes are in the column line between the main shop and the lean-to, and double rows of blacksmith's fires for each heavy hammer are provided in addition to heating furnaces.

In the southwest corner of the building there is a hydraulic forging press of 500 tons' capacity, with two furnaces—one for heavy and one for medium sized work. On the same side of the building, but near the center of the length, is found the tool-dressing plant with its hammers, forges and furnaces, including preheating and high-temperature barium and lead baths, water, oil and brine tanks.

Crude oil is used throughout for the forges and furnaces, the fuel feeding by gravity from tanks located on the hill to the south of the building. By means of reducing valves the oil pressure is cut down at the burners to about 30 lb. The blowers, of which there are three in the building, each have a capacity of about 3500 cu.ft. of air per minute at 6 oz. pressure.

The pipe machinery and other equipment required for copper, tin and general pipe work are located at the north end of the building in a section about 60 ft. in length. These machines are operated in a group by an electric motor of 15 horsepower.

The Bethlehem 500-ton forging press is illustrated in Fig. 2, which also shows the intensifier at the rear of the press. This machine is served by a 3-ton jib crane of 24-ft. radius and by the overhead traveling crane that passes directly over the two heating furnaces, which are some 20 ft. to the right of the press.

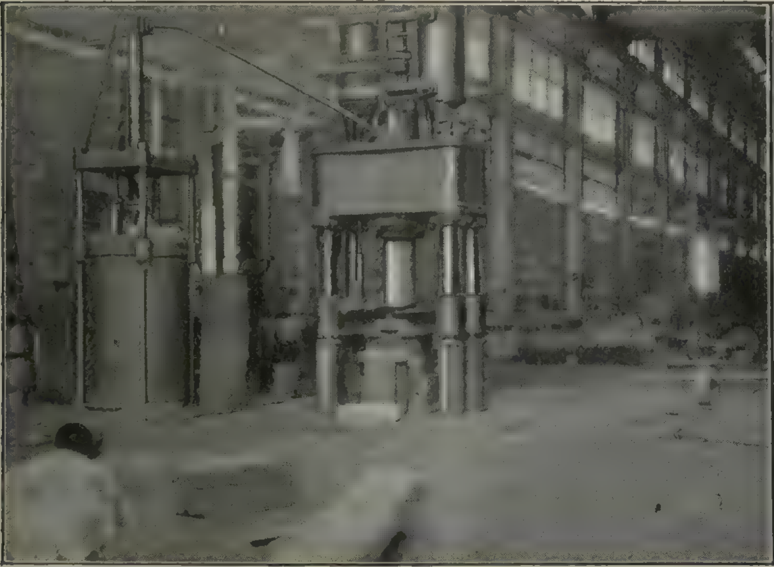


FIG. 2. INTENSIFIER AND 500-TON HYDRAULIC PRESS

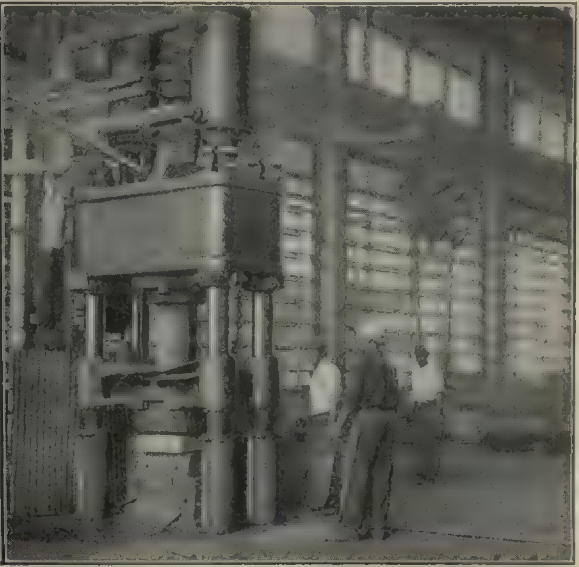


FIG. 3. FORGING A HEAVY SLAB

Fig. 3 illustrates the press in operation, with a large heated slab between the jaws. For various classes of work, particularly in the line of big shafts, a series of large chucks are provided, by means of which one end of the work is gripped and the whole bar revolved as required under the press. Several of these holding devices are illustrated in Fig. 4. When in use they are suspended in the bight of a chain from the crane, and at each stroke of the press the chuck and the work are rotated as far as desired to bring another portion of the work surface into position for squeezing under the press.

There are of course a number of bulldozers, headers and other forming machines in the plant, and many interesting operations are carried on. One piece of special equipment in this department is the air-operated machine shown in Fig. 5. It is used principally for removing bolts from car couplers, for special riveting operations, etc. It consists of a pneumatic rock drill mounted upon uprights above an anvil that is provided with fixture plates in various forms to suit the material to be handled. The chuck end of the drill piston is fitted with a special head for hammering, riveting or other operations, and the machine can of course be operated as rapidly as desired, according to the character of the piece to be handled.

A number of parts in the way of couplers and shackles will be noticed piled up alongside the machine, and a coupler shank and head are shown suspended from a crane jib over the anvil.

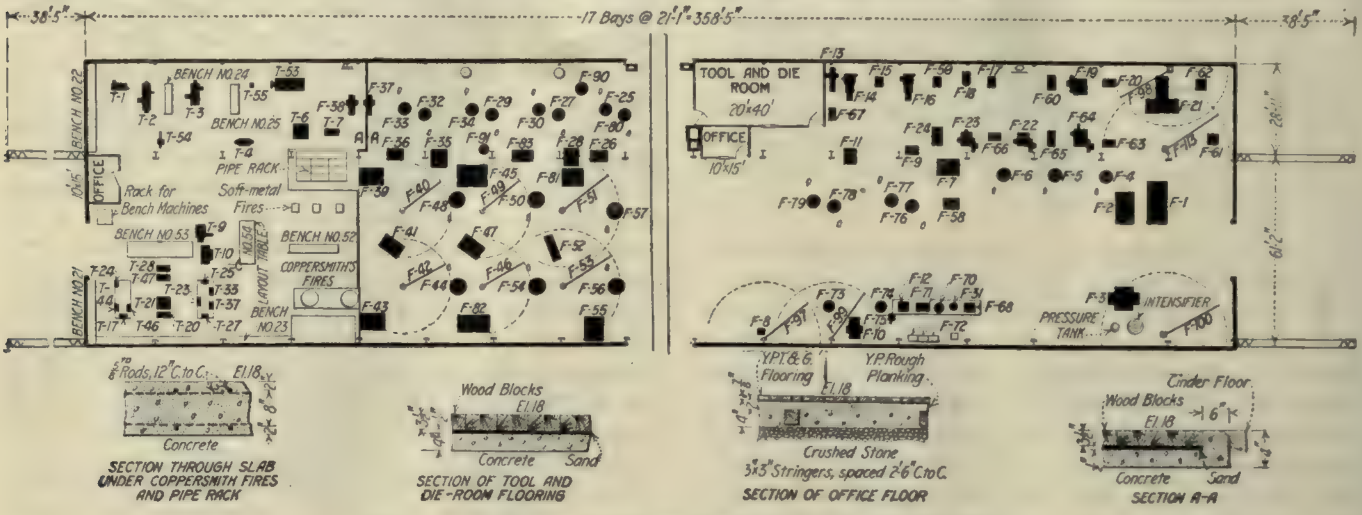


FIG. 1. LAYOUT OF PANAMA FORGE SHOP AT BALBOA

LIST OF MACHINES IN PANAMA CANAL FORGE SHOP

No.	Description	Manufacturer
F-1	Furnace, forging, 6-burner	W. S. Rockwell Co.
F-2	Furnace, forging, 4-burner	W. S. Rockwell Co.
F-3	Press, forging, 500-ton, air or steam	Bethlehem Steel Co.
F-4	Forge, single, hand, 4-ft. diameter	Shop made
F-5	Forge, single, hand, 4-ft. diameter	Shop made
F-6	Forge, single, hand, 4-ft. diameter	Shop made
F-7	Furnace, forging, 4-burner, single end	W. S. Rockwell Co.
F-8	Grinder, double, 14x1½x1½ in.	Valley City Mach. Wks.
F-9	Grinder, double, wet and dry, 14x2x1½ in.	Bridgeport Safety Emery Wheel Co.
F-10	Hammer, steam, single-frame, 600 lb	Bell Steam Engr. Co.
F-11	Hammer, steam, single-frame, 800 lb	Niles-Bement-Pond
F-12	Furnace, high-speed, 2-burner	W. S. Rockwell Co.
F-13	Blower, fan, 36 in., No. 8	B. F. Sturtevant & Co.
F-14	Hammer, helve, 200 lb	C. C. Bradley & Sons
F-15	Furnace, forging, 2-burner	W. S. Rockwell Co.
F-16	Hammer, helve, 100 lb	C. C. Bradley & Sons
F-17	Furnace, forging, 2-burner	W. S. Rockwell Co
F-18	Hammer, belt-power, 300 lb	Beaudry & Co.
F-19	Header, bolt-forging, 1 in., single	Acme Machine Co.
F-20	Furnace, rod, 2 in	American Shop Equip. Co.
F-21	Bulldozer, horizontal pneumatic, 24-in. cylinder, No. 3	Featherstone Foundry Machine Co.
F-22	Header, bolt-forging, 2-in. single	National Machinery Co.
F-23	Header, bolt-forging, 1½-in. single	National Machinery Co.
F-24	Furnace, long rod, 2-burner	American Shop Equip. Co.
F-25	Forge, single, 4-ft. diameter	Shop made
F-26	Hammer, steam, single-frame, 1,110 lb	Bement, Miles & Co.
F-27	Forge, single, 4-ft. diameter	Shop made
F-28	Furnace, forging, oil-burner	W. S. Rockwell Co.
F-29	Forge, single	Shop made
F-30	Forge, single	Shop made
F-31	Furnace, calorex, oil tempering, 30-in. diameter, 33 in. high	W. N. Best
F-32	Forge, single, 4-ft. diameter	Shop made
F-33	Forge, single, 4-ft. diameter	Shop made
F-34	Forge, single, 4-ft. diameter	Shop made
F-35	Furnace, forging, single end	W. S. Rockwell Co.
F-36	Hammer, steam single frame, 800 lb	Niles-Bement-Pond
F-37	Blower, fan, 36 in., No. 8	B. F. Sturtevant & Co.
F-38	Blower, fan, 36 in., No. 8	B. F. Sturtevant & Co.
F-39	Furnace, forging, 4-burner	W. S. Rockwell Co.
F-40	Crane, pillar, 5 ton	Whiting Fdy. & Equip. Co.
F-41	Hammer, steam, single frame, 2,500 lb	Bement, Miles & Co.
F-42	Crane, pillar, 5 ton	Whiting Fdy. & Equip. Co.
F-43	Furnace, forging, 4-burner	W. S. Rockwell Co.
F-44	Forge, 5-ft. diameter	Shop made
F-45	Slab, bending, 2 sections, 5 ft. square	Shop made
F-46	Crane, pillar, 5 ton	Whiting Fdy. & Equip. Co.
F-47	Hammer, steam, single-frame, 2,700 lb	Niles-Bement-Pond

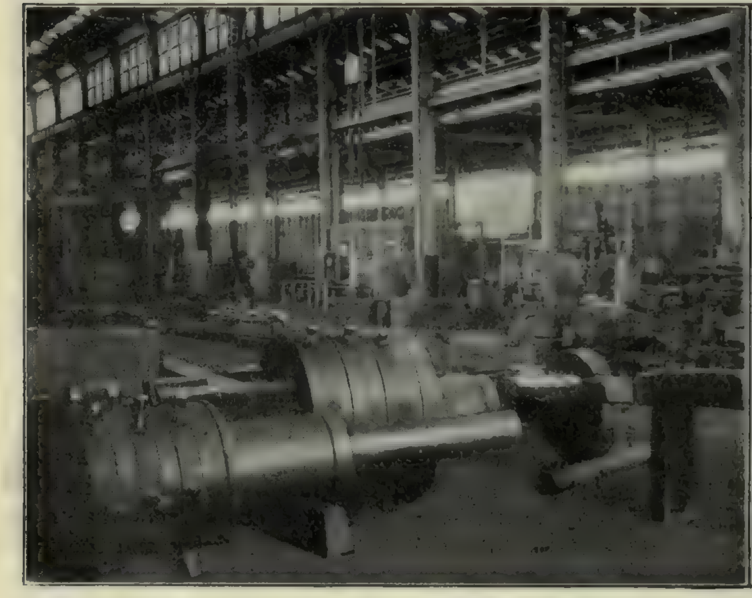


FIG. 4. CHUCKS FOR HANDLING LARGE PIECES

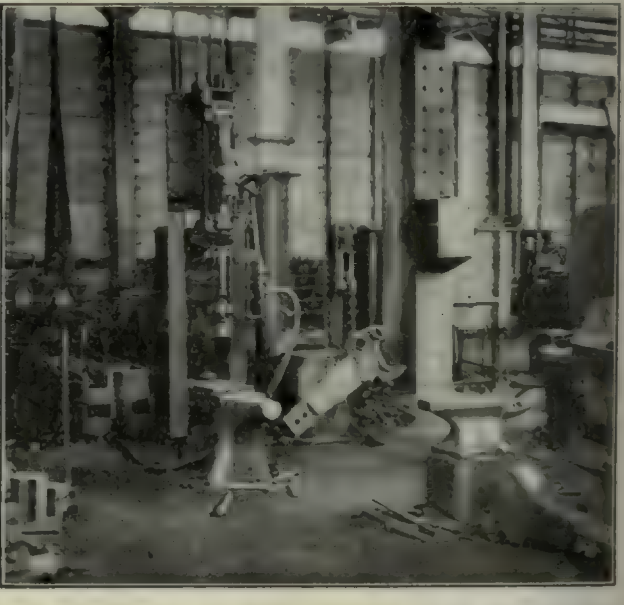


FIG. 5. PNEUMATIC DRILL AS POWER HAMMER

F-48	Forge, 5-ft. diameter	Shop made
F-49	Crane, pillar, 5 ton	Whiting Fdy. & Equip.Co.
F-50	Forge, 5-ft. diameter	Shop made
F-51	Crane, pillar, 5 ton	Whiting Fdy. & Equip.Co.
F-52	Hammer, steam, double-frame, 2,000 lb.	Chambersburg Mfg. Co.
F-53	Crane, pillar, 5 ton	Whiting Fdy. & Equip.Co.
F-54	Forge, 5-ft. diameter	Shop made
F-55	Furnace, forging, 4-burner	W. S. Rockwell Co.
F-56	Forge, hand, 5-ft. diameter	Shop made
F-57	Forge, hand, 5-ft. diameter	Shop made
F-58	Slab, bending, spring tempering	Shop made
F-59	Furnace, forging, 2-burner	W. S. Rockwell Co.
F-60	Furnace, rod, 1½ in., 2-burner	American Shop Equip. Co.
F-61	Furnace, bar	American Shop Equip. Co.
F-62	Furnace, bar	American Shop Equip. Co.
F-63	Furnace, rod, 2 in	American Shop Equip. Co.
F-64	Header, bolt-forging, 1½ in	National Machinery Co.
F-65	Furnace, rod, 1½ in., 2-burner	American Shop Equip.Co.
F-66	Furnace, rod, 2 in., 2-burner	American Shop Equip. Co.
F-67	Furnace, rod, 2 in., 2-burner	American Shop Equip. Co.
F-68	Furnace, lead bath, 2-burner	American Shop Equip. Co.
F-69	Table, air 2x2 ft	Shop made
F-70	Furnace, barium chloride	W. S. Rockwell Co.
F-71	Furnace, reheating	American Shop Equip. Co.
F-72	Tank, tempering	Shop made
F-73	Forge, single, 4-ft. diameter	Shop made
F-74	Forge, single, 4-ft. diameter	Shop made
F-75	Tank, brine, small	Shop made
F-76	Forge, 4-ft. diameter	Shop made
F-77	Forge, 4-ft. diameter	Shop made
F-78	Forge, 4-ft. diameter	Shop made
F-79	Forge, 4-ft. diameter	Shop made
F-80	Forge, 4-ft. diameter	Shop made
F-81	Slab, bending, 5 ft. square	Shop made
F-82	Furnace, forging, 4-burner	W. S. Rockwell Co.
F-83	Hammer, steam, single frame, 1,100 lb	Niles-Bement-Pond
F-84	Forge, portable, square	Shop made
F-85	Crane, traveling, 25 ton	Cleveland Engineering Co.
F-86	Tank, water	Shop made
F-87	Tank, water	Shop made
F-88	Tank, water	Shop made
F-89	Tank, water	Shop made
F-90	Tank, water	Shop made
F-91	Tank, water	Shop made
F-92	Tank, water	Shop made
F-93	Tank, water	Shop made
F-94	Tank, water	Shop made
F-95	Tank, water	Shop made
F-96	Tank, water	Shop made
F-97	Crane, jib	Shop made
F-98	Crane, jib	Shop made
F-99	Crane, jib	Shop made
F-100	Crane, jib	Shop made
F-101	Shears, bar iron, single end, 8x1¼ flat, No. B	Long & Allstatter
F-102	Cutter, sprue, 1⅛ in. diameter and ½x1¾ flat	E. W. Bliss & Co.
F-103	Shears, splitting, ¾-in. plate by 8 ft., No. 579	Lennox Machine Co.
F-104	Crane, traveling, 20 ton	Morgan Engineering Co.
F-105	Crane, traveling, 2 ton	Cleveland Engineering Co.
F-106	Saw, cold, 10–28-in. diameter saw	Railway Appliance Co.
F-107	Heater, tire, 56 in., portable, gasoline	Shop made
F-108	Furnace, calorex, portable, oil burning	W. N. Best
F-109	Rigging, turning, 15 ton	Bethlehem Steel Co.
F-110	Slab, 3 ft. 5 in. x 3 ft. 8 in	
F-111	Slab, 3 ft. 3 in. x 5 ft	
F-112	Forge, 5 ft. x 5 ft. 6 in	Shop made
F-113	Crane, jib, 3 ton	Shop made
T-1	Cutter and threader, 12-in. pipe, No. 108	Curtis & Curtis
T-2	Cutter and threader, 8-in. pipe, No. 13	Jarecki Mfg. Co.
T-3	Cutter and threader, 6-in. pipe, No. 6 Duplex	Bignall & Keeler Mfg. Co.
T-4	Cutter and threader	Bignall & Keeler Mfg. Co.
T-5	Bender, 2-in. pipe	Pedrick & Smith
T-6	Slab, bending, 5 x 5 ft.	Shop made
T-7	Furnace, pipe-heating	Tate & Jones Co.
T-8	Threading and cutting-off, pipe, pneumatic	Shop made
T-9	Shears, squaring and slitting, 36-in., No. 20 gage	Niagara Mach. Tool Wks.
T-10	Shears, squaring, 52 in., No. 16 iron	Niagara Mach. Tool Wks.
T-11	Scales, platform, 2,000 lb., portable	Osgood Scale Co.
T-12	Folder, tin, 30 in.	Niagara Mach. Tool Wks.
T-13	Former, slip-roll, 36 in.	Niagara Mach. Tool Wks.
T-14	Closer, elbow, hand machine, 4 to 7-in. pipe	Niagara Mach. Tool Wks.
T-15	Former, funnel, 10-in. rolls	Niagara Mach. Tool Wks.
T-16	Former, slip-roll, 20 in.	Niagara Mach. Tool Wks.
T-17	Beader, hand power, No. 2	Niagara Mach. Tool Wks.
T-18	Beader, cutter, hand power	Niagara Mach. Tool Wks.
T-19	Machine, setting-down, hand power	Peck, Stowe & Wilcox
T-20	Folder and brake, 42-in. universal, hand, No. 20 iron	Niagara Mach. Tool Wks.
T-21	Shears, squaring, 36 in., No. 18 iron	Niagara Mach. Tool Wks.
T-22	Folder and brake, 42-in. universal, hand	Niagara Mach. Tool Wks.
T-23	Folder, sheet-iron, 32 in.	Niagara Mach. Tool Wks.
T-24	Folder, sheet-iron, 20 in., No. 20 iron	Niagara Mach. Tool Wks.
T-25	Punch, hand lever, ½-in. hole	Niagara Mach. Tool Wks.
T-26	Burrer, small, hand, incased	Niagara Mach. Tool Wks.
T-27	Former, slip roll, 21 in.	Niagara Mach. Tool Wks.
T-28	Folder, sheet, 42 in.	Niagara Mach. Tool Wks.
T-29	Shears, squaring, 36 in., No. 20 gage	Niagara Mach. Tool Wks.
T-30	Forge, circular, coal, 4 sections	Shop made
T-31	Machine, wiring, uncased	Peck, Stowe & Wilcox
T-32	Turner, small (or burr), incased	Niagara Mach. Tool Wks.
T-33	Turner, large, incased	Niagara Mach. Tool Wks.
T-34	Burner, large, hand, incased	Niagara Mach. Tool Wks.
T-35	Burrer, large	Niagara Mach. Tool Wks.
T-36	Crimper and beader, hand	Peck, Stowe & Wilcox
T-37	Groover, 20 in., hand power	Niagara Mach. Tool Wks.
T-38	Groover, 30 in.	Peck, Stowe & Wilcox
T-39	Burrer, small, hand	Niagara Mach. Tool Wks.
T-40	Machine, setting-down, angle, incased	Niagara Mach. Tool Wks.
T-41	Machine, setting-down, hand, incased	Niagara Mach. Tool Wks.
T-42	Turner, small, hand	Peck, Stowe & Wilcox
T-43	Turner, small, incased	Niagara Mach. Tool Wks.
T-44	Groover, 36 in., hand power	Niagara Mach. Tool Wks.
T-45	Turner, large, thick edge	Peck, Stowe & Wilcox
T-46	Former, slip-roll, 84- and 36-in. rolls	Niagara Mach. Tool Wks.
T-47	Former, slip-roll, 37 in., hand power	Niagara Mach. Tool Wks.
T-48	Machine, journal-babbitting, M.C.B. br'ses.	Shop made
T-49	Beader, hand power, No. 4	Niagara Mach. Tool Wks.
T-50	Turner, large (or burr), universal, incased	Niagara Mach. Tool Wks.
T-51	Crimper, hand power, cornice makers	Niagara Mach. Tool Wks.
T-52	Shears, circle, 32 in., No. 22 gage, No. 2	Niagara Mach. Tool Wks.
T-53	Rolls, sheet-metal, 72-in. rolls	D. H. Stoll Co.
T-54	Bender, hand power, 2-in. pipe	Pedrick & Smith
T-55	Grinder, tool, wet, single	Springfield Mfg. Co.
T-56	Machine, wiring, incased, superior	Niagara Mach. Tool Wks.
T-57	Forge, oil	
T-58	Forge, oil	
T-59	Forge, coal	
T-60	Slab, bending, 3 ft. 6 in. x 5 ft.	
T-61	Slab, bending, 3 ft. 6 in. x 5 ft.	
T-62	Clamp, band-saw, for brazing	
T-63	Crane, jib, ¾ ton	Shop made

A Reaction from Oslerism

BY N. E. HILDRETH

"Middle-aged married men preferred! We want good men and will pay the price." These words, ending an advertisement in the "Positions Open" department of a recent issue of the *American Machinist*, impressed me as indicating the return swing of a pendulum marking an economic epoch. The beginning of the epoch dated somewhere near the colonial period, when settled age and gray hairs were regarded as denoting wisdom and capability and commanded such a premium as to cause the young men to powder their hair. The climax of the epoch was reached several years ago, when Dr. Osler was reputed to have relegated to the scrap heap of the "worn outs" all those who had passed the age of 45 or thereabouts.

That we are now experiencing a reaction from Oslerism to a more sane and humane recognition of the economic worth of the middle-aged and old men is being evidenced by the increasing number of advertisements similar to that referred to above, several of which I have recently seen in the *American Machinist* and other journals. Within the last two months several prominent Chicago businessmen of recognized ability and success inaugurated a movement in that city to give employment to the old men—the discards, supposedly too old to be efficient. Something like two thousand responded to the advertisements, and in the first ten days between two and three hundred were placed in positions suited to their experience. I have not seen any recent reports of the success of this movement, but the early results were highly gratifying to the promoters, those employed making good almost without exception, some men of 70 years among the number.

YOUTH IS NOT NOWADAYS IMPERATIVE

A few years ago, help-wanted advertisements contained such phrases as "Must be young men," "Young men wanted," "Not over 30 years of age," etc., while of forty advertisements in the "Positions Open" section of a late issue of the *American Machinist* only two either directly or indirectly indicated that young men were especially desired, while the qualifications required by the greater number of the other advertisers could only be found in men of ripe age and experience.

I have been for several years specializing in so-called "efficiency work"—that is, improving methods and systems, installing piecework and increasing production—and in the four or five machinery-manufacturing plants in which I have had charge of manufacturing operations my observations have been that for dependability, punctuality, loyalty, production and profit-making capacity the experienced middle-aged to elderly men are equal or superior to the younger men.

Why did the advertiser express his wants in the words at the beginning of this article? Because, I believe, he had, many times doubtless, tried out the young man and found him unprofitable because of lack of skill due to inexperience, or unreliable because unsettled, or inefficient because lacking in the steadiness and good judgment acquired with the passing years.

There has been considerable discussion in the *American Machinist* recently on the scarcity of good and all-round mechanics and the reasons therefor. I believe a potent cause to be the attitude of managers in recent years toward men with white temples, it being the policy of some to refuse to employ men over 40, while others also systematically seek excuses to drop from the payrolls those past the meridian of life, for fear of having them pensioners later. This action results not only in reducing the available supply of experienced mechanics, but tends to discourage youth from attempting to learn a trade or stay permanently with one employer.

QUESTION OF LABOR TURNOVER

Another condition that exists in the manufacturing field—namely, the seeming necessity of employing a large number of men in order to secure a comparatively few who stick—I believe to be correlated to and aggravated by this unfortunate attitude of many employers toward middle-aged and elderly labor. An engineer is said to have disclosed from the employment statistics of six states the fact that twelve metal-working factories in those states in a given year hired 45,571 new people to make a gain of 6697 employees. Is it fair to assume that the blame, or the greater part of it, for this great economic waste lies at the door of the 38,874 who did not stick?

The adage, "Young men for war—old men for council," is a good one, but misleading in that it by implication limits the capabilities of both; and I believe a great benefit that is resulting from the present war is the enforced demonstration that the middle-aged and elderly men can fight efficiently, not only on the field of battle, but also in the field of industry.

I am making no plea that our factories be turned into eleemosynary institutions or old people's homes. That would be absurd. Yet, while I believe that phase of the question is legitimate for the consideration of any nation or individual professedly Christian, I think it can be entirely eliminated by those so inclined and ample justification found solely from the economic standpoint for a more extended recognition of middle-aged and elderly men in both subordinate and executive positions of many kinds.

Accurate Setting Device for Internal Grinding

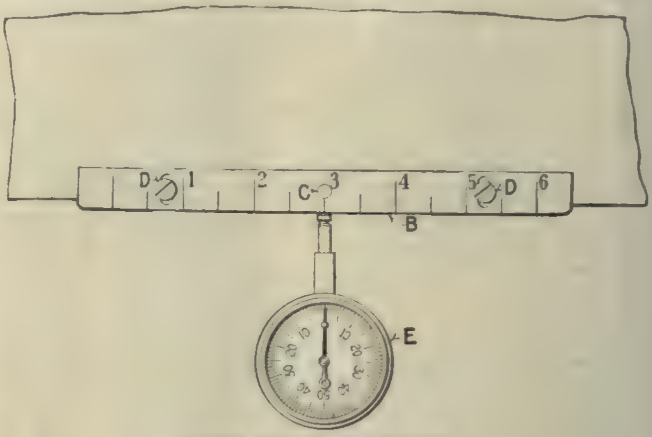
By H. L. Apple

We do a great deal of internal grinding of small holes ($\frac{5}{32}$ to $\frac{1}{4}$ in. in diameter) in perforating dies. The perforating die-holes have a taper of 0.004 in. in 1 in., and the dowel holes are perfectly straight. The dies are mounted on master plates, therefore all the holes in each die must be ground before the die on the master plate is disturbed, which means that the grinder must be set to grind 0.004 in. taper and also to grind perfectly straight on each die.

Not being able to depend on the graduations on the grinder for extreme accuracy, it was a case of more or less cut and try, and this consumed a great deal of time.

In order to reduce the time of setting the machine and to obtain a greater degree of accuracy, I made the attachment here illustrated. This device made it possible to set a machine in a very few minutes so that it would grind a perfectly straight hole or an accurately tapered hole without the usual experimenting.

A is the head on the internal grinder; *B* is an adjustable straight-edge $\frac{3}{16}$ x $\frac{3}{4}$ x 7 in. graduated in half inches, swiveled on a $\frac{3}{16}$-in. pin at *C* and slotted to allow adjustment on the $\frac{3}{16}$-in. clamp screws at *DD*. The dial indicator *E* is mounted on the bracket, which is attached to the bed of the machine.



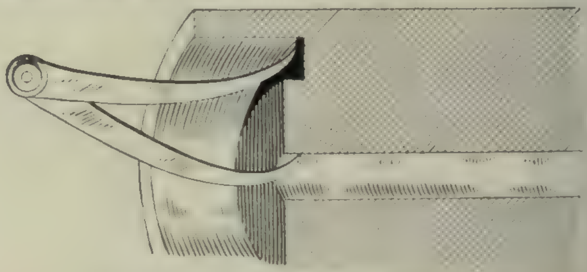
THE SETTING DEVICE

To set the straight-edge, chuck a piece of about $\frac{3}{4}$-in. steel extending say $2\frac{1}{2}$ in. from the chuck, then external grind, setting the swivel table so that the machine is grinding parallel. Now set the straight-edge *A* so that the indicator shows it to be parallel with the travel of the table. After the straight-edge is set and clamped in this position, use the indicator to set the machine. Straight or tapered holes can then be ground with extreme accuracy.

New Form of Caliper

By D. E. Mapes

The convenient tool here illustrated, which is not yet on the market, is a pair of firm joint outside calipers with one leg reversed as shown. It is useful for measuring core holes and the like, to see if there is an equal amount of metal on all sides. It is equally useful for turned work on a lathe, to locate the thickness of a wall where it is not convenient to use a scale and the work is not required to be made to close limits.



APPLICATION OF REVERSED CALIPER

Airplane Engine Repairs at Toronto

BY FRED H. COLVIN

SYNOPSIS—*Airplane engines lead such a strenuous life that the best of care is necessary to keep them in service. As most of the responsibility of a successful flight rests on the engine, mechanical perfection is particularly desirable. The article describes how engines are kept in commission at the new shops of the Royal Flying Corps.*

THE Canadian division of the Royal Flying Corps is systematically arranging for the repair of airplanes and engines. With headquarters in Toronto, the division is planning to have general repairs to both engines and planes made at that point. All the flying fields, which include the first, or primary, field at Deseronto and the secondary fields at Leaside, Ridley Park and Camp Borden, have what might be called field repair shops for minor repairs and also for the regular overhauling and cleaning which become necessary after 50 hours of actual flying. In the same way minor repairs to planes and landing gear are also made in the shops at the various flying fields.

When, however, a crankshaft has been bent by a severe crashing of the machine on landing, no repairs are attempted at the flying field, but the complete engine is shipped to the main repair shop at Toronto. Here it is taken apart and thoroughly examined in every particular. Broken and damaged parts are removed and replaced, and the engine put in shape for actual service and shipped back to the flying field as soon as it has been tested.

Owing to the difficulty of securing skilled mechanics for all this work, it has been found advisable to pick the best men available and train them along special lines of repairs. Under the guidance of a few skilled mechanics men become fairly expert in handling connecting-rods, piston pins and work of that kind, and this method has been found to work out as well as can be expected where skilled men cannot be secured. It takes comparatively little training to make a man fairly skillful, and by keeping him continually on some particular job he soon learns to handle it in a very satisfactory manner.

BOXES FOR EASY HANDLING

Special trays, or boxes, which can be easily handled, are made for holding the different parts on their way through the shop, and great care is taken to have every part absolutely right before the engine is reassembled. The forms used in keeping track of this work as it goes through the shop are illustrated herewith.

Engines are allotted to Engine Repair Park, as the shops are termed, by the Royal Flying Corps headquarters. Each engine is given a logbook for all future work. This book gives a complete history of the engine at all times. On receipt of allotments, a job number is given to the engine by the commanding officer, and all departments are advised of this number when they receive the engine.

The engines are then sent to the dismantling department, which immediately advises the office of the commander that they have been received, giving both their own and the maker's number. The logbooks then go to the office, which forwards them to the inspection department; there particulars of all work required to be done are filled in, and the work actually performed and passed is entered. No department except the inspection department makes entries in the logbooks.

On completion of the engine, the logbooks are returned to the commanding officer for his signature. These books are packed and dispatched with the engines to the flying fields. The entries in the logbooks, while as concise as possible and not giving details as to the replacement of bolts, nuts, etc., only the main parts being mentioned, are such, however, as to enable the squadrons to obtain a good knowledge of the work which has been done on the engines.

Should it be apparent from the condition of the engine that it has not had fair treatment while with the squadrons, an entry to that effect is made in the logbook and where possible a remedy is suggested. No work is started on an engine until after receipt of the job number.

THE FORMS USED

The dismantling department makes out Form No. 1 in duplicate, retaining one copy and forwarding the other to the inspection room. All parts of the engine are thoroughly cleaned before leaving the dismantling department and the valves lightly ground in to facilitate inspection.

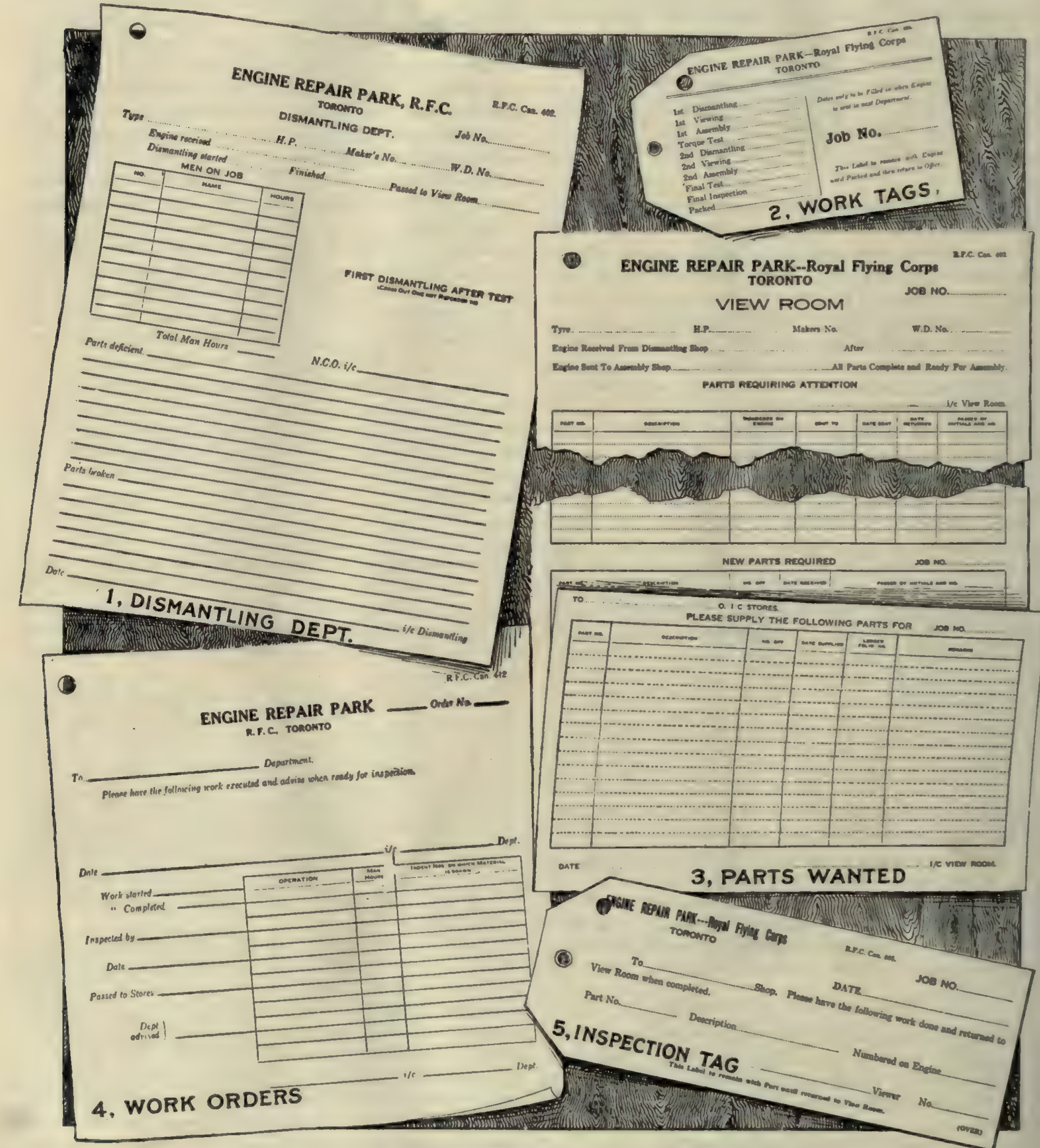
The dismantling department also makes out a blue tag, Form No. 2, furnishing as many copies as there are parts trays for the engine. These forms remain with the engine until it has passed through the shops and is ready for packing.

Form No. 3 is made out by the inspection department, the lower portion being used for drawing parts from the stores. This leaves a carbon copy of stores drawn for the sheet beneath. The carbon copy is retained and completed by the inspection room upon receipt of parts.

Form No. 4 is made out by the inspection department. It gives particulars of the work to be done and is attached to each part requiring attention. The department doing the work completes the form, sending it back to the inspection room together with the part when the work is finished. No engine leaves the inspection room until it is complete in all its parts. Should any parts not be in stock, the engine remains there until they are secured and have passed inspection. A red tag, Form No. 5, remains with the engine until its return to the inspection room.

Form No. 6 is now started by the inspection department, and this, together with its envelope, No. 7, remains with the engine until it is completed. All entries on this card are made by the inspection department, which forwards it to the commanding officer as soon as the final test of the engine is completed and it is ready for service.

Form No. 8 is made out by the assembly department, the inspectors signing in the top right-hand column as the several operations of assembly are inspected and passed. A carbon copy of the valve and magneto setting is made and forwarded direct to the testing department.



ENGINE REPAIR PARK, R.F.C.
TORONTO
DISMANTLING DEPT.
R.F.C. Can. 402.
Job No.
Type .... H.P. .... Maker's No. .... W.D. No. ....
Engine received ....
Dismantling started .... Finished .... Passed to View Room ....

MEN ON JOB		
NO.	NAME	HOURS

Total Man Hours ________
FIRST DISMANTLING AFTER TEST
Parts deficient ________
N.C.O. i/c ________
Parts broken ________
Date ________
________ i/c Dismantling

1, DISMANTLING DEPT.

ENGINE REPAIR PARK—Royal Flying Corps
TORONTO
1st Dismantling ....
1st Viewing ....
1st Assembly ....
Torque Test ....
2nd Dismantling ....
2nd Viewing ....
2nd Assembly ....
Final Test ....
Final Inspection ....
Packed ....
Dates only to be Filled in when Engine is sent to next Department.
Job No. ....
This Label to remain with Engine until Packed and then return to Office.

2, WORK TAGS,

ENGINE REPAIR PARK--Royal Flying Corps
TORONTO
R.F.C. Can. 402
JOB NO. ....
VIEW ROOM
Tyre .... H.P. .... Makers No. .... W.D. No. ....
Engine Received From Dismantling Shop .... After ....
Engine Sent To Assembly Shop .... All Parts Complete and Ready For Assembly.
PARTS REQUIRING ATTENTION
.... I/c View Room.
NEW PARTS REQUIRED JOB NO. ....

TO ....
O. I C STORES.
PLEASE SUPPLY THE FOLLOWING PARTS FOR JOB NO. ....
DATE .... I/C VIEW ROOM.

3, PARTS WANTED

R.F.C. Can. 412
ENGINE REPAIR PARK ________ Order No. ________
R.F.C., TORONTO
To ________ Department.
Please have the following work executed and advise when ready for inspection.
________ i/c ________ Dept.
Date ________
Work started ________
" Completed ________
Inspected by ________
Date ________
Passed to Stores ________
Dept advised ________

OPERATION	MAN HOURS	

________ i/c ________ Dept.

4, WORK ORDERS

ENGINE REPAIR PARK---Royal Flying Corps
TORONTO
R.F.C. Can.
To .... Shop. Please have the following work done and returned to View Room when completed.
DATE ________
JOB NO. ________
Part No. ________ Description ________ Numbered on Engine ________
________ Viewer No. ________
This Label to remain with Part until returned to View Room.
(OVER)

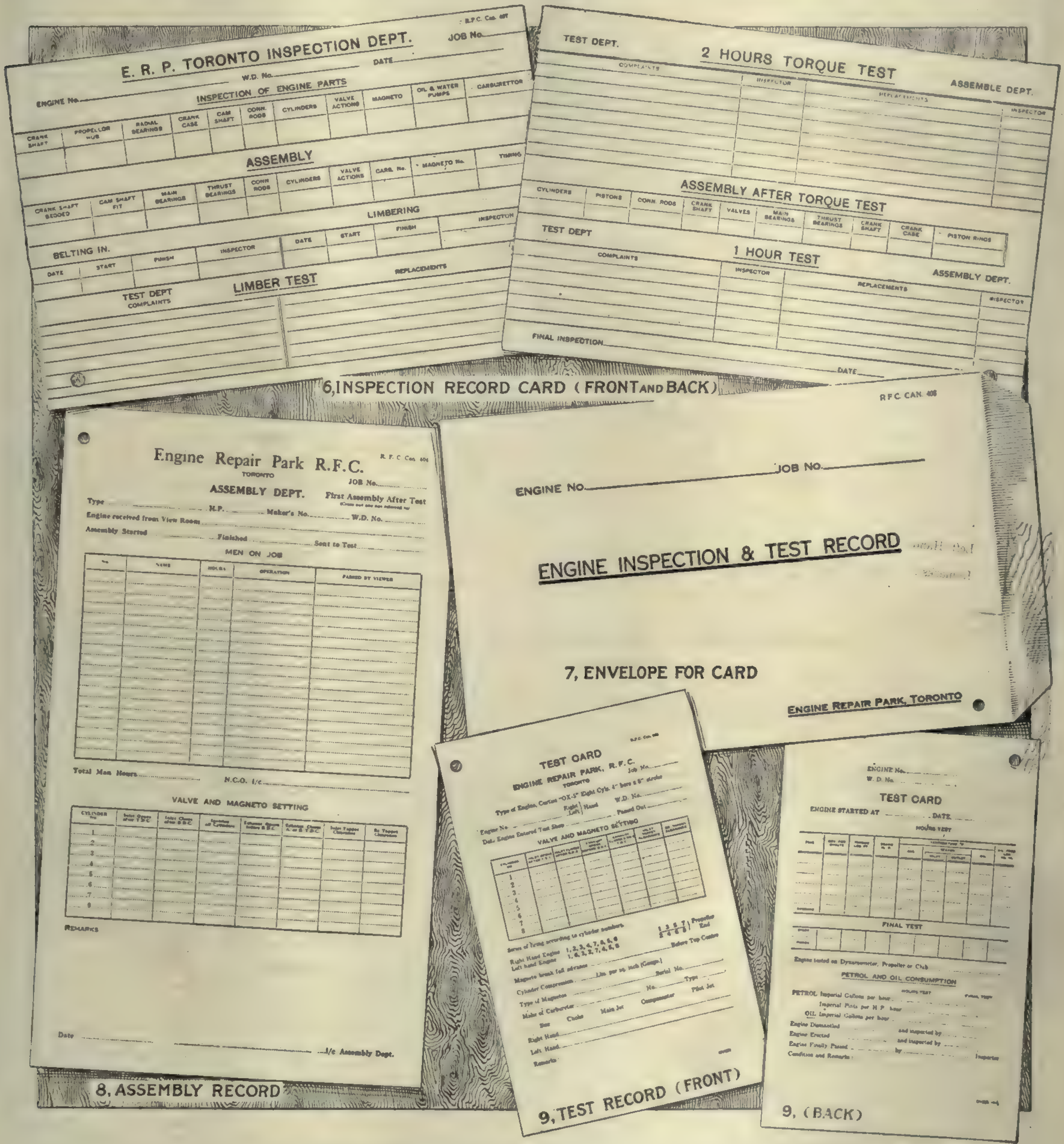
5, INSPECTION TAG

FIGS. 1 TO 5. STANDARD DISMANTLING AND INSPECTING FORMS

Form No. 9 is then made out by the test department. The setting of the valves and the magneto is shown as it remains after the engine has been tested and passed for torque. This will not necessarily be the same as that given by the assembly department if better results can be obtained with some other setting. All settings are given in degrees and not as measurements of the stroke.

On completion of the tests, Form No. 9 is sent to the office of the commanding officer, where it is duplicated on Form No. 10 for sending out with the engine logbook. The original is then returned to the test department, where it is filed for future reference.

As the engine passes through the shops for the second dismantling, reassembly, etc., after the first test, a second form, having the same job number as the original, is made out by each department. These forms are kept with the first forms by each department. Each department keeps its completed forms in numerical order, according to the job numbers, so as to be easily found for reference. All departments make a daily report before 9 a.m., as shown in Form No. 11, to the commanding officer in charge of the entire school.



R.F.C. Can. 407

E. R. P. TORONTO INSPECTION DEPT.

JOB No.

DATE

W.D. No.

ENGINE No.

INSPECTION OF ENGINE PARTS

CRANK SHAFT	PROPELLOR HUB	RADIAL BEARINGS	CRANK CASE	CAM SHAFT	CONN. RODS	CYLINDERS	VALVE ACTIONS	MAGNETO	OIL & WATER PUMPS	CARBURETTOR

ASSEMBLY

CRANK SHAFT BEDDED	CAM SHAFT FIT	MAIN BEARINGS	THRUST BEARINGS	CONN RODS	CYLINDERS	VALVE ACTIONS	CARB. No.	MAGNETO No.	TIMING

BELTING IN.

DATE	START	FINISH	INSPECTOR

LIMBERING

DATE	START	FINISH	INSPECTOR

TEST DEPT

LIMBER TEST

COMPLAINTS	REPLACEMENTS

TEST DEPT.

2 HOURS TORQUE TEST

ASSEMBLE DEPT.

COMPLAINTS	INSPECTOR	REPLACEMENTS	INSPECTOR

ASSEMBLY AFTER TORQUE TEST

CYLINDERS	PISTONS	CONN. RODS	CRANK SHAFT	VALVES	MAIN BEARINGS	THRUST BEARINGS	CRANK SHAFT	CRANK CASE	PISTON RINGS

TEST DEPT

1 HOUR TEST

ASSEMBLY DEPT.

COMPLAINTS	INSPECTOR	REPLACEMENTS	INSPECTOR

FINAL INSPECTION

DATE

6, INSPECTION RECORD CARD (FRONT AND BACK)

R.F.C. CAN. 408

ENGINE NO.

JOB NO.

ENGINE INSPECTION & TEST RECORD

7, ENVELOPE FOR CARD

ENGINE REPAIR PARK, TORONTO

Engine Repair Park R.F.C.

TORONTO

R. F. C. Can. 406

JOB No.

ASSEMBLY DEPT.

First Assembly After Test

Type H.P. Maker's No. W.D. No.

Engine received from View Room

Assembly Started Finished Sent to Test

MEN ON JOB

No.	NAME	HOURS	OPERATION	PASSED BY VIEWER

Total Man Hours N.C.O. i/c

VALVE AND MAGNETO SETTING

CYLINDER No.							
1							
2							
3							
4							
5							
6							
7							
8							

REMARKS

Date I/c Assembly Dept.

8, ASSEMBLY RECORD

TEST CARD

ENGINE REPAIR PARK, R.F.C.

TORONTO

Job No.

Type of Engine, Curtiss "OX-5" Eight Cyls. 4" bore x 5" stroke

W.D. No.

Engine No. Right / Left Hand

Date Engine Entered Test Shop Passed Out

VALVE AND MAGNETO SETTING

CYLINDER No.						
1						
2						
3						
4						
5						
6						
7						
8						

Series of firing according to cylinder numbers. 1 3 5 7 / 2 4 6 8 Propeller End

Right Hand Engine 1, 2, 3, 4, 7, 8, 5, 6

Left hand Engine 1, 6, 3, 2, 7, 4, 5, 8

Magneto break full advance Before Top Centre

Cylinder Compression Lbs. per sq. inch (Gauge)

Type of Magneto Serial No.

Make of Carburetor No. Type

Size Choke Main Jet Compensator Pilot Jet

Right Hand

Left Hand

Remarks

9, TEST RECORD (FRONT)

ENGINE No.

W. D. No.

TEST CARD

ENGINE STARTED AT DATE

HOURS TEST

FINAL TEST

Engine tested on Dynamometer, Propeller or Club

PETROL AND OIL CONSUMPTION

HOURS TEST FINAL TEST

PETROL Imperial Gallons per hour

Imperial Pints per H. P. hour

OIL Imperial Gallons per hour

Engine Dismantled and inspected by

Engine Erected and inspected by

Engine Finally Passed by Inspector

Condition and Remarks:

9, (BACK)

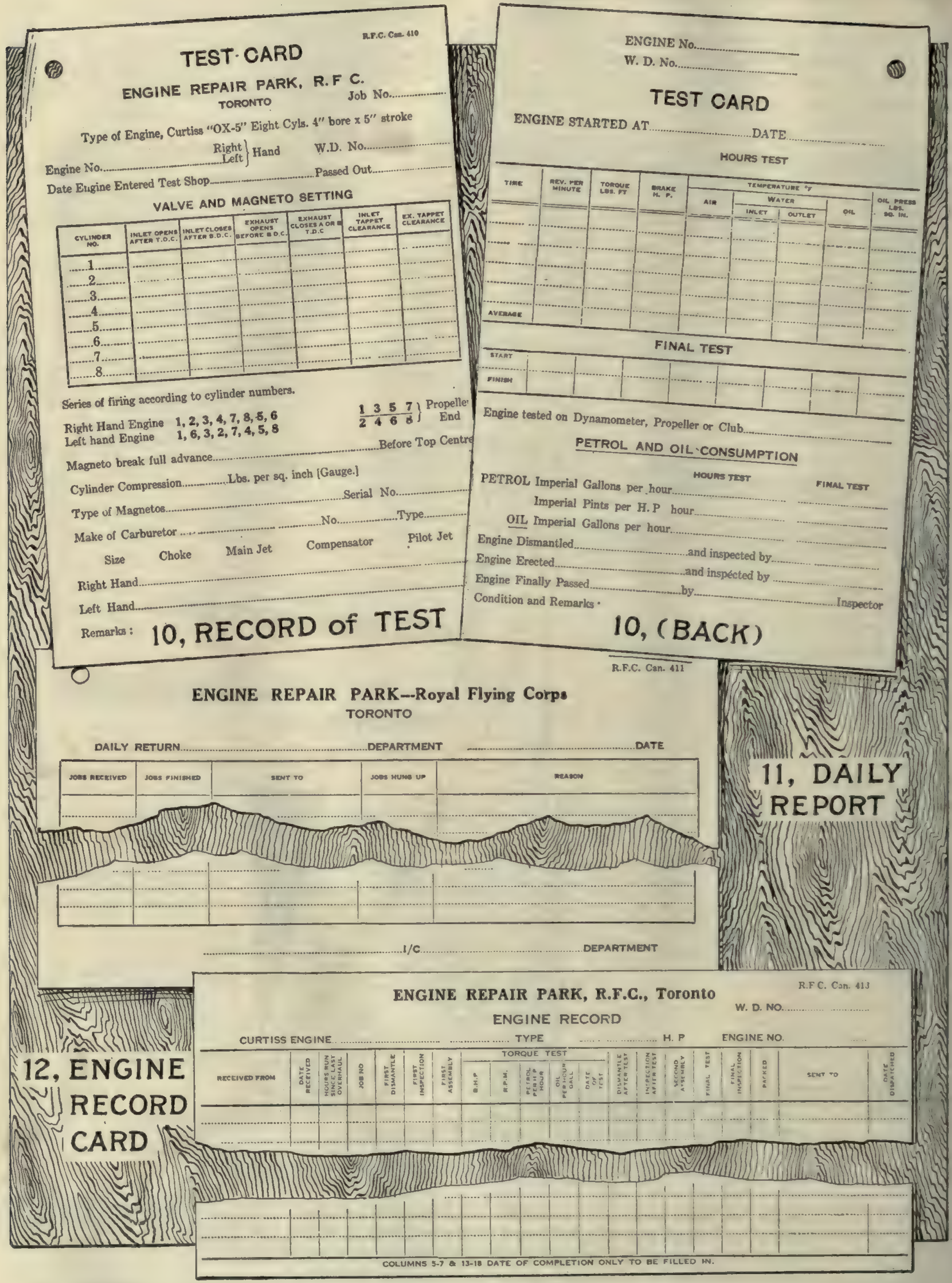
FIGS. 6 TO 9. INSPECTION, ASSEMBLY AND TEST FORMS

Form No. 12 shows an engine-record card which is kept in the office of the commanding officer and is brought up to date from the returns by the several departments given in Form No. 11. This gives a concise history of each engine as long as it remains in service.

All time spent and material used at the repair park are accounted for under the headings which show where all charges should be made.

Job numbers include all time and material used in connection with the repair and rebuilding of airplane engines and also the overhaul and repairs of motor transport vehicles. These numbers are allotted by the commanding officer, who advises the departments concerned of the numbers allotted to each engine or motor transport vehicle.

Stock numbers include all time and material used on manufactured work, such as engine parts, tools or ar-



R.F.C. Can. 410

TEST CARD

ENGINE REPAIR PARK, R. F C.
TORONTO

Job No.

Type of Engine, Curtiss "OX-5" Eight Cyls. 4" bore x 5" stroke

Engine No. Right/Left } Hand W.D. No.

Date Engine Entered Test Shop Passed Out

VALVE AND MAGNETO SETTING

CYLINDER NO.	INLET OPENS AFTER T.O.C.	INLET CLOSES AFTER B.D.C.	EXHAUST OPENS BEFORE B.D.C.	EXHAUST CLOSES A OR B T.D.C	INLET TAPPET CLEARANCE	EX. TAPPET CLEARANCE
1						
2						
3						
4						
5						
6						
7						
8						

Series of firing according to cylinder numbers.

Right Hand Engine 1, 2, 3, 4, 7, 8, 5, 6
Left hand Engine 1, 6, 3, 2, 7, 4, 5, 8

1 3 5 7 } Propeller
2 4 6 8 } End

Magneto break full advance Before Top Centre

Cylinder Compression Lbs. per sq. inch (Gauge.)

Type of Magnetos Serial No.

Make of Carburetor No. Type

	Size	Choke	Main Jet	Compensator	Pilot Jet
Right Hand					
Left Hand					

Remarks:

10, RECORD of TEST

ENGINE No.
W. D. No.

TEST CARD

ENGINE STARTED AT DATE

HOURS TEST

TIME	REV. PER MINUTE	TORQUE LBS. FT	BRAKE H. P.	TEMPERATURE °F				OIL PRESS LBS. SQ. IN.
				AIR	WATER		OIL	
					INLET	OUTLET		
AVERAGE								

FINAL TEST

START								
FINISH								

Engine tested on Dynamometer, Propeller or Club

PETROL AND OIL CONSUMPTION

	HOURS TEST	FINAL TEST
PETROL Imperial Gallons per hour		
Imperial Pints per H. P hour		
OIL Imperial Gallons per hour		

Engine Dismantled and inspected by
Engine Erected and inspected by
Engine Finally Passed by Inspector
Condition and Remarks

10, (BACK)

R.F.C. Can. 411

ENGINE REPAIR PARK—Royal Flying Corps
TORONTO

DAILY RETURN DEPARTMENT DATE

JOBS RECEIVED	JOBS FINISHED	SENT TO	JOBS HUNG UP	REASON

I/C DEPARTMENT

11, DAILY REPORT

R.F C. Can. 413

ENGINE REPAIR PARK, R.F.C., Toronto

W. D. NO.

ENGINE RECORD

CURTISS ENGINE TYPE H. P ENGINE NO.

RECEIVED FROM	DATE RECEIVED	HOURS RUN SINCE LAST OVERHAUL	JOB NO	FIRST DISMANTLE	FIRST INSPECTION	FIRST ASSEMBLY	TORQUE TEST					DISMANTLE AFTER TEST	INSPECTION AFTER TEST	SECOND ASSEMBLY	FINAL TEST	FINAL INSPECTION	PACKED	SENT TO	DATE DISPATCHED
							B.H.P	R.P.M.	PETROL PER H P HOUR	OIL PER HOUR GALL	DATE OF TEST								

COLUMNS 5-7 & 13-18 DATE OF COMPLETION ONLY TO BE FILLED IN.

12, ENGINE RECORD CARD

FIGS. 10 TO 12. VARIOUS TEST AND RECORD FORMS ticles manufactured for other units. All requests for this class of work are made out on a special form, the article passing through the inspection department. They are then transferred to the repair stores and reissued by them to the proper department.

All order numbers originate in the drawing office, where a book is kept which records all numbers issued. Where drawings are required, these bear the stock order number in addition to its drawing number. Should further similar articles be required after completion of the first order, the new order will have the same number as the original and be followed by a letter of the alphabet, commencing with A.

How Order Numbers Are Given

Works order numbers include all repairs or alterations to machine tools, plant or buildings. Requests for this class of work are made out by the department requiring the work to be done. This takes a works order number preceded by the initial letters of the department, for example, W. O. M/S202 stands for works order number 202, issued by the machine shop. Each department keeps a record of all orders issued.

Permanent works orders (common to all departments). Only time spent on these orders during the working hours of the park is to be accounted for.

Working order number 1001—Cleaning.
Working order number 1002—Drill.
Working order number 1003—Guards.
Working order number 1004—Leave.
Working order number 1005—Excused duty or hospital.
Working order number 1006—Orderly duties.
Working order number 1007—General work in connection with laying out plant.

Each department renders a weekly summary of all time, in man-hours, worked on each order. This goes to the stores by 9 a.m. Monday. The stores keep a record of all time spent and material used on each order, in the form of a loose-leaf ledger.

Time sheets are made out by all noncommissioned officers below the rank of sergeant (with the exception of clerks and storemen).

The time sheets are signed by the noncommissioned officer in charge of the section, and passed to the officer in charge of the department, who files them when the necessary information has been secured.

Parts That Need Attention

After an engine has been run from 100 to 150 hours, it is given a complete overhauling. New connecting-rod bearings, and in most cases main bearings, are also installed. These bearings are cast in the shop, on a brass back, and after being fitted in place are carefully lined and reamed to the proper size. Scraping is practically unknown, as is now the case in nearly all the better grade automobile shops.

There are a great variety of breakages from various causes. Among these is the breaking of the piston pin, which usually destroys the piston and frequently breaks the small end of the connecting-rod. This is probably caused by the piston pins being case hardened too deep, which makes them brittle, owing to the lack of the soft core, as these pins are hollow.

The bearing of these pins is in the aluminum piston, as has previously been described in connection with the building of the Curtiss motor. These wear in time, and oversize piston pins are being tried to remedy this difficulty. Bronze bushings may also be adopted later in case of further wear, or if the enlarged pins do not prove entirely satisfactory.

Crankshafts are frequently bent when the propeller strikes the earth in making a bad landing, and a special 35-ton hydraulic press is being installed for straightening these shafts. It is the intention to clamp the end shaft bearings in a suitable fixture and apply pressure wherever it may be necessary in order to bring the shaft back to its normal position or to within 0.002 in. of straight. If the shaft is over 0.020 in. out of line, it is not usually considered advisable to attempt straightening.

Repairing Crank Case by Welding

When a crankshaft becomes bent from an accident of this kind, it usually cracks or otherwise mutilates the crank case or engine face, or both. Many of these can be repaired by an expert oxyacetylene welder, but it is very necessary to hold the pieces firmly in position to prevent their being badly warped by the local application of intense heat. To avoid this, heavy cast-iron blocks are to be used, to which the cases will be bolted so as to hold them firmly in position during the welding operation. In this connection it is interesting to note that a large heating furnace has been provided into which the crank case, already bolted on its heavy cast-iron form, can be heated as hot as may be necessary, before the welding is attempted. This, in some instances, is about 200 deg. below Fahrenheit, the melting point of the alloy, as this temperature has been found to assist the welding to a large degree and also to prevent warping after the piece is removed from the cast-iron form.

There is also considerable repair work on the engine radiators, which means sheet-metal work, soldering and brazing to a considerable extent. In all the repair departments it is necessary to exercise extreme care, particularly when green men are being broken in.

Cutting Coarse-Pitch Screws

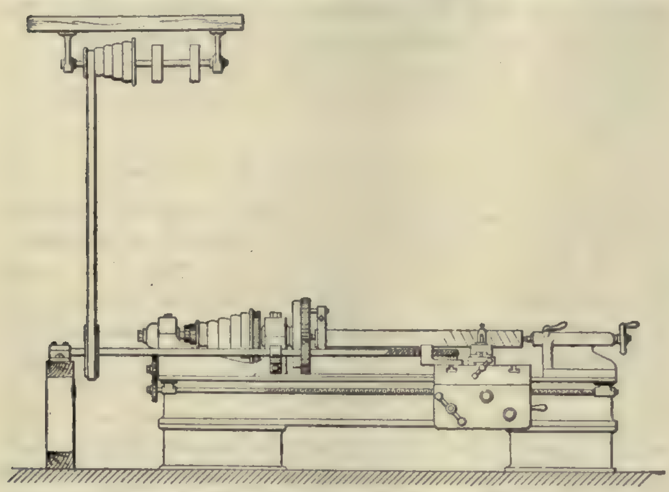
By H. L. Turner

I once had to rig up to cut a 2½-in. pitch thread on a 24-in. lathe with a four-pitch lead screw and no change gears for threads coarser than ½-in. pitch.

The only gears available for special rigging were a pair with cast teeth of 1¼-in. pitch and having a ratio of 2½ to 1. In order to use these I had to have a screw of 1-in. pitch. This difficulty was overcome by making a new lead screw with a pitch of two threads per inch, which was substituted for the regular lead screw in the lathe. The nut was then babbitted to fit it, and with the lathe geared as it would have been to cut two threads per inch with the regular four-pitch lead screw, a left-handed 1-in. pitch thread was cut on the end of a piece of 1$\frac{15}{16}$-in. shafting.

The illustration will serve to explain the rest. The 1$\frac{15}{16}$-in. shaft was supported along the front of the lathe by one bearing fastened to the front of the headstock, and another carried by a trestle on the floor. The threaded end of the shaft ran in a babbitted nut fastened to the top of the lathe carriage, as shown. In order to furnish a satisfactory drive with reverse motion, the countershaft with its cone pulley and drive pulleys was turned end for end in its bearings. The drive pulleys on the lineshaft were shifted to line with the countershaft pulleys in their new position.

The larger of the two gears was bolted to the faceplate, and the smaller one was keyed to the 1$\frac{15}{16}$-in. shaft, on which was also mounted a 30-in. driving pulley, which was belted to the small step of the countershaft cone pulley. As the lathe was driven from the shaft which also acted as lead screw, there was no unusual stress on the lathe parts, and a heavy cut could be taken without danger of breakage. I believe the most unusual feature of the job was the making of the special lead screw with which to thread the 1$\frac{15}{16}$-in. shaft.



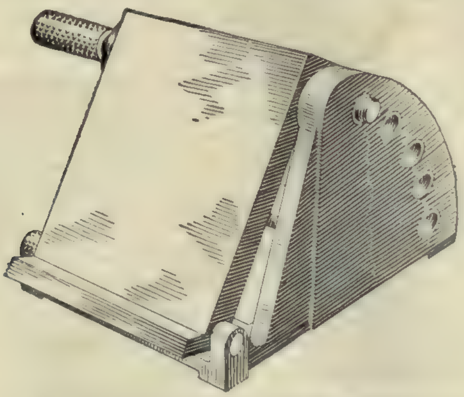
THE COARSE THREAD-CUTTING RIG

An Adjustable Angle Iron

By Leigh Hunt

After designing a drill jig for a piece of work that had five angular holes, besides a few straight ones, my next proposition was to design angle irons that would give the required angles.

Formerly all drill jigs used for drilling holes in a piece of work on an angle had a separate angle iron for each hole. My idea was to do away with all but one, thus cutting down expense.



AN ADJUSTABLE ANGLE IRON

The illustration shows the main base made of cast iron, which holds the hardened and ground steel bushings that are inserted to give the different angles required.

The top plate, upon which the drill jig is set, swings on the lower pin and rests on the long locating pin with the knurled handle. The plate also has two small hardened steel plates screwed on, as shown. These take the wear on the hardened and ground steel locating pin.

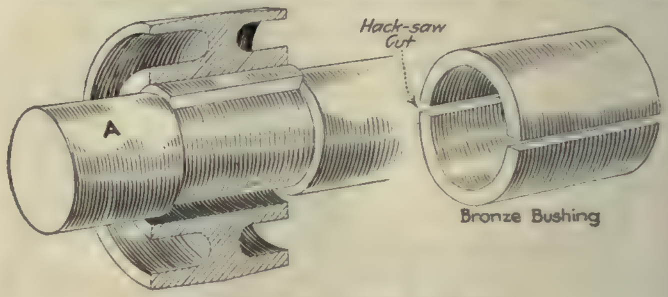
It is well to stamp or in some way mark opposite each hole the angle it is for.

This angle iron proved very satisfactory, and the design was followed out in all others that were made. We found that the adjustable type not only cut down tool expense and the bother of having five angle irons around the drill press, but also considerably increased production.

Bushing a Loose Pulley

By C. Hecker

An article in a recent issue of the *American Machinist*, about bushing a motor shaft, reminded me of a somewhat similar repair job on a loose pulley that came under my supervision some time ago. Both the pulley and shaft were badly worn but the size of the shaft at *A* could not be changed. The illustration shows how the pulley was bored out and how the shaft was turned down. The bushing was bored an easy running fit for the shaft and turned the same for the pulley. A hacksaw did the rest.



BUSHING FOR LOOSE PULLEY

While this kind of a job may be subject to criticism, there is one thing to be said in its favor—it worked.

Safe-guarding Industries from Preventable Fire Loss

A little book has just been issued by the National Board of Fire Underwriters, entitled "Safeguarding Industries—A War-Time Necessity." It has been prepared by the Underwriters for the Council of National Defense with the view of aiding the elimination of the fire waste that grew in 1916 to $2.10 per capita over the loss in 1915 of $1.71. Thus, $214,000,000 was wasted last year in fires that were largely preventable. This money would have built nearly 30,000 airplanes or many hundreds of torpedo-boat destroyers.

Folded into this little pamphlet is a "Self-Inspection Blank." This asks a number of questions, all very practical, bearing upon plant conditions. The object of this blank is to call attention of foremen, superintendents and managers to what they should look for in the way of proper fire-preventing conditions. Both the pamphlet and the inspection blank are very helpful.

Series for Draftsmen and Designers

The Drafting-Room Apprentice[*]

BY CHARLES M. HORTON

BROADLY speaking, and with reference to preliminary education only, draftsmen may be divided into three classes—college men, correspondence-school graduates and drafting-room apprentices. Of college men, looking always from the viewpoint of preliminary education, understand, it might be said that they know too much; that is, their education is too diffuse to permit them immediate and ready application to this one small branch of engineering, which probably is why college men make such a poor showing in a drafting room at first. On the other hand, of those worthy young men who have labored nights and spare time through a correspondence-school course of drafting, it might be said that they do not know enough, a fact that is quite evident whenever this type of draftsman tackles his first job. That brings us down to the drafting-room apprentice.

I have purposely listed him last, because I think that he makes the best draftsman. Assuredly, he is a man who invariably knows his business and knows it in all its ramifications, from the best way to shape a casting for the molder to the way a blacksmith upsets an end of iron. Your correspondence-school draftsman rarely understands these things at first, and your college Johnny, in his school days, was too busy absorbing theory to pay much attention to these trivial matters.

Steve Winthrop began as a drawing-room apprentice. He signed in for three years in a large general jobbing shop, one that built huge triple-expansion engines for the Government and, going to the opposite extreme, minute grate bars for furnaces in the chemical industry. When he entered upon his apprenticeship, Steve did not know a blueprint from a connecting-rod, and all metals—brass, cast iron, steel—looked alike to him. Of a curious and inquiring turn of mind naturally, however, and given, right from the start, the privilege of bumming around in the shops, he soon learned to differentiate these metals. Also, being early instructed in the gentle art of making blueprints, he soon learned what these were and what they were for. From that time on, his education in the game as a whole was acquired rapidly. In the phrase, "privilege of bumming around in the shops," lies the answer to the success of drafting-room apprentices in later life. They do make the best draftsmen. Steve learned more about the machinist trade in six months, just standing around with his hands in his pockets, watching machinist work and asking questions, than the average machinist apprentice learns in a year, because the latter gets his instructions and practice piecemeal and at long intervals, whereas Steve, when he got tired of bothering a planer hand with questions, would saunter over to a boring-mill guy and proceed to become a pest and a nuisance to this man.

Steve was a good kidder, though, even in those days, and I ween his visits were welcome to the younger machinists—sort of a break in the monotonous grind. Then, too, young Steve had information as to what was under way in the drafting room, and this seemed to interest the men in the shop—in fact, *did* interest them, for they always wanted to know, although just why they wanted to know, Steve himself never was able to understand. Possibly they wanted to get ready to stand from under if the work showed signs of slackening.

But Steve's privileges were not confined to the machine shop. He bummed around in the foundry and in the pattern shop also. In fact, Steve spent more time in the shop, these days, than he did in the drawing room. He liked the atmosphere. Nevertheless, he had his blueprints to make and his petty drawings to turn out, these last under the combined supervision of the entire drafting-room force, some of whom were downright "crool" in their criticisms. Still, Steve managed to weather every gale, and to learn in time the value of different lines and what section lining to use for steel and what for brass, and altogether he early won the sobriquet of the Old Man's white-haired boy. Steve used to do other things, too. The Old Man—the president of the organization—used to take Steve out on inspection trips around the plant, at which times Steve used to

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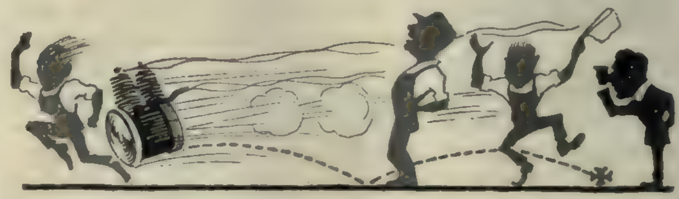
drive rods here and there into the soil with a hammer, under the critical eye of the Old Man—markers for a new fence or a new building to be erected some time in the future. The Old Man had great respect for a man who could swing a hammer and hit the object aimed at without missing, and Steve was "there" in that stuff. Indeed, the Old Man once raised the salary of a wop helper who demonstrated on several occasions that he could screw up a nut! All of which—to get back—helped greatly toward Steve's general education. It was general, too—Steve's education—which, in view of what he was after, made it the more valuable. A draftsman must have a working knowledge of at least three of the allied trades in order to be proficient. Lacking this knowledge, he will design castings that no molder can mold, and he will draw up machine parts that no machinist can machine. Steve in his own work frequently entertained doubts as to the practicality of something upon which he was working and, after worrying the other draftsmen about the matter, would duck down into the shops, the courts of last resort to Steve, and inquire there into the matter. Thus he learned, and in so learning became more and more proficient along general lines as time went on. He liked the work and went to it like a dog to a bone.

Yet there were frequent dry spells in this particular drafting room—times when the work was slack and when Steve had nothing whatever to do. One such time he proved that he had initiative. It was after he had been in the game about a year.

It occurred to him one day to design an engine of his own, an engine the like of which never had been built before—nor since—one embodying his own pet juvenile ideas. Athrill with the joy of creation, he went eagerly to the task, scarcely stopping to eat or sleep. He got all the handbooks he could find in the drafting room on the subject. He spread himself a nice clean piece of drawing paper, sharpened all his pencils to a fine working point, got himself set on his stool properly before the table and waited for inspiration. After a long time—a sad, long time—the inspiration came. It would be a little two-cylinder engine Steve decided, vertical type, with cylinders 3 x 4 in., say, and the steam chest located between the cylinders, with the valves back to back and rubbing against each other. The big and valuable feature about this engine was to be the single steam chest for two cylinders. Not so rotten, eh? One steam pipe, too, you know. Great mechanical economy. Not that he ever hoped to see it built—not that. But he did want to startle the chief and the other deckhands into a realization that he, Steve Winthrop, knew his business. Having the idea now fully in his mind, he bent over the table and began to make lines. Well, he did startle the chief and the deckhands. The chief chuckled over the idea, asked Steve where he got it, while the draftsmen soon began to butt in with ideas of their own, in order to make the thing work properly. Not only that. Word of the tremendous discovery got into the front office, with the result that the Old Man, ever on the alert to encourage Steve, gave Steve permission and put the proper orders through the shop, to have the engine built when the drawings were ready, but to have it all built by apprentice boys. That is to say, the patternmaker apprentices were to make the patterns; the machine-shop apprentices were to make the machine parts; the foundry apprentices were to make the castings. Steve was in a delirium of joy. He humped himself to it by day and dreamed of it by night.

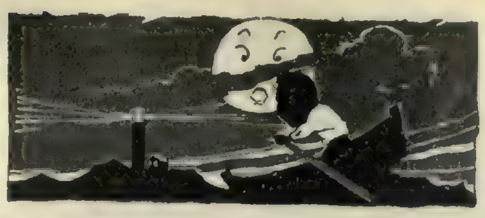
The kids in the shop got excited, too. Steve put in a lot of time talking the thing over with them, and in the fever that was upon him he completely forgot his daily tasks. Blueprints hung on the drying rack for days at a stretch, or until wanted and yelled for by someone; drawings forgot to get themselves filed away evenings; even the young woman stenographer missed Steve's smiling and shiny countenance hanging over her table. But Steve was on the way to making good, so he did not care. He worked out the general arrangement with one hand while he shooed off the older draftsmen with the other, and then carefully drew up and traced and blueprinted the details.



After that he was conspicuous by his absence in the drafting room. He spent every waking moment in the shop, hanging around the apprentices, and even got peeved when called up in the drawing room to dig out a drawing or to make a blueprint. He even thought of complaining at these interruptions to the Old Man. Why could not the chief make his own blueprints and dig up his own drawings during such a momentous time?

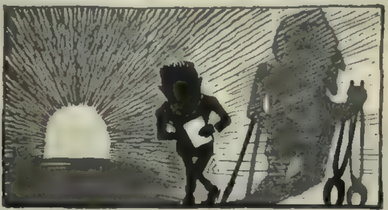
The d— thing ran! It did, for a fact. It was only about a foot high and a foot long, but size did not seem to stop it. It whizzed over like a rocket; and because everybody had been skeptical about it, including Steve, everybody had neglected to bolt it down, and in consequence it ran all over the machine-shop floor. But it ran! Steve? That little stunt filled Steve with a confidence in himself that forever afterward stood by him. He tackled bigger things later in life, things of vital importance, and they worked just as that first engine had worked; and he did it only because of the success of that first undertaking. Had it failed, Steve today might be listed with the failures, since failure in that first venture would unquestionably have robbed Steve of much of his self-confidence.

Steve learned to do other things during that eventful apprenticeship. He learned to estimate the weight of castings from blueprints; installed a blower for the cupola in the foundry; learned to go into the field and measure up intricate machines and then duplicate them in drawings of his own fashioning later. And one other



thing he learned, the nature of which he never knew whether to gloat over or be ashamed of. The Old Man sent for him one evening just before quitting time. It seemed there had come in an order for a set of peculiar furnace tools, the like of which the company never had made and never had seen and so did not know anything about, although the Old Man knew there was such a furnace in operation, something that in itself was secret, and believed he could duplicate the tools if only someone, Steve, say—a youngster who could do it without attracting attention—could break into that plant and make a sketch of the tools. Thus it was put up to Steve with instructions. The instructions were to the point. Steve was to journey to a certain place that night; get into a certain rowboat which he would find waiting for him; row to a certain island and to a certain place on that island; hunt up a certain man, who would guide him to the furnace and indicate the tools and then would leave him. Steve was not to take any measurements. He was to sketch the shape of the tools as best he could, make a rough stab as to their length and size—and then beat it away from there to the boat as fast as his young legs would carry him.

Steve drew a deep breath and, filled with much importance, set out. He found the boat. He rowed across to the island. He made a landing. Here he got cold feet; but orders were orders, especially when emanating from the Old Man, and with his heart in his throat he set out to find the man. And he found the man—a workman. That individual very mysteriously conducted Steve about a mile from nowhere and into the soft glow of a huge furnace. Around this furnace Steve saw six or eight peculiar shaped tools. He knew that these were those; and as the man disappeared into the night, Steve got out his pad and pencil, glanced furtively about him and went to work making sketches. He got home late that night. But late as it was, he amplified his sketches while the appearance of the tools remained fresh in his mind, and the next morning he proudly handed them over to the Old Man. Needless to say, knowing Steve, the order was filled without complaint, and a good many orders like it afterward. Steve had earned his right to call himself a draftsman.



This was but one of a number of remarkably individual opportunities to learn that came to Steve during his apprentice days. Lack of space forbids my narrating others. Yet the lesson is plain. Steve acquired a viewpoint on the game of drafting which he could have gained nowhere else. He learned to see big in what of itself is but a small branch of engineering. College men are taught to see big, certainly. But the viewpoint is one of bigness over the whole field of engineering. Steve was taught to see big in just one tiny field of engineering. Therefore, he came out of that apprenticeship, as all youngsters emerge from any apprenticeship, with a fine working grasp of the game. He did not know much about B.t.u.'s and the like, yet he could take cards, and read them, from triple-expansion engines, like an old-timer. And he knew the actual cross-bending breaking point of bars of cast iron because he broke so many of these bars in a testing machine, as part of his duties, that he got nervous prostration. And he knew the actual area in square inches on a propeller blade—one the company made for the Government—because he had to lay it out in chalk on the actual blade and count 'em and make a report.

A good, two-handed education, always, is that offered any apprentice in any trade, provided the organization desires to live up to the papers that it compels the youngster to sign. In the case of the drawing-room apprentice, he not only learns to make drawings, but he receives careful instruction into the whys and wherefores, to say nothing of the opportunities around him, in the shops, to prove out for himself much that is told him in the drawing room. So he grows in exact ratio to his own native ability and intelligence. And when, as not infrequently happens, the apprentice, once his period of service is at an end, cuts loose from his alma mater—though this is considered rank ingratitude on the part of the organization—and sets sail for another job and another organization, he generally finds himself more competent than he thought he was, by the simple process of comparing his work with the work of others. Thus is added one more competent man to the trade.

It would be interesting to know just the number of men who have "gone big" in engineering who began their work as apprentices in some shop. I believe their number is legion. And I know, and state the fact with the conviction of one who knew him, and so knows, that George Westinghouse was the past grand master of them all. He knew, too. Because there never was a whiter man to his help, one who, for one single thing alone, was responsible for the movement today everywhere, which, interpreted, foretells the passing of the "soulless" corporation. George Westinghouse gave his turkeys and his half-days Saturday before others in this country were even thinking about them. Peace be with him!

And he was an apprentice.

Chicago Machinery Club Has Big Time

Saturday, Aug. 25, was a red-letter day in Chicago's history. The Chicago Machinery Club, which, as announced in a recent issue of the *American Machinist*, has just secured permanent clubrooms in Machinery Hall, held its first outing at the Chateau Desplaines, at Lyons, Ill. The program was in keeping with the progressiveness of the Western machinery men and included a ball game between the famous Friction Back-geared Stars and the Screwdriver Salesmen or Supplymen. Machinery manufacturers who had occasion to be in Chicago on this date were unfortunate if they did not participate in the general good time which was extended by the club to all those who were present at the outing.

Manufacturing Operations on a Combination Sugar Bowl

SPECIAL CORRESPONDENCE

SYNOPSIS—*In this article are shown some of the operations required in making a combination sugar bowl. All the tools are not shown, as similar work is done on various elements. Examples of drawing, forming and trimming dies are, however, illustrated. Types of wooden chuck used for the final turning are also shown.*

THE H. O. Rogers Silver Co., Taunton, Mass., has recently commenced the manufacture of the combination sugar bowl seen in Fig. 1. The most important and interesting operations in making this piece of plated silverware are here described. With the exception of the ornamental bird, the handles and the spoon holders, which are cast, the bowl is pressed.

In making the body of the bowl the material, which is hard white metal 0.0312 in. thick (No. 22 gage) is first blanked and then given its first drawing operation. The blank is placed in the die, Fig. 2, and receives its second draw with the punch *A*. By this process the body is formed into an almost semicircular shape, as shown by the part alongside the die.

FINISH-FORMING THE BODY

In Fig. 3 is illustrated the punch press for finish-forming the body. The die is made from tool steel and the force from hard white metal. The manner in which the force is made is interesting. After the die block has been machined on the inside to suit the part to be shaped, it is fastened on the machine with four screws, as shown. Molten metal is then poured into the die, and the drop *A* is lowered. The metal is allowed to

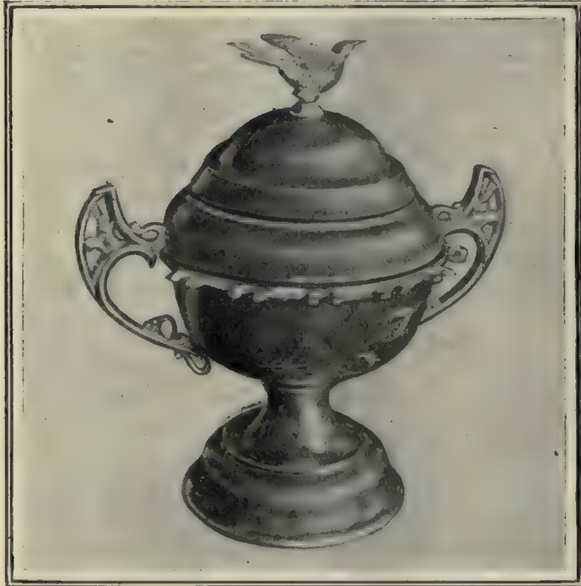


FIG. 1. COMBINATION SUGAR BOWL

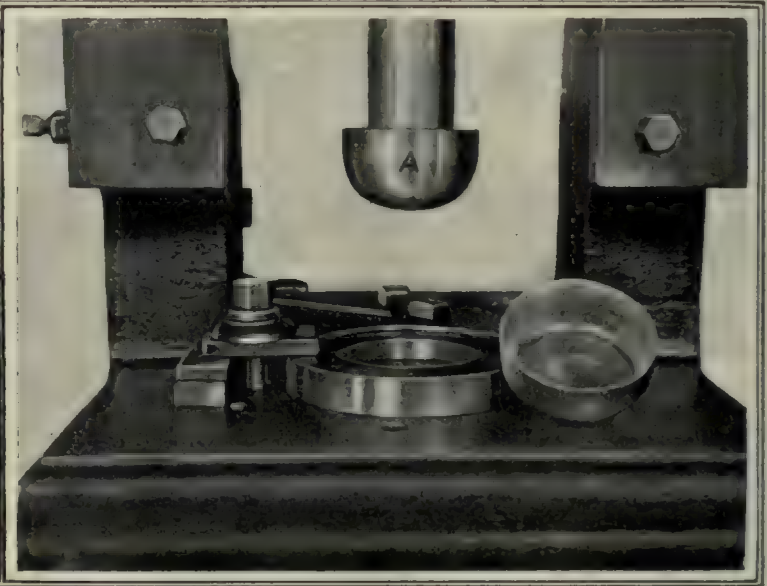


FIG. 2. DRAWING OPERATION ON BODY

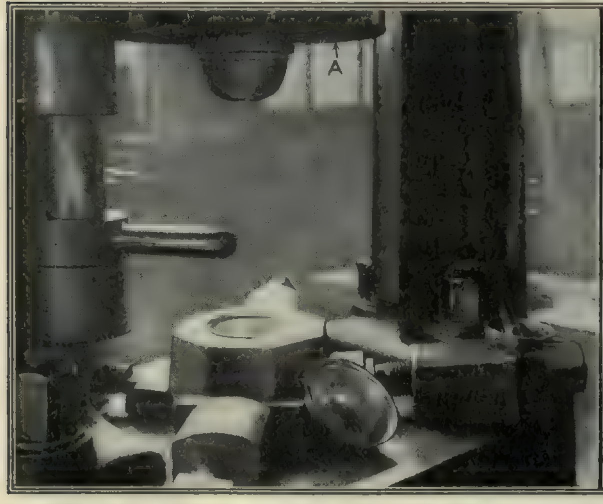


FIG. 3. FINISH-FORMING THE BODY

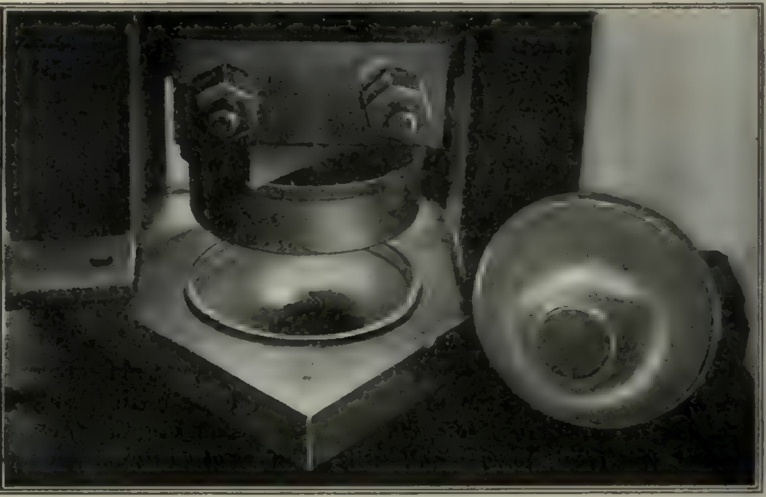


FIG. 4. TRIMMING THE EDGES

solidify, some of it entering the slots in the drop. When it has cooled, the drop is raised and any superfluous metal removed. The force thus produced has the correct shape for stamping out the pieces. One of the parts to be formed is shown in the die; another, which has been finish-formed, is tilted against the die.

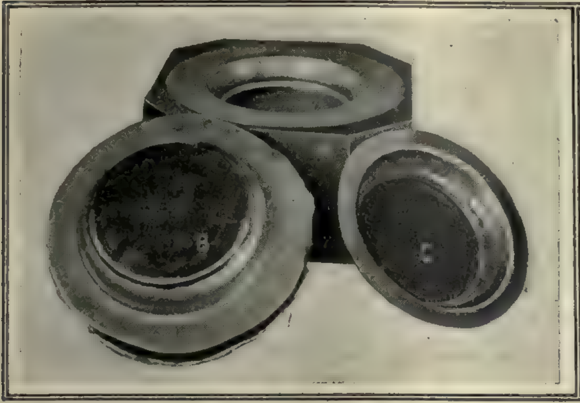


FIG. 5. FORMING THE NECK

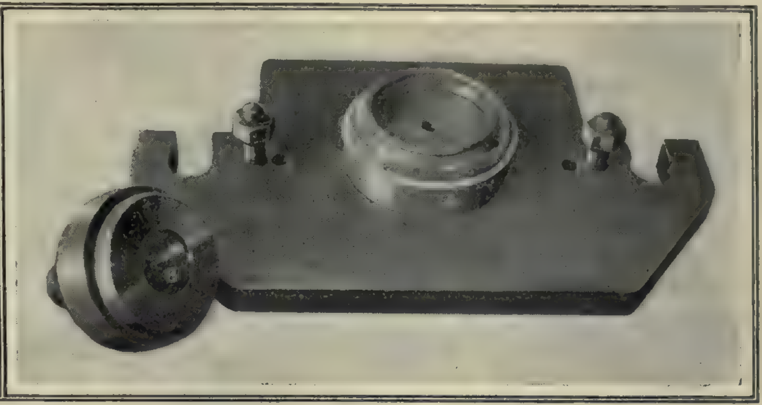


FIG. 6. ROLLING THE EDGE

The next operation is trimming the edges of the body. This work is performed with the press and tools shown in Fig. 4. The piece is placed in the die, as shown, and the punch, which has a circular cutting edge, is fed onto the part, trimming the edge.

MAKING THE NECK

For making the neck, the stock, which is also of the same thickness as the body, is first blanked and then given a drawing operation, the purpose being to assist in the next operation, which is forming. The tools used are shown in Fig. 5. The die *A* is made of tool steel, and the force *B* is obtained in a manner similar to that described for the body force. These tools are fitted to a drop press similar to that shown in Fig. 3. One of the necks after being formed may be seen.

The center of the neck is then cut out as the next operation. The formed piece is put in a die, being located by its outside diameter. A punch of the correct size is fed down and removes the center of the neck. The edge of the piece is rolled with the tools illustrated in Fig. 6. The neck is placed in the die *A*, which is fastened on the bed of a punch press. The punch *B*, as it is fed down, turns over, or rolls, the upper edge of the neck, following the contour of the punch.

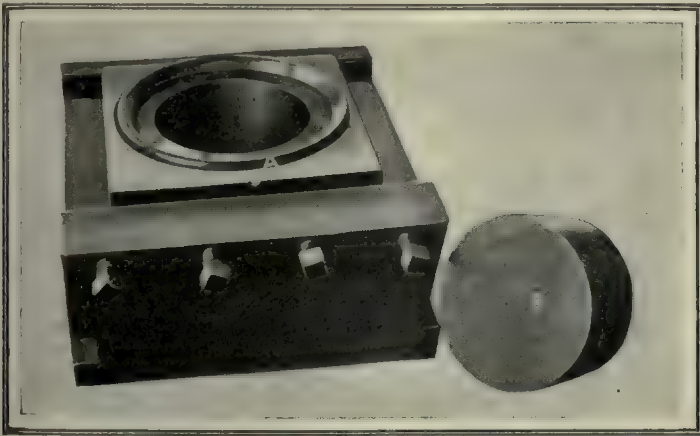


FIG. 7. TRIMMING THE OUTSIDE

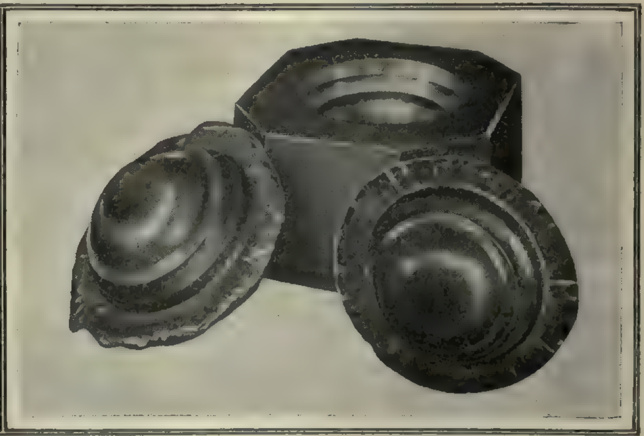


FIG. 8. FORMING THE COVER

The piece shown on the die has had this operation performed and gives a good idea of the work that is done. The outside edge of the neck is then trimmed to size with the tools illustrated in Fig. 7. The piece is placed in the die *A* and is located by its outside diameter. The punch *B* is brought down to trim the edge, leaving it the correct diameter for attaching to the body punching.

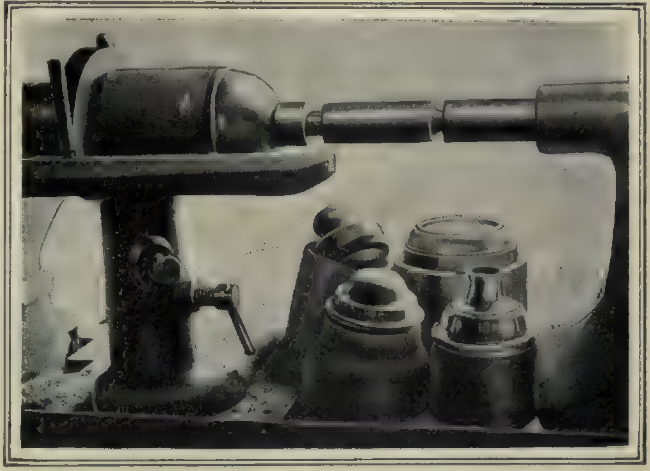


FIG. 9. TURNING THE PARTS

For the cover, the stock is first blanked, then drawn, after which the forming operation is completed with the tools shown in Fig. 8. The die and force are made in a manner similar to that previously described. One of the formed covers may be seen near the die. The cover is then trimmed on the edge to the correct diameter, and the edge is rolled in the same manner as described for the neck. The various parts of the sugar bowl are turned, or skimmed up, so that their outside surfaces will be smooth. For this purpose the pieces are held on wooden chucks, and the machining is done in a speed lathe.

One of the bodies *A*, Fig. 9, is shown held in the chuck, ready to be turned. Other chucks and parts are on the bed of the lathe. The base, body, neck, spoon holder and handles are then fastened together with solder, and the ornament is attached to the cover in a similar manner. The body is afterward engraved with a design or left plain, as desired.

The final operation is silver-plating and polishing, after which the sugar bowl is ready for the purchaser.

Proportioning a Boring Bar for Maximum Stiffness

By G. M. Strombeck

In the boring of 8-in. British shells under the severe conditions imposed by forced production, it was necessary to provide the stiffest possible boring bar. No computations for strength were made, as the bar was laid out as large as the space allowed. The first bars were made of steel castings, but it was found that to give the best service they would have to be made of hammered steel.

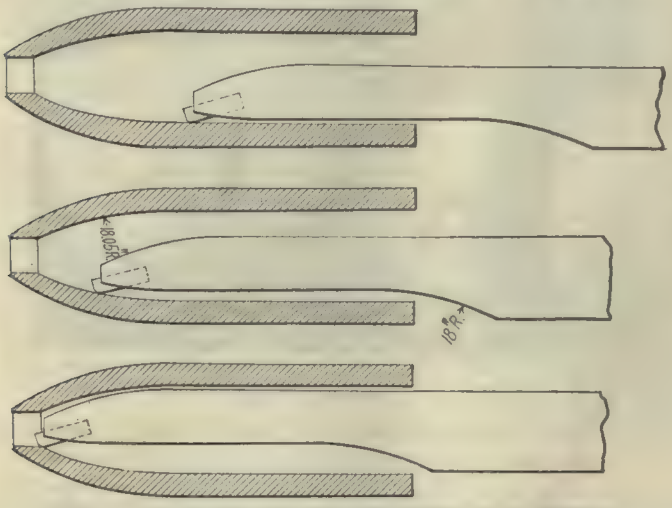


FIG. 1. VARIOUS POSITIONS OF BAR IN SHELL

The difficulty was to get a bar that would bore clear to the end of the nose and yet be rigid enough without obstructing the washing out of the chips.

Fig. 1 shows the bar in the three positions in the shell and indicates the points to be observed in the solution of the problem. In the upper figure the bar is seen in place for turning the cylindrical portion; in the second the nose is partly machined. It will be observed that as the tool approaches the center line of the shell the cross-section of the bar at the end of the shell increases and that the outline of the forward side has the same radius as the inside of the nose of the shell. The first bar was laid out with this part of the bar a straight line, but it was evident that this meant either excessive clearance at some points or interference at others. The best conditions were obtained by curving it as here shown.

In the making of the bar time was saved by first milling away the larger portion of the stock. Next it was suspended on the centers *AA*, Fig. 2, and the forward side turned, after which it was transferred to the centers *BB*. To bring the part *C* down to a 2$\frac{3}{8}$-in. radius required handwork to a templet.

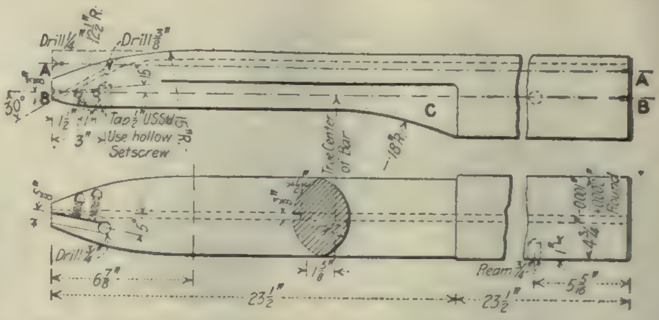


FIG. 2. SHOWING HOW THE BAR WAS MACHINED

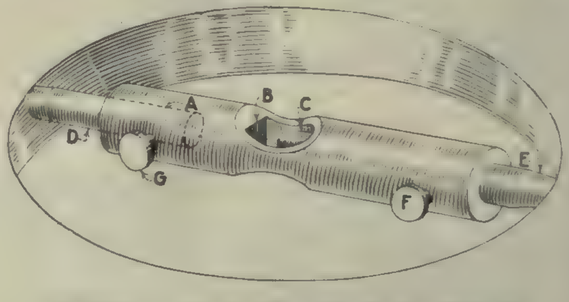
The angles of the tool slot are those found best after a lot of experimenting. The cooling compound was carried in a copper tube laid in the milled groove at the rear. This delivered it through the $\frac{1}{4}$-in. hole to the very tip of the tool.

The Use of Feeler Gages

By William Wilson

The accompanying illustration suggests another of the many uses to which the ordinary feeler gage may be put by the machinist who is not possessed of an internal micrometer.

The tube *A*, which can be of brass or any suitable material, is divided in the center by *B*, which is about $\frac{1}{8}$ in. thick; the ends are drilled to take the steel rods *D* and *E*. The center of the tube has an opening *C*, to allow for the insertion of any desired feeler gage.



INTERNAL GAGE FOR USE WITH FEELER

Suppose it is desired to bore a hole several thousandths of an inch larger than a diameter already turned. The gage is first adjusted to the finished diameter by means of the rod *D*, which is clamped in position by *G*. The feeler gage of required thickness to give the difference in diameter is then slipped between the inner face of the rod *E* and the portion *B*, and *E* is then clamped in position by *F*. The gage is then ready for use.

I saw this gage in the hands of an old mechanic who might now be considered out of date, but it certainly has all the accuracy, though perhaps lacking the convenience, of our more modern instruments.

Spot Welding at the Chalmers Plant

Special Correspondence

SYNOPSIS—*In this article are shown some of the applications of the spot welder. A clutch disk to which reinforcing pads are added to increase the thickness of the wearing parts, also two fenders that have been built up with the spot welder, providing neat and strong parts, are illustrated. Attaching a hinge to a sheet-metal part with the spot welder is an interesting example of the possibilities of the process.*

THE field for electric welding is rapidly broadening, and one important use for it is in manufacturing parts. With this process, production is increased and the finished part presents a neat appearance. The Chalmers Motor Co., Detroit, Mich., has a number of spot welders in operation, and some of the work done is here illustrated. The machines are Detroit and National electric spot welders.

In Fig. 1 are shown the fixture and one of the clutch disks. The operation performed on the disk is to spot weld reinforcing pads on the lugs. The clutch disk is 0.0101 in., No. 32 gage, and the reinforcements are ⅛ in. thick. In welding, the disk is placed on the fixture *A*. It is located by the three pins, which fit in the holes of the piece. The reinforcements are placed in a similar manner on the pins, and eight spot welds are made in each, or 24 for a clutch. The time required to perform the welding operation is in the vicinity of 1½ minutes.

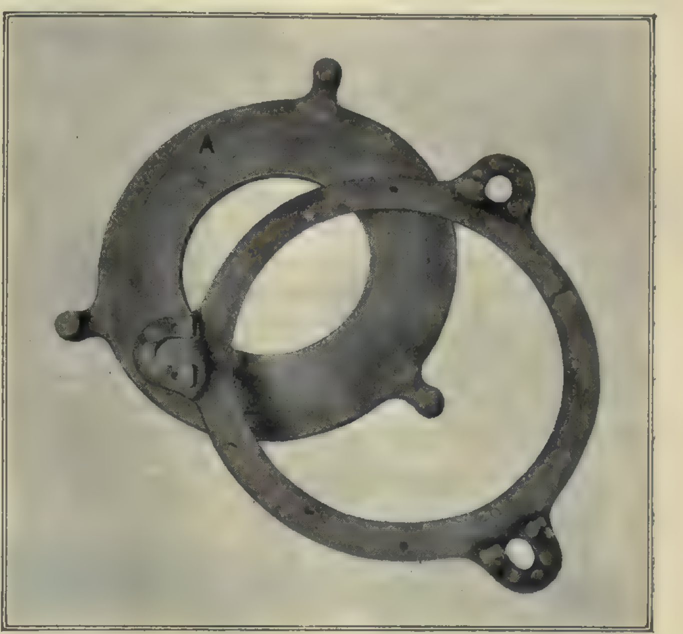


FIG. 1. WELDED PADS ON CLUTCH DISKS

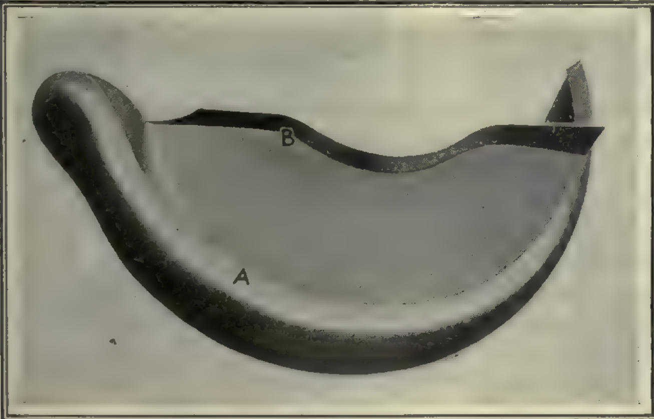


FIG. 2. WELDED REAR FENDER

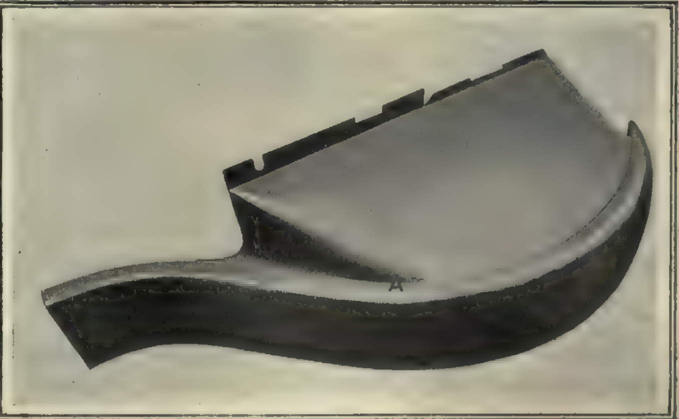


FIG. 3. WELDED FRONT FENDER

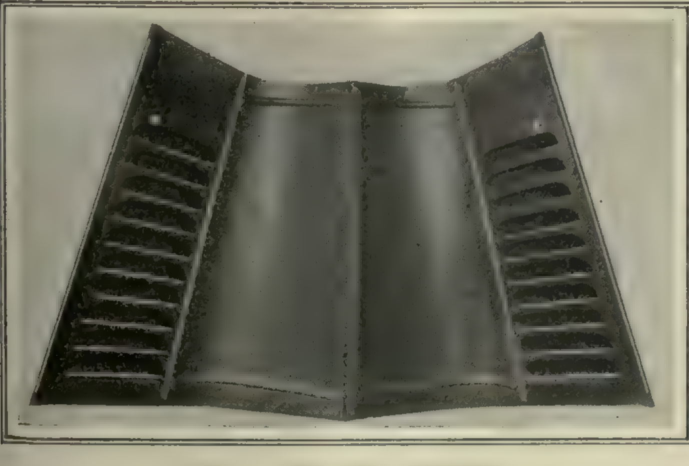


FIG. 4. WELDED BONNET

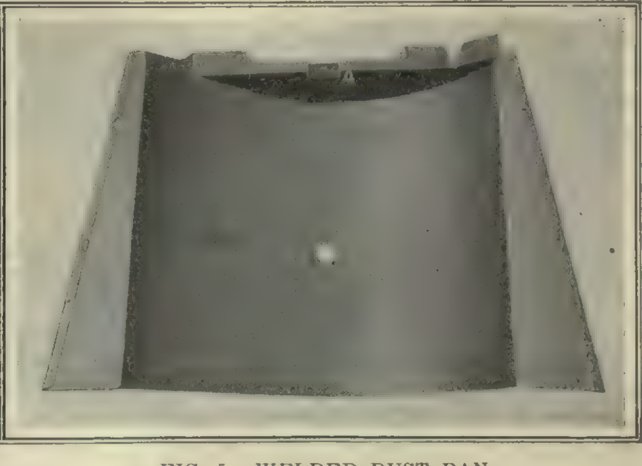


FIG. 5. WELDED DUST PAN

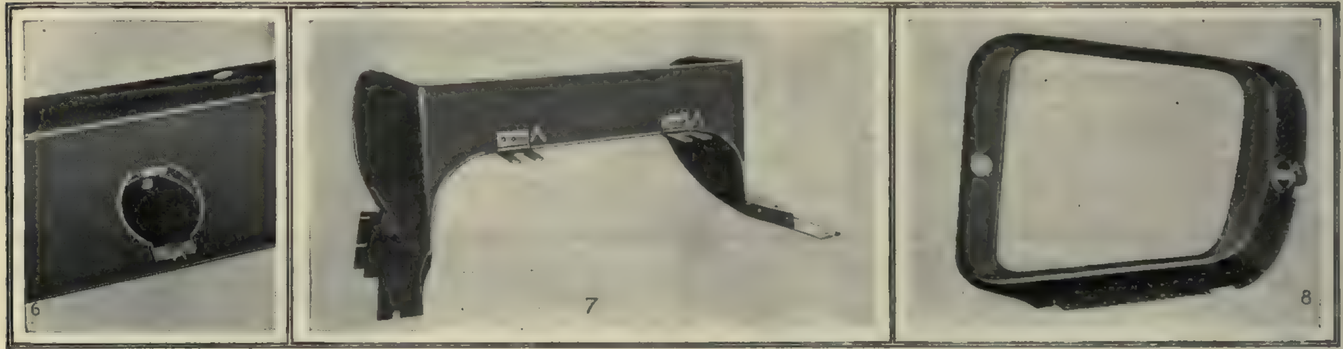
In making the fenders the spot welder is now being used extensively. In Fig. 2 is illustrated a rear fender that has been fashioned by this method. The metal for the fender is 0.031-in. (No. 22 gage) steel. In building up the sections to form the fender shown, 125 spot welds are used. The time required for the welding operation is 5 min. It will be observed that the skirt is welded to the fender at *A* and also the support at *B*.

THE FRONT FENDERS

One of the front fenders, shown in Fig. 3, is also built up with the spot welder. The steel used for this fender is also 0.031 in. (No. 22 gage) thick. The skirt is welded to the fender along the seam *A*, and 110 spot welds are made. The approximate time required for the welding operation is the same as that required for the rear fender.

In making the bonnet, Fig. 4, the spot welder is employed to attach four reinforcing strips to the inside, two at each end. The metal for the bonnet is 0.031 in. (No. 22 gage) thick. To attach the strips, 44 spot welds are required, and the average time is 2 minutes.

The dust pan, Fig. 5, is made in two sections from 0.025-in. (No. 24 gage) steel. The end *A* is then attached to the main body of the dust pan with 60 spot welds. The time required to weld one of these parts is 2 minutes.



FIGS. 6 TO 8. VARIOUS WELDED PARTS USED ON THE CHALMERS CAR

Fig. 6—Welded front dust shield. Fig. 7—Welded hood sill. Fig. 8—Welded radiator shell

An interesting operation is performed on the front dust shield—namely, welding the hinge for a sight-hole cover. The hinge, Fig. 6, at *A*, is united with three welds. The shield and cover are made from 0.025-in. (No. 24 gage) steel. This method of attaching the hinge provides a neat appearance, and the finished piece is proving strong and serviceable.

In Fig. 7 is shown a hood base, or sill, to which two angles *A* are welded. The sill is cut and then bent to shape with the edges rolled. The two angles are attached in the correct position, using two spot welds for each angle.

WELDING RADIATOR SHELL

The radiator shell, Fig. 8, is made from No. 32 gage steel. It is cut and bent to shape, and the various holes are punched. The water-inlet pipe *A* is then welded to the shell, using 10 spots for the operation. The average time required to attach this inlet pipe is ½ min. Other parts are also being spot welded at this factory, but the examples shown will illustrate the possibilities of the spot welder as a manufacturing medium.

Dimensions of Standard Metric Machine Screws

In response to requests for information regarding the sizes of metric machine screws, the following translation from *Zeitschrift für Instrumentendkunde* has been prepared. The formulas are based on the diameter of the screw D in millimeters, and the table is figured out from these proportions to the nearest appropriate value. The illustrations show the different types of heads referred to and also give the dimensions. No threads are given.

$d =$ Diameter of screw shank;

$D = \frac{1}{3}(5d + 1) =$ Head diameter of cylindrical and hemispherical heads;

$D_v = 2d =$ Head diameter for countersunk heads, rounding off to the nearest whole or half millimeter when d exceeds 3;

$h_s = 0.6D =$ Height of head for all forms of slot-head screws;

$h_l = 0.8D =$ Height of head for all forms of capstan screws.

In countersunk screws the head is made with a countersunk taper of 90 deg.; the top of the head is given a spherical contour of radius $2d$, or else the side of the head is made cylindrical at the upper edge to the height of $0.4d$.

$b = 0.1d + 0.2 =$ Width of slot;

$t = 0.5d + 0.3 =$ Depth of slot;

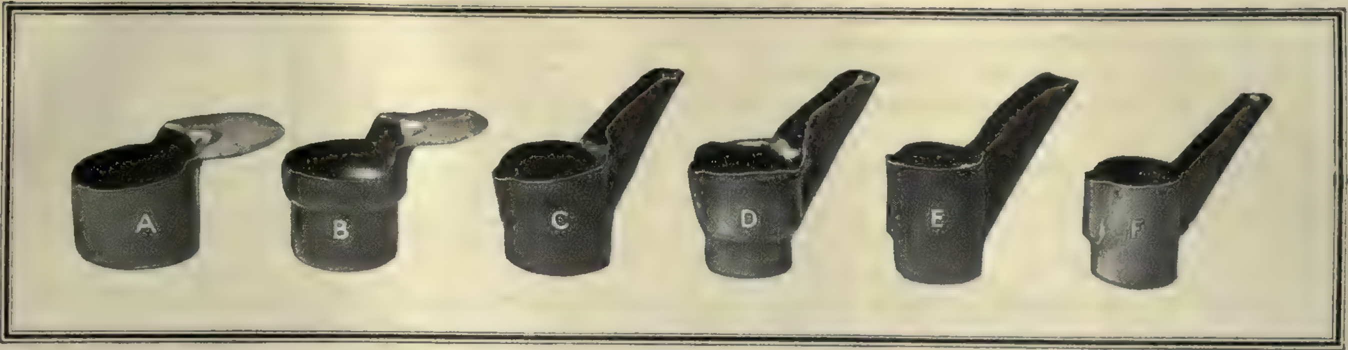
$l = 0.35d + 0.45 =$ Diameter of capstan hole;

$L = 3d + 1 =$ Length of threaded portion of shank.

Length of neck (unthreaded portion of shank) is an integral multiple of $0.5d$.

FORMS AND DIMENSIONS OF METRIC MACHINE SCREWS

d Mm.	D Mm.	D_v Mm.	h_s Mm.	h_l Mm.	b Mm.	t Mm.	l Mm.	L Mm.
10.0	17.0	20.0	10.2	13.6	1.2	5.3	4.0	31
9.0	15.5	18.0	9.2	12.3	1.1	4.8	3.6	28
8.0	13.5	16.0	8.2	11.0	1.0	4.3	3.2	25
7.0	12.0	14.0	7.2	9.6	0.9	3.8	2.9	22
6.0	10.5	12.0	6.2	8.3	0.8	3.3	2.5	19
5.5	9.5	11.0	5.7	7.6	[illegible].8	3.0	2.4	17
5.0	8.5	10.0	5.2	7.0	0.7	2.8	2.2	16
4.5	8.0	9.0	4.7	6.3	0.7	2.5	2.0	14
4.0	7.0	8.0	4.2	5.6	0.6	2.3	1.8	13
3.5	6.0	7.0	3.7	5.0	0.6	2.0	1.7	11
3.0	5.3	6.0	3.2	4.3	0.5	1.8	1.5	10
2.6	4.7	5.2	2.8	3.8	0.5	1.6	1.4	9
2.3	4.2	4.6	2.5	3.4	0.4	1.4	1.3	8
2.0	3.7	4.[illegible]	2.2	3.0	0.4	1.3	1.1	7
1.7	3.2	3.4	1.9	2.6	0.4	1.1	1.0	6
1.4	2.7	2.8	1.6	2.2	0.3	1.0	0.9	5
1.2	2.3	2.4	1.4	1.9	0.3	0.9	0.9	5
1.0	2.0	2.0	1.2	1.6	0.3	0.8	0.8	4

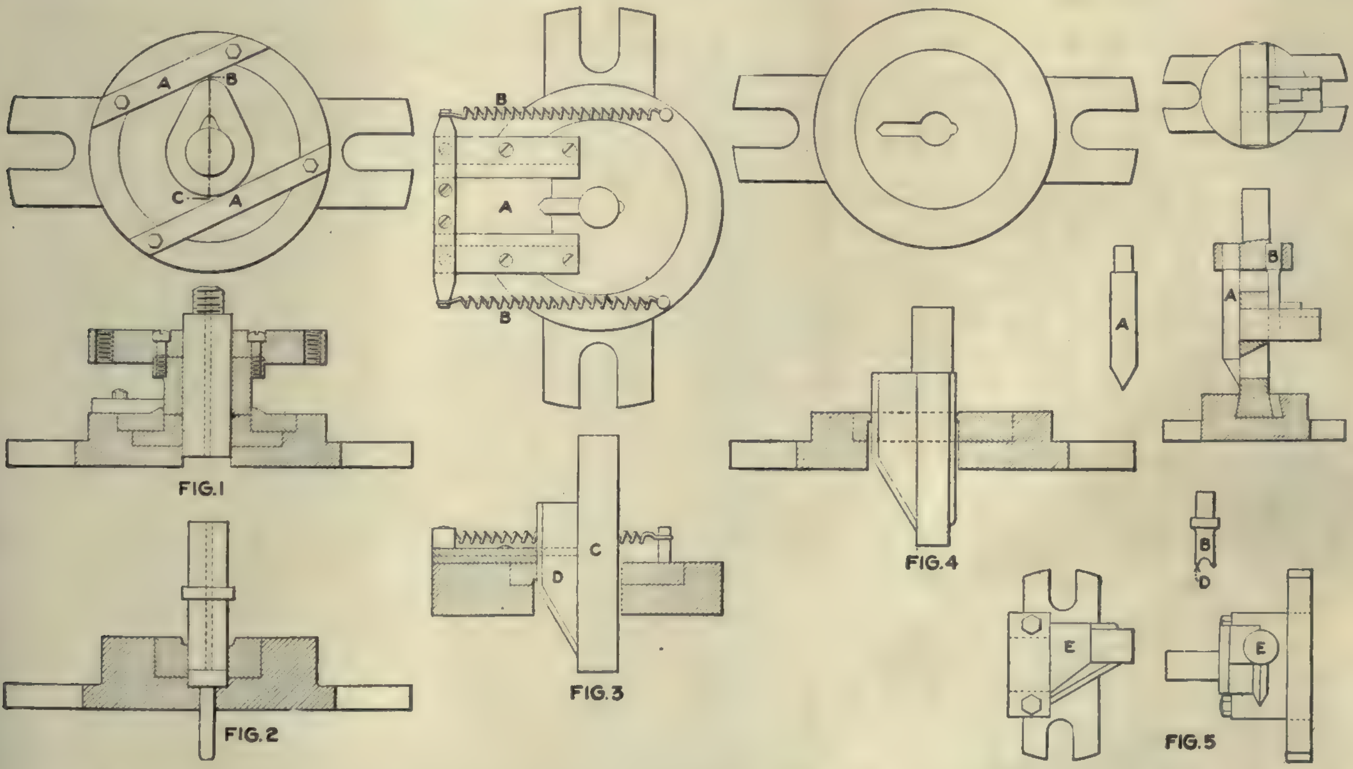


Press Tools for an Oil-Can Spout

By C. W. Lucas

THE drawn shell seen in the headpiece is made in nine operations and two anneals, five draws, one stamping and three trimming operations. The metal is brass, 0.020 in. thick, the blank being 4.5 x 3.250 in. By placing the set edges *A*, Fig. 1, at 70 deg. to the center line *BC*, a strip 4.25 in. wide was used as stock.

The first operation is done on a small cam-drawing press. Coming from this, the diameter of the shell is 1.75 in., and the depth 1½ in. The production on this operation is 15,000 per day. It has been found that there is an advantage in making the drawing die of a separate piece of steel from the cutting die, as shown in Fig. 1. When the drawing die becomes worn and has to be reground, this can be done by taking it apart and grinding the drawing and the cutting die separately. In round blanking and drawing dies, it is the custom to make both dies of one piece of steel, on account of the irregular shape of the cutting die; but it is a slow job to regrind the drawing die when both are made of one piece.



FIGS. 1 TO 5. DETAILS OF DRAWING AND TRIMMING DIES USED FOR MANUFACTURING AN OIL-CAN SPOUT

The second drawing operation is performed with a single-acting reducing die, Fig. 2, the shell being reduced to 1.5 in. in diameter for 1 in. of its depth. In this operation a ratchet dial feed is used and the production is 25,000 per day.

The third drawing operation is made possible by the reducing die, Fig. 3, having the slide *A* placed on the side where the spout is to be formed. This slide has tension on it, caused by the springs *B*. As the punch *C* descends, the lip *D* presses against the metal left to form the spout, which pushes the slide *A*. This slide, acting on the same principle as a jumper ring in a combination drawing die, keeps the metal smooth in the spout while it is being formed to shape. In this operation a ratchet dial feed is used and the production is 25,000 per day.

The fourth operation is done on a single-acting reducing die like Fig. 2. The shell is reduced to 1.25 in. in diameter for 0.5 in. length. In this operation a ratchet dial feed is used, the production being 25,000 pieces per day.

The fifth operation is performed with the reducing die, Fig. 4. The cylinder of the shell is reduced to a 1.25-in. diameter. In this operation a ratchet dial is also used, the production reaching 25,000 per day.

The sixth operation is done in a stamping die set in a crank press. For this operation, which sharpens the corners on the shell, a ratchet dial is used, giving a production of 25,000 a day.

The trimming of the shell is done in three operations: First, the nose and air vent are trimmed in one operation by the punches *A* and *B*, Fig. 5, the punch *A* being made with a V-shaped cutting edge to fit the spout, and the punch *B* with a cutting edge *D* to fit the air vent of the shell. In the second trimming operation one side is trimmed in the die *E*, Fig. 5. The third trimming operation is done in a die similarly made, but the reverse of the die *E*.

Foot presses are used in all the trimming operations, and a production of 10,000 a day is secured in each of these operations. Soap water is the lubricant on all the drawing operations.

French Gages for Sheets, Wire and Screw Threads

By J. A. Lucas

Shown herewith are tables of diameters of wire and thicknesses of sheet stock, which are still extensively used in France and also in other parts of the world influenced by French immigration.

The French Metric Decimal Gage—By this system the number expresses directly the diameter of the wire or thickness of the sheet in tenths of a millimeter; thus, No. 8 wire would be 0.8 mm., and No. 9, 0.9 mm. The numbers run from 1 to 100 and the sizes from 0.1 to 10 mm. This system is used on repair work and is still the standard in a few of the more conservative of the old established manufactories.

TABLE I. STANDARD FRENCH WIRE GAGE OF 1857

No.	Diam., Mm.	No.	Diam., Mm.	No.	Diam., Mm.	No.	Diam., Mm.
0	0.50	4	0.34	8	0.25	12	0.18
1	0.46	5	0.30	9	0.23	13	0.17
2	0.42	6	0.28	10	0.22	14	0.16
3	0.37	7	0.27	11	0.20	15	0.15

TABLE II. WESTPHALIAN WIRE GAGE OF 1868

No.	Diam., Mm.	No.	Diam., Mm.	No.	Diam., Mm.	No.	Diam., Mm.
1	0.6	9	1.3	17	2.8	24	5.0
2	0.7	10	1.4	18	3.1	25	7.0
3	0.8	11	1.6	19	3.4	26	7.6
4	0.9	13	1.8	20	3.8	27	8.8
5	1.0	14	2.0	21	4.2	28	9.4
7	1.1	15	2.2	22	4.6	29	10.0
8	1.2	16	2.5	23	5.5		

TABLE III. STANDARD "BODY" GAGE NO. 1*

No.	Diam., Mm.	No.	Diam., Mm.	No.	Diam., Mm.	No.	Diam., Mm.
P	0.50	22	0.32	34	0.14	46	0.07
12	0.47	24	0.29	36	0.12	48	0.06
14	0.44	26	0.26	38	0.11	50	0.05
16	0.40	28	0.22	40	0.10		
18	0.37	30	0.20	42	0.09		
20	0.34	32	0.17	44	0.08		

* This gage is widely used and is almost universally the standard for the manufacture of machines and appliances for the textile industry.

TABLE IV. NO. 2 "BODY" GAGE*

No.	Diam., Mm.	No.	Diam., Mm.	No.	Diam., Mm.	No.	Diam., Mm.
10	0.50	19	0.36	28	0.22	38	0.11
11	0.48	20	0.34	29	0.21	40	0.10
12	0.47	21	0.33	30	0.20	42	0.09
13	0.45	22	0.32	31	0.19	44	0.08
14	0.44	23	0.30	32	0.17	46	0.07
15	0.42	24	0.29	33	0.16	48	0.06
16	0.40	25	0.28	34	0.14	50	0.05
17	0.39	26	0.26	35	0.13		
18	0.37	27	0.24	36	0.12		

* The use of this gage is more limited than that of the No. 1 Body Gage. It is the same as the standard body gage, but with intermediate numbers. This is in French called Gauge Carcasse.

TABLE V. STANDARD FRENCH GAGE FOR FINE METAL SHEETS AND WIRE*

No.	Diam., Mm.	No.	Diam., Mm.	No.	Diam., Mm.	No.	Diam. Mm.
P15	0.15	P3	0.37	9	1.4	21	4.9
P14	0.16	P2	0.42	10	1.5	22	5.4
P13	0.17	P1	0.46	11	1.6	23	5.9
P12	0.18	P0	0.50	12	1.8	24	6.4
P11	0.20	1	0.6	13	2.0	25	7.0
P10	0.22	2	0.7	14	2.2	26	7.6
P 9	0.23	3	0.8	15	2.4	27	8.2
P 8	0.25	4	0.9	16	2.7	28	8.8
P 7	0.27	5	1.0	17	3.0	29	9.4
P 6	0.28	6	1.1	18	3.4	30	10.0
P 5	0.30	7	1.2	19	3.9		
P 4	0.34	8	1.3	20	4.4		

* Widely used for manufacturing of every description and adopted also by the Government.

TABLE VI. LIMOGES GAGE*

No.	Diam. or Thick., Mm.	No.	Diam. or Thick., Mm.	No.	Diam. or Thick., Mm.	No.	Diam. or Thick., Mm.
0	0.39	7	1.12	14	2.02	21	5.10
1	0.45	8	1.24	15	2.14	22	5.65
2	0.56	9	1.35	16	2.25	23	6.20
3	0.67	10	1.46	17	2.84	24	6.80
4	0.79	11	1.68	18	3.40		
5	0.90	12	1.80	19	3.95		
6	1.01	13	1.91	20	4.50		

* Named after Limoges, a city in southern France, where enameled ware is manufactured in large quantities. This gage is used for both wire and sheet metal, not only throughout France, but also in Belgium.

The French system was adopted at a convention held in Paris by the "Société d'Encouragement pour l'Industrie Nationale." The thread is 60 deg., formed by the equilateral triangle *ABC*, Fig. 1, flattened at top and bottom as shown by the two parallel lines that are lettered *D* in the illustration of the French system thread.

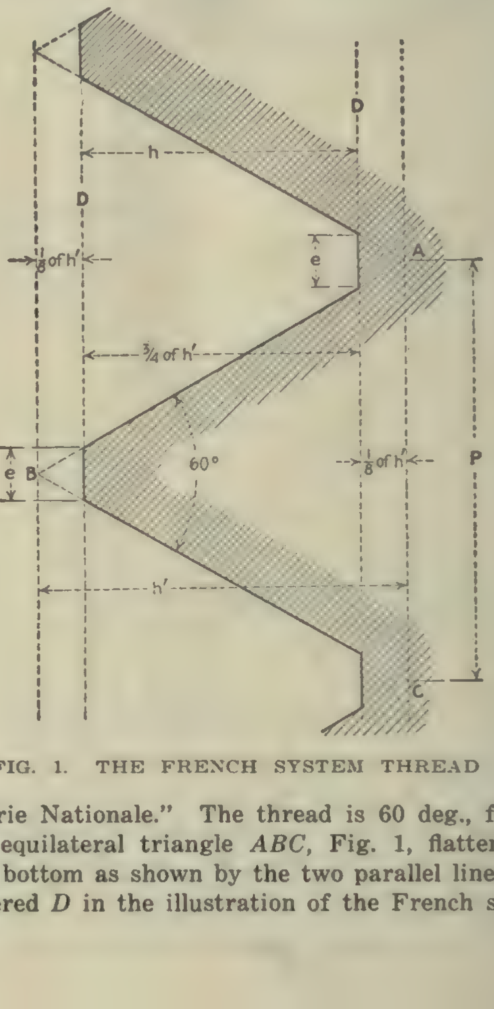


FIG. 1. THE FRENCH SYSTEM THREAD

$$h = \frac{p}{2}\, tg\ 60\ \text{deg.} = 0.866p;$$
$$h = \tfrac{3}{4}h' = 0.64952p;$$
$$e = \tfrac{1}{8}p = 0.125\ p.$$

The height h of the thread is equal to three-fourths the height h' of the triangle ABC. The diameter of the screw is measured from the flat on the top of the thread.

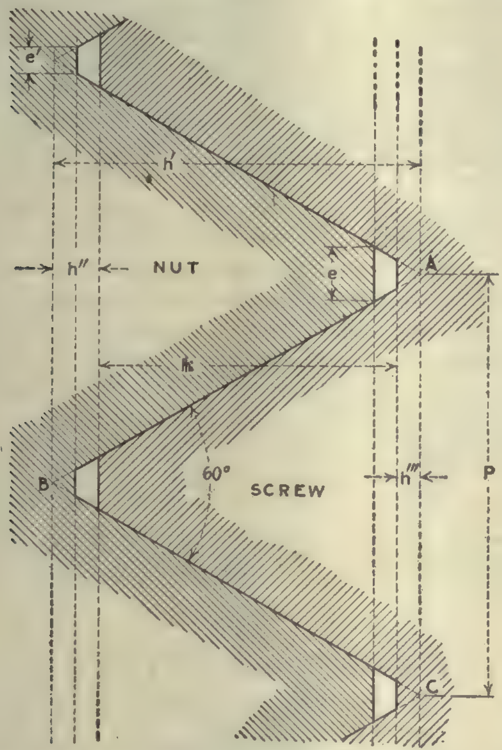


FIG. 2. SECTIONAL VIEW OF INTERNATIONAL SYSTEM SCREW AND NUT

TABLE VII. FRENCH SYSTEM OF THREADS (S. F) *

Diam., Mm.	Pitch, Mm.	Diam., Mm.	Pitch, Mm.	Diam., Mm.	Pitch, Mm.	Diam , Mm.	Pitch, Mm.
5	1.00	18	2.50	32	3.50	48	5.00
6	1.00	20	2.50	34	3.50	52	5.00
8	1.00	22	2.50	36	4.00	56	5.50
10	1.50	24	3.00	38	4.00	60	5.50
12	1.50	26	3.00	40	4.00	64	6.00
14	2.00	28	3.00	42	4.50	68	6.00
16	2.00	30	3.50	44	4.50	72	6.50

*Unlisted intermediate sizes are the same pitch as the next lower size in the table.

TABLE VIII. FRENCH STANDARD (S. F.) NUMBER SIZES OF SCREWS

Number of Screw	Pitch of Screw, Mm.	Diameter of Screw, Mm.	Number of Screw	Pitch of Screw, Mm.	Diameter of Screw, Mm.
0	1.0	6	10	6.0	64
1	1.5	10	11	6.5	72
2	2.0	14	12	7.0	80
3	2.5	18	13	7.5	88
4	3.0	24	14	8.0	96
5	3.5	30	15	8.5	106
6	4.0	36	16	9.0	116
7	4.5	42	17	9.5	126
8	5.0	48	18	10.0	136
9	5.5	56	19	10.5	148

TABLE IX. FRENCH SYSTEM (S. F.) SCREWS MODIFIED FOR USE BY THE NAVY DEPARTMENT ONLY

Diam., Mm.	Pitch, Mm.	Diam., Mm.	Pitch, Mm.	Diam., Mm.	Pitch. Mm.	Diam., Mm.	Pitch, Mm.
6	1.00	20	2.50	34	3.50	52	5.00
8	1.25	22	2.50	36	4.00	56	5.50
10	1.50	24	3.00	38	4.00	60	5.50
12	1.75	26	3.00	40	4.00	64	6.00
14	2.00	28	3.00	42	4.50	68	6.00
16	2.00	30	3.50	44	4.50	72	6.50
18	2.50	32	3.50	48	5.00		

The International Screw-Thread System—In 1898 the mechanical engineers of France, Switzerland and Holland, comprising the International Convention for the Standardization of Threads, met at Zurich, Switzerland, and established the International system of screw threads now used in all the above-mentioned countries and Belgium. The system was based on the French system with the following slight changes:

1. The clearance at the bottom of the thread should not exceed one-sixteenth of the height h' of the triangle ABC, Fig. 2. The shape of the clearance is left to the judgment of the designer or manufacturer. The convention decided that it is often desirable to round the top and bottom of the thread.

2. The diameter of 5 mm. was eliminated. The pitch of the 8-mm. diameter screw was raised from 1 to 1.25 mm. The pitch of the 12-mm. diameter screw was raised from 1.50 to 1.75 mm. Screws of 26, 28, 32, 40, 44 and 50 mm. were eliminated.

TABLE X. INTERNATIONAL SCREW THREAD

Diam., Mm.	Pitch, Mm.	Diam., Mm.	Pitch, Mm.	Diam., Mm.	Pitch, Mm.	Diam., Mm.	Pitch Mm.
6	1.00	14	2.00	30	3.50	52	5.00
7	1.00	16	2.00	33	3.50	56	5.50
8	1.25	18	2.50	36	4.00	60	5.50
9	1.25	20	2.50	39	4.00	64	6.00
10	1.50	22	2.50	42.	4.50	68	6.00
11	1.50	24	3.00	45	4.50	72	6.50
12	1.75	27	3.00	48	5.00		

$$h' = \frac{P}{2}\, fg.\ 60\ \text{deg.} = 0.866\ p \qquad h'' = \tfrac{1}{8}\ h' = 0.1082\ p$$
$$h''' = \tfrac{1}{16}\ h' = 0.0541\ p$$
$$e = \tfrac{1}{8}\ p = 0.125\ p$$
$$h = \tfrac{13}{16}\ h' = 0.7036\ p \qquad e' = \tfrac{1}{16}\ p = 0.0625\ p$$

TABLE XI. INTERNATIONAL SYSTEM

Outside Diam. of Screw, Mm.	Pitch, Mm.	Diameter: Root of Screw, Mm.	Diameter: Small Diam. of Nut, Mm.	Depth: Of Thread, Mm.	Depth: Of Contact, Mm.
6	1.00	4.60	4.70	0.70	0.65
7	1.00	5.60	5.70	0.70	0.65
8	1.25	6.24	6.38	0.88	0.81
9	1.25	7.24	7.38	0.88	0.81
10	1.50	7.88	8.06	1.06	0.97
11	1.50	8.88	9.06	1.06	0.97
12	1.75	9.54	9.82	1.23	1.14
14	2.00	11.18	11.40	1.41	1.30
16	2.00	13.18	13.40	1.41	1.30
18	2.50	14.48	14.76	1.76	1.62
20	2.50	16.48	16.76	1.76	1.62
22	2.50	18.48	18.76	1.76	1.62
24	3.00	19.78	20.10	2.11	1.95
27	3.00	22.78	23.10	2.11	1.95
30	3.50	25.08	25.46	2.46	2.27
33	3.50	28.08	28.46	2.46	2.27
36	4.00	30.36	30.80	2.82	2.60
39	4.00	33.36	33.80	2.82	2.60
42	4.50	35.66	36.16	3.17	2.92
45	4.50	38.66	39.16	3.17	2.92
48	5.00	40.96	41.50	3.52	3.25
52	5.00	44.96	45.50	3.52	3.25
56	5.50	48.26	48.86	3.87	3.57
60	5.50	52.26	52.86	3.87	3.57
64	6.00	55.56	56.20	4.22	3.90
68	6.00	59.56	60.20	4.22	3.90
72	6.50	62.86	63.56	4.58	4.22
76	6.50	66.86	67.56	4.58	4.22
80	7.00	70.14	70.90	4.93	4.55

Present War To Be Fought Out on Engineering Lines

"This is a war of engineers." Just what does this oft-quoted phrase mean? Capt. Gustave P. Capart, of the general staff of General Pétain, who came to this country as a member of the French scientific commission, indicates that the answer to this question involves a new understanding of what military operations are today.

Captain Capart, in an interview with the *Electrical World*, points out that this war is being fought with prime materials. Old warfare was a football game compared with the modern struggle, in which tons of material are hurled back and forth between opposing armies, and carloads of foods, of machinery and supplies and of men are constantly transported to the line of action on both sides.

The modern battle, Captain Capart states, is a problem of roads and a problem of transport. In the maintenance of railways and roads, as well as in the construction of new extensions, a large and highly trained personnel is required for the laying of tracks, for repair shops, drivers and conductors, for the handling of construction material, etc.

Cableways and telpherage systems have given extraordinarily valuable service at the front. In one installation 600 mules were turned to other service by the installation of a telpherage system. The automobile, with its *camions* and its tractors, is another link in the service.

THE ELECTRICAL ENGINEER

The electrical engineer is playing a wonderful part in this war. Great distribution systems for electric light and power have been necessary for the use of armies. The headquarters of the armies, the cantonments, artillery, repair shops, hospitals, air service, etc., all use electric power. Machinery and skilled men are necessary for air compressing, rock drilling, trenching machines, etc.

The Government of the United States has comprehended fully the importance of organization of engineers in these many lines, and the engineer regiments which have already responded to the military needs indicate the ability of this country to furnish the class of men needed for the military industrial work.

In this country we must understand that to prosecute the war successfully we must think not only of materials and of human energy in tremendous totals, but we must think of using materials and literally of using human energy with the highest efficiency. Men must be selected for their places in this great industrial war, not on the basis of their physical characteristics alone, not on their ability to carry a gun, but on the basis of special knowledge to fit them for positions of responsibility and of specialized training which this war of engineers demands.

OTHER ENGINEERS NEEDED

Military operations may be thought of as being conducted today in four zones—first, the firing line; second, the military zones immediately surrounding the firing line; third, the avenues and channels of communication between the military zone and what may be called the world-wide zones of supplies to that military zone, and fourth, the zones of supplies themselves, which include the countries at war and the countries which are supplying food, machinery and materials for the countries at war.

Captain Capart points out that specialized engineering training is necessary in all these war zones. On the firing line—troops in contact with the enemy—engineers are involved in the strictly military operations, mining engineers are planning the executing of trench work, earth work, concrete work and so on. On this same battle line are engineers who maintain what the French so interestingly explain as a *liaison*—the nerves of communication between the various sectors of the armies, the telephone, the telegraph, the semiphore, the wigwag system, wireless, heliograph; in short, the coördination of communication by every means known to science.

In the military zone, which is entirely in the control of the military and potentially and actually threatened by the enemy, engineers are busy building and maintaining roads, constructing, maintaining and operating railroads, building, rebuilding and operating automobiles, constructing narrow-gage railroads, cableways, telpherage systems, etc. In this military zone electrical engineers are at work building and operating lighting and power plants, erecting and maintaining distributing lines, handling the network of telephone and wireless centers of communication. Water-works and water-supply engineers, sanitary engineers, engineering construction gangs erecting shelters and raising camps and cantonments and repair shops for airplanes, automobiles, artillery, small arms—all are necessary, and more are required in the military zone.

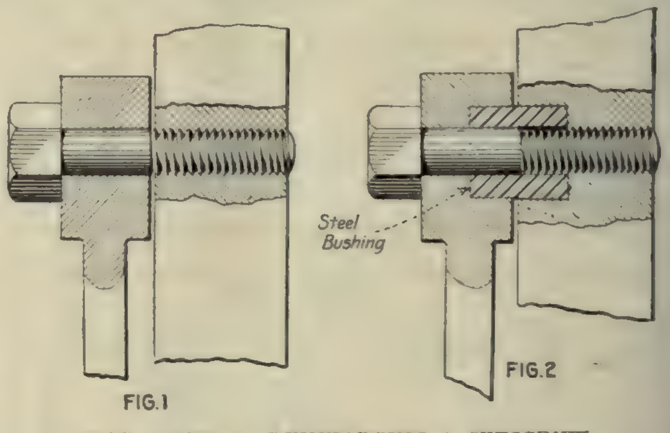
In the same way, Captain Capart has indicated that engineers with their specialized knowledge are needed especially in the great problems that touch upon the transportation of the necessary materials between the military zone and the sources of supply which constitute what we have called the fourth great zone.

In this country we have already started the organization of this work, and the organization of the engineers and scientific men for the military army which is necessary to stay at home and maintain and develop the men, machinery and supplies needed at the front.

Reinforcing a Setscrew

BY L. V. LAUTHER

The setscrew on a stiffening rod of a loom frame (Fig. 1) frequently broke off, probably on account of side stress, as when assembled on the place to be used looms generally are not machined but filed. To overcome this trouble I bored a ¾-in. hole concentric with the old ½-in. hole, half in the frame, half in the rod end, as in Fig. 2, fitted a steel bushing in the frame to drive lightly, slid the rod with the recess over it and put the setscrew in. No more breaks have occurred since.



FIGS. 1 AND 2. REINFORCING A SETSCREW

Right-Angle Triangle

On page 123 the solution for Fig. 12 reads Tan = Cos = Hyp. This is an error, the correct reading being Adj. ÷ Cos = Hyp.

IDEAS FROM PRACTICAL MEN

Machining Bevel Pinions

By A. O. Karcher

Superintendent Challenge Machinery Co., Grand Haven, Mich.

About three years ago, while with a large auto concern in Detroit, I worked out a tool set-up for machining the main-bevel drive pinion shown herewith.

The first operation—to finish the taper hole and face back—is done in a screw machine or automatic turret lathe. Operation 2—keyseating—is done on any keyseater.

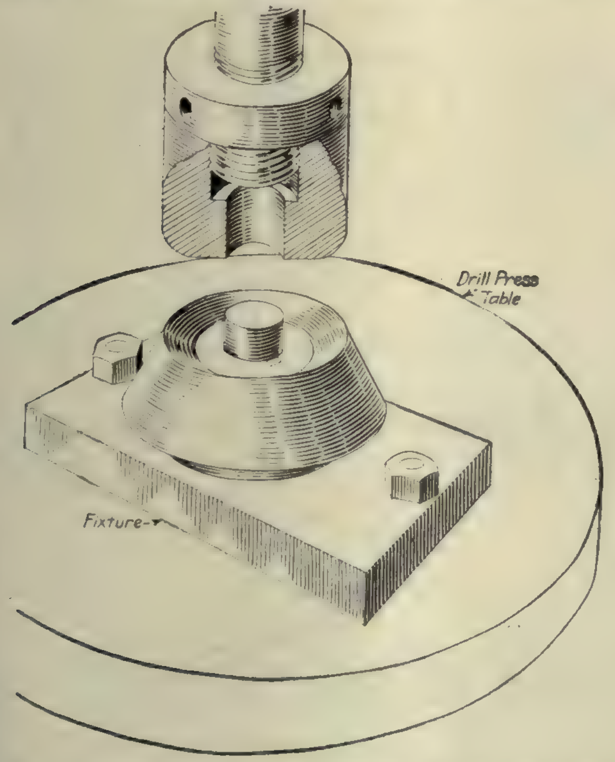


FIG. 1. TOOLS FOR FINISHING FRONT FACE AND ANGLE OF BEVEL GEARS

Operation 3—finishing the front face and angle—is done in a high-speed drill press by the tool shown in Fig. 1. The holding fixture consists of a hardened taper pin in a steel block with a fixed key. The gear is placed on the taper pin and swept to form and size by the high-speed facing-form tool in the drill-press spindle, which pilots on the taper pin in the table fixture. The end of the shank extends into the pilot hole in the form-facing tool, and the form tool is threaded and secured by a locknut on the spindle. This allows an adjustment for grinding and also for maintaining the correct thickness of the blank, as the tool is forced by hand until the reduced end of the shank bears on the pilot of the taper pin, always assuring a close dimension.

Operation 4 is done in a lathe with the equipment sketched in Fig. 2. The headstock spindle is fitted with a ball center; the tailstock spindle has an arm with the center set at an angle and off center to correspond with the face angle of the pinion. The lathe is equipped with two toolposts, one for finishing the back angle and one for turning the outside diameter.

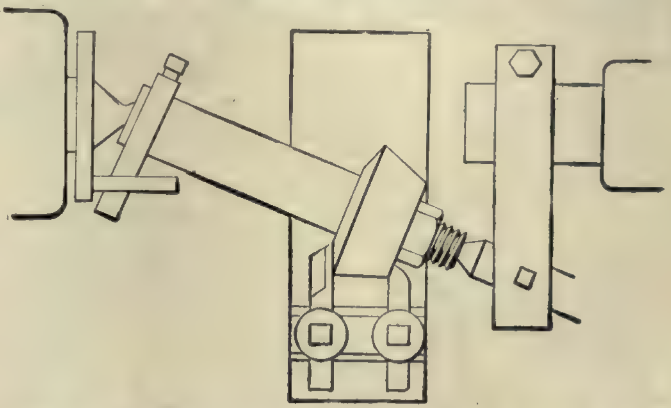


FIG. 2. TURNING OUTSIDE DIAMETER AND FACING BACK ANGLE OF BEVEL PINION

After the size is secured, the cross-slide is locked and not moved. When the cut is finished, the ball-center arbor with the gear is removed, the carriage run back, another arbor with gear put in, the back angle finished first by forcing the carriage back to a stop, then the outside cut started. While this is going across, the operator removes the finished gear from the second arbor and places an unfinished blank on it; consequently, a continuous operation is secured.

On operation 3—facing the end of the blank—it is possible to get 200 per hour from nickel alloy blanks about 3¼ in. in diameter.

On operation 4—facing the back angle and turning outside diameter—the rate was 25 per hour on the same-sized blank.

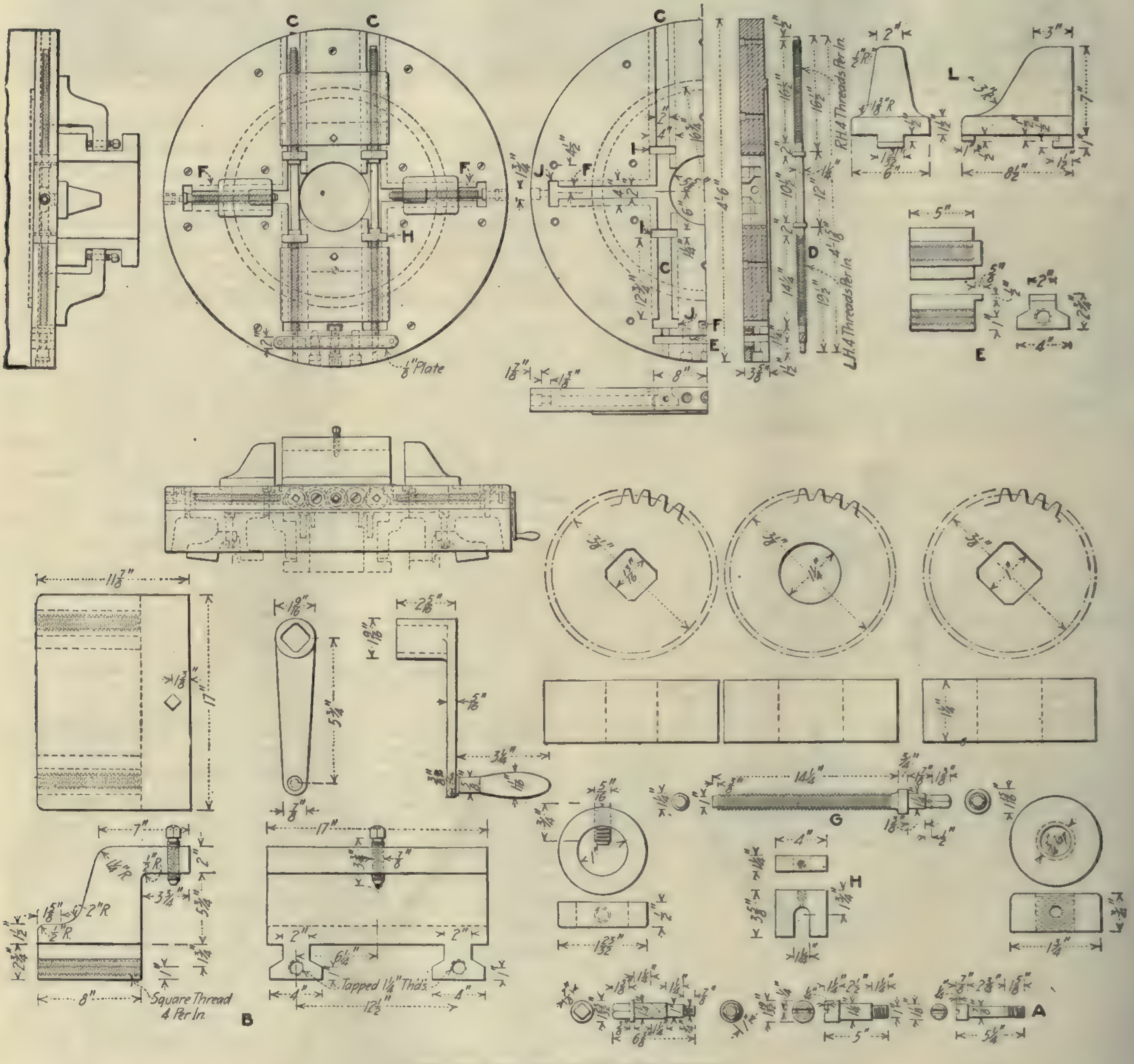
Driving-Box Chuck

By Joseph K. Long

Herewith is shown a specially designed chuck for holding driving boxes upon a boring mill. For getting them in proper center quickly, it has no equal. The base or bottom is a solid cast-iron piece finished to 3⅝-in.

thickness. In addition, it has a ring protruding ½ in. This is 1½ in. in width, and the outside diameter of the ring is 35 in.; inside diameter, 32 in. This ring fits in a corresponding ring cut in the table of the boring mill.

The diameter of the boring-mill table is 4 ft. 6 in., and the baseplate of the chuck is the same, thus presenting a neat and uniform appearance. Fifteen screws like *A* secure the chuck to the boring-mill table. The platen has in the center a hole 11¼ in. in diameter, for cuttings to drop into and also to clear the boring bar and tool. The detail *B* shows the main sliding jaws of the chuck; there are two such and they are moved apart or together up against the sides of the driving box, which are next to the driving-box shoes. These two jaws are planed on the bottom on two places 4 in. wide and 1 in. high. They are then beveled at a 30-deg. angle to a width of 2 in., and these parts are neatly fitted to corresponding slots planed in the bedplate, as shown at *C*. One jaw is tapped right- and one left-hand, to suit the screw.



DETAILS OF DRIVING-BOX CHUCK

One end of the screw *D* has 2¼ in. more of thread than the other, and care must be taken to see that just this much of both screws is screwed into the block having the right-hand thread. Then the block having the left-hand thread is brought up against threads on the other end of the screws; both are turned, and the jaws move in toward the center. Before this much is put in place, two blocks, given as detail *E*, must be put in place, one each in the slots marked *F*, which are planed in the table at right angles to the jaw slots. One of these is tapped right- and one left-hand, and at *G* is shown the type of screw that moves them independently of each other.

The detail *H* represents a block that is dropped into place in the slots *I*. There are four of the blocks, but of course the two jaws that fit on two long screws must all be put in before these four blocks are put in place. Four slots, like *J*, are for clearance in planing out the slots; and where the short screws are concerned, the end forms a rest or backing for the shoulder near the end of the screws.

The two jaw screws are connected by gears, as illustrated, so that when the center gear is turned, both screws turn in unison in the same direction. When all the gears are in place, a ⅛-in. wrought-iron plate with beveled edges is fastened over them as a gear guard to keep dirt out and also to keep a man's fingers out, a feature that is also important.

At *L* are shown details of one of the two blocks that are removable in order to put the driving box on or off. The base, or plate, is of cast iron; the jaws are steel castings, while the gears are of soft or axle steel, as are also the pins.

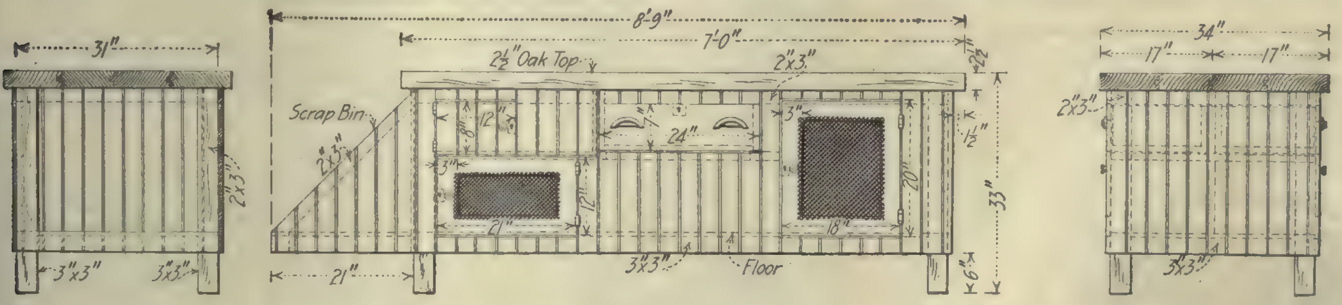
The two small blocks shown are for adjusting the box along the large jaw faces, in order to bore more or less out of the part that rests on the axle. One of these blocks has to be taken out when the box is put on the machine or removed therefrom. That operation is easy, owing to the block being shorter than the part that moves it in against the box. When all jaws and setscrews are tightened up, it would take about as much of a lift to loosen the box as would be necessary to pull the machine off its foundation.

Benches for a Small Shop

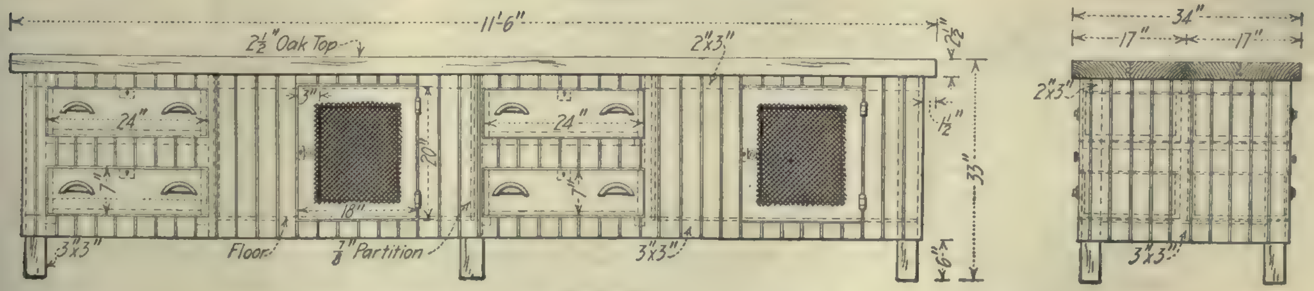
By Joseph K. Long

No doubt *American Machinist* readers will be interested in the type of work bench such as here illustrated. It is for use in engine houses and small shops where room is at a premium.

Bench *A* is a two-man bench, each man having a slide which gives him a drawer for his better class of tools and a large cupboard and a small one for heavy tools such as sledges, cutters, cutting bars and also for waste, oil cans and overclothes. Bench *B* is for four men, two on a side. In this, each man has two drawers, one large cupboard and no scrap bin. The doors and drawers in these benches are fitted with lock and key.



BENCH A



BENCH B

TWO-MEN AND FOUR-MEN SHOP BENCHES THAT ECONOMIZE ROOM

The doors are of "Knoburn" expanded metal lath or wire mesh and are good from a sanitary standpoint.

The top is made of 2½-in. oak boards placed lengthwise, and these are set on 2 x 3-in. crossplanks. Made in this way the top is heavy enough for any vise, presents a neat, sanitary appearance and is an improvement over benches built directly from the floor up, as there is 6 in. of space between this type of bench and the floor.

Machine-Forging Wide Winged Parts

By J. V. Hunter

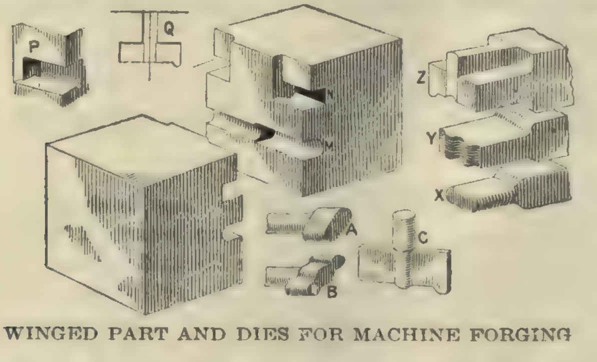
Although the forging machine has been of great service to the forge shop for many years, it seems as if only in the past few years has the full use been made of this type of forging that its efficient service and development really warrant. In the past many parts have been made under the drop hammer, with an attendant great waste of stock and incorrect placing of the fiber of the steel, while now by a previous operation in the forging machine it has been found possible greatly to facilitate the production.

Some of the more recent forging-machine products have been replacing parts which formerly it was thought necessary to make of either steel or malleable castings; and it stands to reason that forged parts should have equal or greater strength, even though the sections of metal are lighter.

The production of forgings with thin spreading wings or sections of like nature has always been a typical drop-hammer job, because the repeated blows of the hammer lend themselves remarkably well to spreading the metal. The illustrated case is one where the forging machine has been found applicable to work of the kind described.

This piece has a round stem of ¾-in. diameter, with a length of 5 in. From opposite sides of this are two wings extending about 1½ in. with a width of 1 in., but with a thickness of ⅛ in. only. Consequently, great care must be taken with the operations of forging in order to insure the metal spreading sufficiently to entirely fill the dies. The shape of the forging is shown at *C* in the sketch.

The first operation in this process is that of gathering sufficient stock—a simple upsetting job, made in the pass *M* of the dies shown, in which *X* acts as the header. This produces the forging as indicated at *A*. This section is an oblong, to provide the necessary metal on the two sides of the stem.



WINGED PART AND DIES FOR MACHINE FORGING

Should the final spreading operation be attempted from this point in any forging of this nature, its success would be most doubtful; for when the pressure of the header came on the upset metal, so much of it would probably be crowded out along the stem passage that there would be insufficient left for filling out the wings. Consequently, the next pass should be a necking operation, by which the metal close to the stem is crowded down very thin, thus preventing any tendency toward crowding out of the dies. The result of this operation is shown at *B*, which has been produced by holding the upset end of the rod vertically in the dies *N*, in which the header *Y* plunges.

All the pieces being worked are carried on the same heat through the two operations mentioned and are then laid aside for reheating before the final operation. For this last operation the die impressions, as shown at *P* and *Q*, are located on an opposite upper corner of the die blocks. Consequently they cannot be made use of at the same time that the other operations are in service. Therefore, to use the last pass, the blocks are reversed in the machine, and the header *Z* is lined up for use with them. The forgings are inserted in the last pass in a manner similar to the second pass. The header, in operating, presses out the two side lugs of the upset metal to form the shape of the finished wings. The header has a small upper extension, which comes up about the stem of the forging to hold the work in perfect alignment while being operated upon.

This has seemed the most practical way of performing these forging operations and to my mind is open to only one real criticism, which concerns the position of the fin that is formed from what surplus stock can crowd out around the edges of the header. This fin stands vertically to the flat surface of the wings and all around their edges; consequently, an ordinary trimming die will not remove it unless the wings have been made of sufficient size in the rough forging so that a small amount can be trimmed off from all edges. This would be apt to distort the forging considerably. It has been our practice to hammer these fins out into a nearly flat plane with a hand hammer, so that in this shape they can be caught and trimmed off by an outline punch and die without the tendency toward crowding through that would otherwise be the case.

Trimming, of course, bends the wings somewhat. To straighten them, a ⅛-in. shim is removed from behind one of the die blocks, so that they do not close by the exact thickness of the wings. The forgings are then inserted in the stem end of the first pass *M*, so that the wings extend outward on the flat faces of the die blocks; then a pressure blow of the dies will flatten the work out in perfect shape.

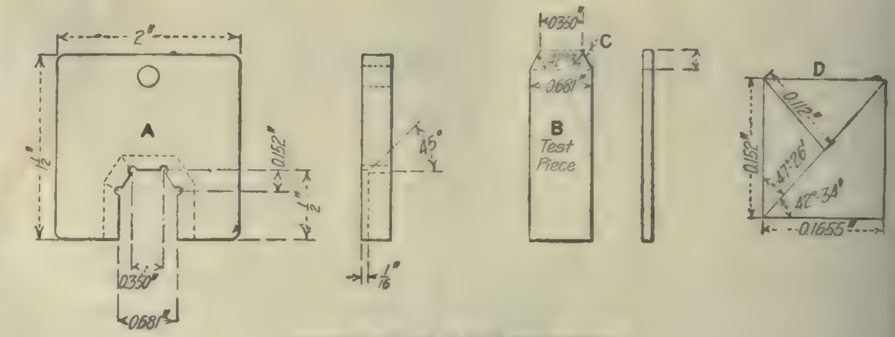
As I mentioned at the beginning, this is a typical drop-hammer forging job, but in our particular case we have found it less costly to produce the work in the manner described rather than to do it under the hammer. However, other jobs that might appear similar should be subjected to careful analysis of all the conditions involved, before determining which method to follow.

Problem in Gage Testing

By Charles Sehl

The gage shown at *A* was given to me to be "checked up." The angle on the test piece *B* was not given. Taking 0.152 in. as the side opposite and 0.1655 in. as the side adjacent, I found by the "American Machinist Handbook" that the angle was 42 deg. 34 min.

I made the test piece *B* of ⅛ B. & S. flat ground stock. To do this accurately, it was necessary to know the distance from the apex *C* to the base. Referring to *D*, the hypotenuse is 0.152 in., and 0.73719 is the sine of 47 deg. 26 min. Multiplying 0.152 in. by 0.73719. we have 0.1120 in. as the distance from the point *C* to the face of the angle.



PROBLEM IN GAGE TESTING

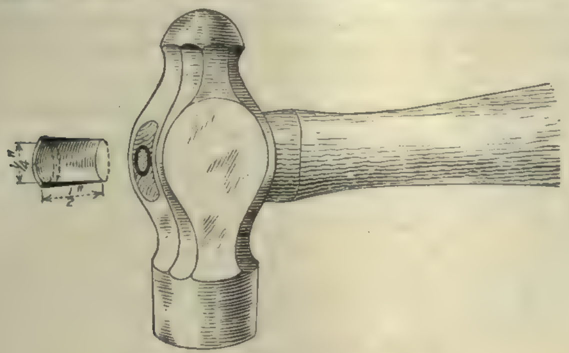
With the aid of a sine bar the test piece was then set up at an angle of 47 deg. 26 min. on an angle plate. The height gage was set to the corner *C*, and 0.112 in. was ground off each corner. All this should perhaps have been done in the drafting room; but few draftsmen make provision for the production of such work or give a thought as to how the toolmaker is to do it.

It is probable that there are other ways of doing this job, and an exchange of ideas on the subject would be of benefit to all of us.

How to Keep a Hammer on the Handle

By Daniel F. MacNeil

My hammer kept coming off the handle, so my shop partner put me next to this kink: I removed the iron wedge that was in my hammer and drove in a hardwood one, then one like the illustration on top of the wood. It is made of ¼-in. pipe ground to a taper and cut off about ½ in. long.



THE HAMMER AND WEDGE

Arc-Forming Attachment for Lathe and Shaper

By John Christman

The illustrations show an attachment for forming radii on different kinds of work. It can be used on a shaper, a lathe and other machines, and if properly operated, good results are obtained. The mechanism may be best understood by studying Fig. 1, which shows the principle. The base *A* carries a slide *B*, and at right angles to this is a slide *C* on the member *D*. Also mounted on the base *A* is a worm gear *E* operated by the worm and handle. The worm gear is provided with a slot *G* passing through its center. In this slot is a stud *H*, which can be adjusted and secured at any distance from the center of the worm gear, within the confines of the slot. The upper end of this stud bears in a hole in an arm *I* secured to the top slide *C*.

For the sake of demonstrating, two pencil holders *J* are secured to the slide *C*. If the worm wheel *E* is caused to rotate, the pencils *K* will duplicate the path described by the center of the stud *H* around the axis of the wormwheel *G*. In this way, boring or turning can be done as indicated diagrammatically in Fig. 2.

In Fig. 3 is shown the outfit as designed for use, and also some forms of tools with inserted cutters. Referring to Fig. 3, the sliding block *A* is mounted on a screw *B*. The amount that *A* is off center determines the diameter of the circle to be turned or bored. The block *A* is set by means of a socket wrench *C* inserted through the hole *D* when the end of the screw *B* is in line with the inner end of the hole *D*. Two pins *E* and *F* are provided for ascertaining how much the block *A* has been set off center. The pin *E* is secured to the tool slide, while *F* is stationary in the bottom slide.

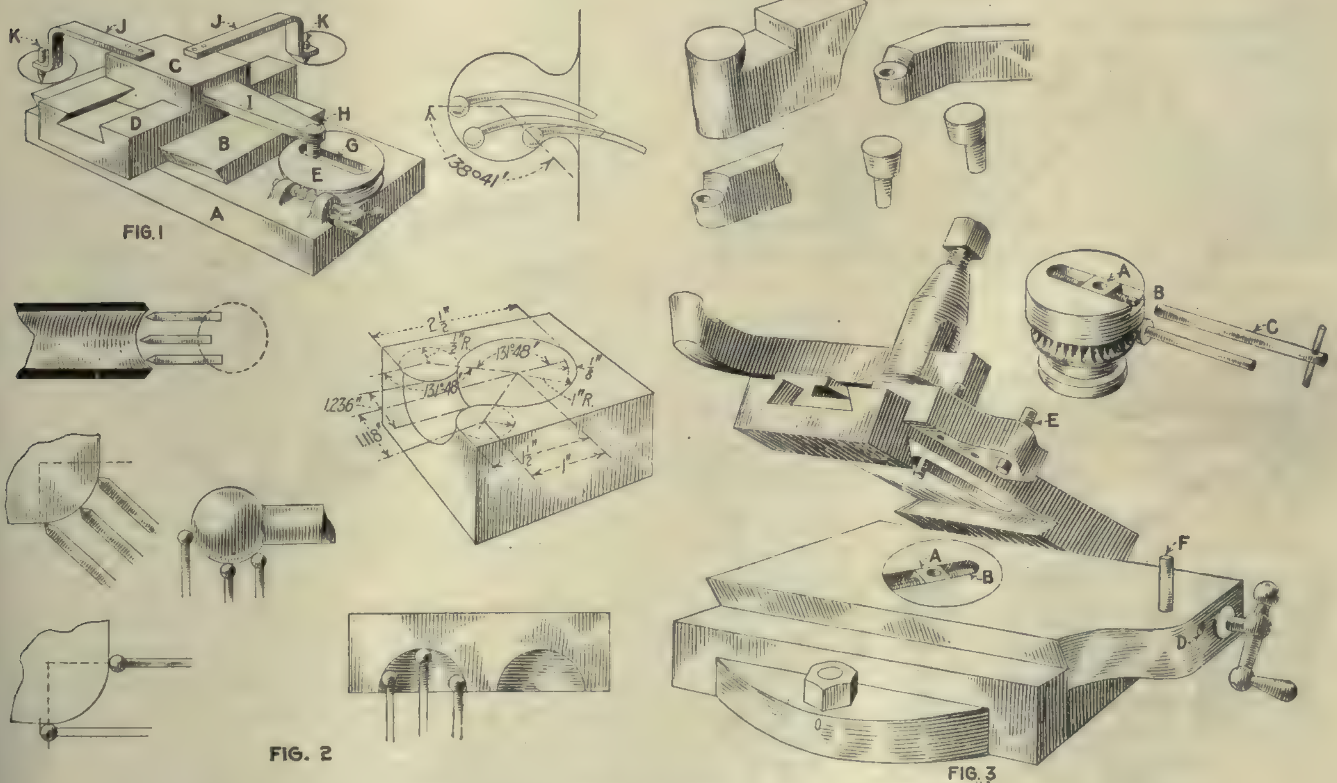


FIG. 1

FIG. 2

FIG. 3

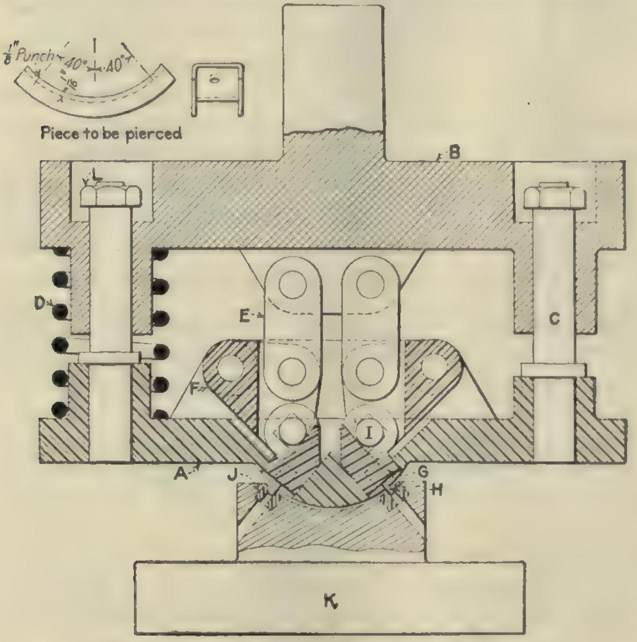
FIGS. 1 TO 3. THE ARC-FORMING ATTACHMENT

Piercing Oblique Holes

By Fred Rauter

The die illustrated was designed to pierce the holes in the piece shown. The cast-steel blank holder *A* is suspended from the cast-iron secondary ram *B* by the guide pins *C*, pressed in *A* and a sliding fit in *B*. The springs *D* transmit the power for the blank holder *A*. The links *E* were hinged on the secondary ram and on the punch forcers *F*, which in turn were pivoted in the lugs cast integral with the blank holder. The punch holders *G*, which are a sliding fit in *A*, carry the piercing punches *H*. The hardened-steel pin *I* is pressed into the punch holder *G* and serves as a rest for the forcer *F*, which is cut out square to allow for the angular movement of the punch holder. The button dies *J* are pressed into the cast-iron base *K*.

The illustration shows the die at the bottom of the stroke. The die operates as follows: The blank holder *A* and the secondary ram descend as a unit, until the blank holder strikes the piece to be pierced, holding it securely on the die. The secondary ram continues its downward course, setting the toggle arrangement in motion, thus piercing the holes. On the return stroke the ram *B* ascends, withdrawing the piercing punches and stripping the work. The blank holder *A* remains stationary until the nuts *L* bottom in the counterbored holes. The ram and the holder then ascend as a unit.

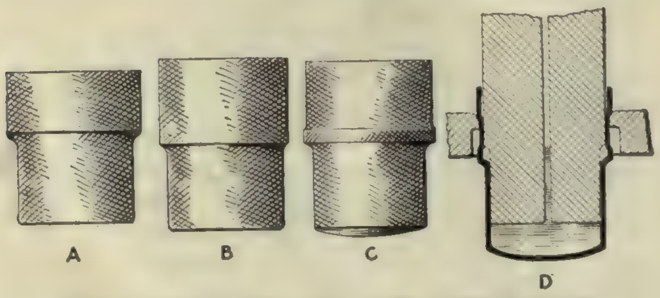


DIE FOR PIERCING OBLIQUE HOLES

A Freak Shell—Its Cause and Cure

By Charles Doescher

Sometimes, when putting through a lot of brass shells similar to the one shown (see *B*), a number of so-called freak shells are discovered. For some unknown reason these are out of shape. While there are a number of causes that result in "freak shells," there are times, when one can offer no good reason.



THE FREAK SHELL AND HOW IT WAS MADE

A good illustration of a freak shell is shown at *C*, while the shell as it should be is shown at *B*. The cause is this: When redrawing the large diameter, an unusual amount of the soap-water lubricant (used for redrawing the shells, was occasionally left in the bottom of a shell. As the solution could not escape quickly enough through the air hole in the ram when the punch descended, the result was that the solution ahead of the punch acted on the shell in a manner similar to that illustrated at *D*. This in turn caused the bulged part of the shell to be forced through the redrawing die *without being operated on by the punch*, which in turn caused this part of the shell to bulge after it was forced through the working part or edge of the die.

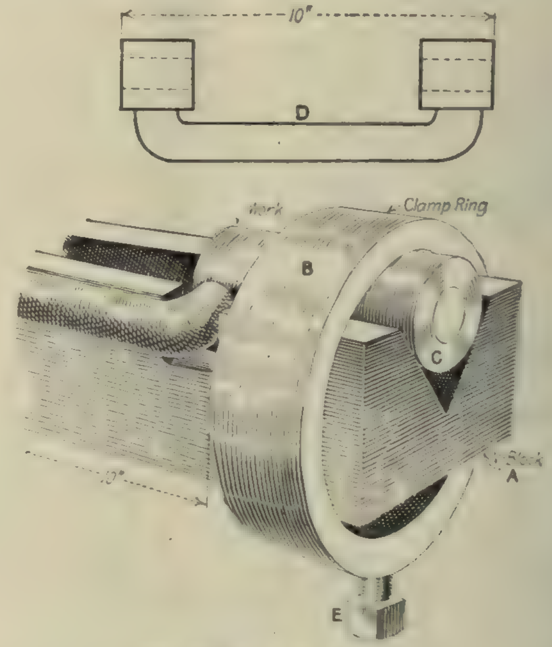
The cure for this trouble was a larger air hole in the punch, to allow the water to escape, besides keeping the lubricant out of the shells as much as possible, preparatory to feeding them to the die.

Simple Drilling Jig for Use on a Yoke Casting

By J. E. Baker

The jig shown for drilling two $\frac{9}{16}$-in. holes through the yoke casting *D* is inexpensive and can be quickly made. One end of the jig is shown in the perspective; the opposite end is rigged up the same.

The V-block *A* and the two clamping rings *B* were made of scrap. The two pilot bushings *C* have the same diameter as the bearings to be drilled. The bushings *C* are clamped in the V-block *A* by means of the clamping ring *B* and the setscrews *E*.



THE WORK AND THE JIG

The yoke castings *D* can be drilled to two sizes on this jig, with overall dimensions of 10 and $8\frac{15}{16}$ in. respectively. The jig can be changed instantly for either job.

The drilling is done in a drilling machine, the jig resting on a center in the table. The top hole is drilled and the jig reversed for the other hole.

Editorials

Industrial Efficiency and Fatigue in British Munition Factories

EXECUTIVES in American shops are facing not only the possibility, but rather the more or less immediate necessity of employing women to do the work of men. The first draft of American young men will not make a serious difference in industrial conditions, although with the present demands upon labor and machinery there are none too many of us even with all hands on the job. But as successive drafts make themselves felt, there will be need of a gradual replacement which, in fact, is already noticeable in particular industries. When this time comes, it must find the American shop executive prepared to handle these changed conditions intelligently and effectively.

The cheapest way to learn is from the experience of others, and perhaps the most satisfactory way for American shop managers to acquaint themselves with what they will need to know is through a study of what England's shop executives have learned through experience.

A great deal of this information can be obtained from our own Department of Labor in the form of pamphlets. A number of these contain very useful comments on what has been found in connection with making up the labor shortage in England and particularly with the experience in compensating for this shortage by the employment of women. One of the most helpful of these pamphlets is entitled "Industrial Efficiency and Fatigue in British Munitions Factories." This is a pamphlet of some 203 pages; and while it is impossible to reproduce a summary of the contents of it in the present restricted space, a few of the findings will be of interest.

The data collected are in all cases prejudicial to night work, which although necessary in the present crisis is thought undesirable. When night work must be performed, it is found that where the shifts are managed on a discontinuous system the rate of output at night is substantially equal to that during the day, but that under a continuous night-work system the rate of production is definitely less.

The unprofitableness of extensive overtime is emphasized by cases where time gained by extraordinary hours has been lost in normal hours even under favorable factory conditions. In one engineering department of a firm engaged in heavy work where the normal day-shift work is 53 hours and the night-shift work is 60 hours, 53 per cent. of the time gained by overtime work in a given four weeks was lost by subsequent loss of time and sickness.

Piecework systems of payment were found in general to offer more incentive to workers than other rewarding systems such as premium and bonus plans, which being of more complicated nature, do not as readily interpret themselves to the mind of the average employee.

Observations on the time lost by women brought out the fact that girls of from 14 to 16 lose the least time, while those of 19 and 20 are the worst. The former class average 7½ per cent. in lost time, the latter $9\frac{3}{10}$ per cent., while the average for women of over 21 is 8 per cent.

One interesting point developed is that the incentive value of wages depends entirely upon what they buy and that the mere possession of money does not form an inducement unless there is an opportunity of spending it. Anyone familiar with the industrial classes knows how the rise of output occurs before a public holiday with the ample opportunity of spending money. It is therefore observed that an opportunity of spending wages must be considered as a part of the inducement to earn them.

In the section of this pamphlet devoted to an inquiry into the health of women engaged in munition factories, considerable statistics are presented covering general conditions of employment, hours of work, lost time, posture, nutrition, transit, personal hygiene, ailments and special points of interest. As a concluding paragraph the following is worthy of note:

"If proper care and forethought are exercised, there seems no reason why women and girls suitably selected and supervised and working under appropriate conditions should not take their place in munition factories and carry out many operations hitherto considered fit only for men, without permanent detriment to their future health."

War Industries of Japan

THIS war has already upset the world's political equilibrium. It has materially altered individual human relationships and radically changed the relationships of nations. But further than this, it is reaching slowly and surely into the world's present industrial fabric, pulling a thread here and adding one there until the pattern in many places becomes a new one.

The nation that is perhaps undergoing the greatest economic changes—outside of the active participants in the struggle—is Japan. One reason for this may be that with her small land area and concentration of population the industrial effect of the cataclysm is more marked than where the same effect is spread over a greater area. It may also be that Japan, having grown accustomed to rapid changes, as is evidenced by her wonderful advance in civilization during the last half century, is in an ideal mental condition to adapt herself to the advantages of these rapidly changing conditions. However this may be, Japan, the mysterious nation of the East, is rapidly becoming a land of machine shops and foundries. She is apparently disproving Kipling's well-known lines:

"For East is East and West is West,
And never the twain shall meet."

One of the clearest exemplifications of the changing conditions in Japan is that contained in the article by H. I. Sibley on page 397 in this issue. What picture of industrial change could be more graphic than that drawn by the author in the following words:

"Geographically, the location is no more suited to foundry work than to truck gardening, but it so happens that the native loam of this section is admirably adapted to the molding of castings, and before the war two or three foundries grew there much as mushrooms would spring up in the propitious soil. These foundries were doing a desultory business; came the European War with its subsequent embargo on metal exports by the warring nations, and the foundry trade in Japan began to boom. The old foundries of Kawaguchimachi flourished, expanded; their owners began to make money slowly, and then they became rich. Other inhabitants of the village regarded them wistfully—why could they not become rich, too?

"Surely there were greater profits in sowing molten metal in their garden patches and reaping a harvest of door hinges, flatirons and ferrules than laboriously raising green onions and rice. A crop of garden truck only twice a year, but a crop of hardware every day! And so the little foundries sprang up, literally, in the backyards of Kawaguchimachi."

Many of us over here have come to look upon the molders' art as one of the most complicated and difficult of the many contributory arts essential but subsidiary to the building of machinery. Many of us who operate shops, but not foundries, and who therefore must negotiate with foundry operators to secure our castings have had impressed upon us time and time again the difficulty of obtaining satisfactory molders, and hence the necessity of charging high prices for castings; but here in Japan under the spur of possibilities we find, again quoting the author's words:

"The entire family helps him with enthusiasm. He has taken in all his relatives who are not busy elsewhere, for most concerns in Japan are family affairs, and even his children take a hand. Young Hashimoto is learning to make molds, while little daughter Oukisan clatters back and forth gleefully with her arms full of patterns and tools. And even mama-san, with all her household duties, finds time to make the cores."

Seriously speaking, however, when Japan turns its gardens into foundries, in the face of such obstacles as pig iron at $114 per ton and untrained labor and improvised buildings and haphazard equipment, it is showing a commercial and industrial adaptability that is one of the most remarkable byproducts of the world's war.

Uninterrupted Output

IT IS the practically unanimous opinion of thinking men in the United States that interruptions of output in industries vital to the conduct of war are, during war time, so injurious to public welfare as to be treasonable. This idea, of course, develops from the fact that an army without fighting tools and supplies has no chance of winning battles. It brings up the point that those who make the tools of war and the accessory supplies required are also *in* the war and a part of it, just as much as the soldier who goes "over the top."

Public opinion is generally quick to condemn a soldier who is cowardly or who intentionally aids the enemy. If a part of our military organization, say a single company or a single regiment, should band together and conspire to benefit themselves at the expense of our cause—should malinger to the detriment of our country's war progress—they would find very few back home who would take it upon themselves to make excuses for their conduct or to intercede against their punishment.

Perhaps it is because the man in uniform catches the eye and the imagination where the man in civilian clothes goes unnoticed that what is rightly considered a breach of patriotism and obvious disloyalty in the soldier should be casually dismissed when attempted by the equally important civilian who must keep the soldier supplied with material. Unfortunately, it is a fact that this is so, as we all have had occasion to observe during the past few months. It is a sad commentary on equality in this country, if while certain of our young men accept the hazards of war abroad and the fatiguing efforts accompanying them and the small compensation for so doing, those who are left behind should capitalize the opportunity for the furtherance of their own ends.

It is impossible to say of course that such acts have the intention of aiding the enemy. However, it is questionable if we can afford to analyze motives when effects are undeniably apparent. The halting of an important industry at this time is as much an aid to Germany as would be the defection of a number of regiments.

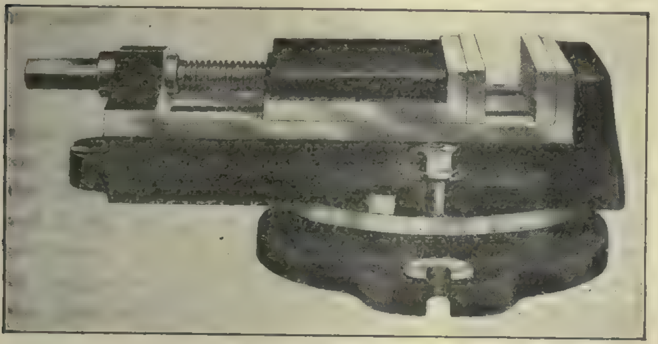
It is well for us to remember that war is too serious a matter to be allowed to become any one man's opportunity. It is unjust to those who go to the front under military rule and who are accepting in their one-dollar-per-day compensation an average reduction of wages of from three to four hundred per cent.; who have no eight-hour day and no extras for overtime—it is unjust to these men who are defending American civil government and American capital and labor that they should be compelled to contrast with their own sacrifices the criminally selfish actions of a few radicals, who would deprive America of arms in order to gain personal advantages thereby.

Happily, the great body of American labor is patriotic and has the success of America at heart. But the few loud-talking individuals who *are* attempting to utilize this opportunity for selfish purposes should receive treatment that will decisively prevent the spread of the hydrophobia with which they are afflicted.

SHOP EQUIPMENT NEWS

Moback Machine Vises

The Moback Tool and Machine Manufacturing Co., 330 Atlantic Ave., Boston, Mass., is now marketing a line of vises to be used on millers, drilling machines, grinders, shapers, planers or other machines. The vises are built either with a swivel base, as illustrated, or with a plain base, the swivel base being simply an addition to the plain vise. The base is graduated in degrees. Side ears are provided, so that the vise may be used either way of the table. The jaws are hardened and ground and are removable in case of breakage. A number of sizes are made.



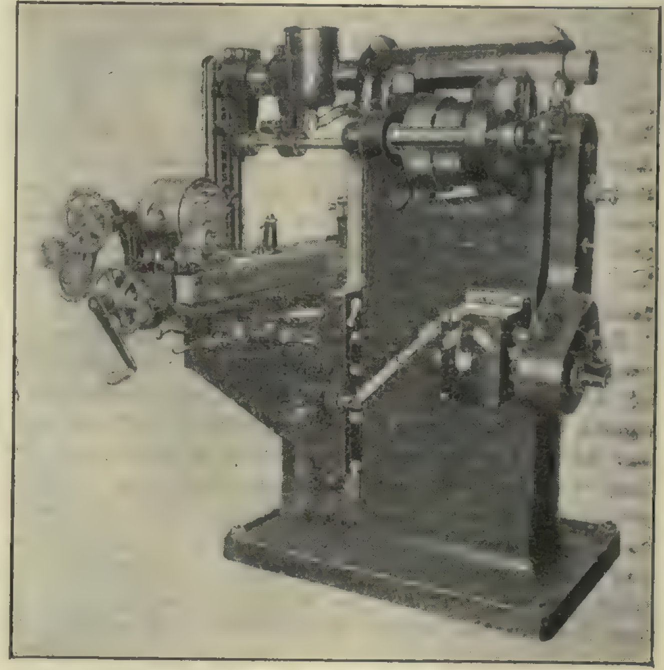
MOBACK SWIVEL VISE

Ford-Smith Miller

The Ford-Smith Machine Co., Ltd., Hamilton, Ont., is now marketing the miller illustrated, which is known as No. 2 "Universal." The column, which is of the box-type construction, is provided with a door and shelves for storing tools and wrenches. The spindle is a crucible-steel forging, a $\frac{13}{16}$-in. hole being machined through its entire length. The front end is threaded to receive a chuck or cutter head, the threads being protected by a cap when not in use.

Phosphor-bronze bearings are provided, the front being of the tapered type, while that at the rear is of the standard form. Adjustment of the rear bearing is secured by drawing up the phosphor-bronze bush that fits into a tapered hole in the column. A standard B. & S. taper is used in the spindle, the front end of which is slotted to provide for a positive drive. The knee is a box-type casting, webbed on the inside to resist the stresses from the saddle and table. Gibs are of the solid adjustable type. A telescoping screw is used, the thrust being taken by ball bearings. The table has automatic feed in both directions and is equipped with positive knock-outs. It is oiled by felt wipers.

The arbor support is easily applied and supports the arbor both in the center and on the end. A two-speed countershaft of the friction type is used. When desired, an automatic oil pump, the necessary piping and a tank are supplied as extras; the table top is regularly equipped with oil channels.



UNIVERSAL MILLER NO. 2

Working surface of table, $41\frac{1}{2}$ x 10 in., equipped with three $\frac{5}{8}$-in. T-slots; longitudinal feed, 25 in.; crossfeed, 8 in.; vertical feed, 18 in.; face of column to brace, 25 in.; diameter front spindle bearing, $2\frac{15}{16}$ in.; spindle speeds, twelve, 12 to 360 r.p.m.; diameter overhanging arm, $3\frac{3}{4}$ in.; overhanging arm to center of arbor, 8 in.; width of belt, 3 in.; feeds, nine, 0.006 to 0.055 in. per spindle revolution; floor space, 81 x 98 in.; weight, 3150 pounds

No Interference with Gisholt Co.

A number of people have formed the opinion that, since the principals of the Gisholt Machine Co. are interested in and control the Northwestern Ordnance Co., of Madison, Wis., there may be a cessation of the activities of the Gisholt company in tool manufacture.

This conception is wrong, since the Northwestern Ordnance Co. will have and now has in the course of construction an entirely independent plant that will operate with an entirely independent organization in no way interfering with the Gisholt Machine Co.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Hotel Powhatan, Washington, D. C., Sept. 1, 1917—The conditions pointed out in a recent editorial concerning the delay in producing rifles for the National Army have not been materially improved, although there has been a marked quickening of effort to decide on the remaining details so that the manufacture could proceed. This, however, had not been done at last reports on the authority of one high in the councils of this department.

The daily press, however, continue to assure us that rifles are being produced, but as they mention that the first one was delivered to Secretary Bakers on Saturday, Aug. 25, practically five months after our entry into the war, the supply can hardly be as great as the ordnance department would have us believe. And even this could not have been complete in every detail as at least one detail, the leaf of the battle sight, had not been decided upon at that time.

Much as we would like to believe, and to advise our readers, that all is well and that there will be plenty of rifles for our men when they reach the training camps, the facts remain as previously stated and serious delays are probable unless there is more rapid action than has yet been the case. It would be more pleasant to assure ourselves and others that this work had gone forward as rapidly as possible, that decisions had been promptly made and that rifles would be ready when wanted. But it is far better to know the truth, to look the situation in the eye and take steps not only to remedy this but to prevent its occurrence in future in all lines of munition work.

THE EXAMPLE OF ENGLAND

And this means to follow the example of England in wiping out the bureaucracy with its unavoidable tendency toward red tape, narrow vision, personal jealousy, and its inexperience in doing business in a large way. It means the placing of all this work in the hands of men who understand modern production methods, men who can discriminate between essentials and nonessentials and who are not hampered by the traditions of an outgrown system.

If the delay in securing rifles was the only instance of this bureaucratic inefficiency, it would not be so significant. But as it extends to many other lines it becomes all the more important that we not only rectify this particular delinquency but that we prevent its recurrence in this and other lines of munition work.

We are in this war to win and we have no doubts whatever as to the outcome. But in helping to make the world safe for democracy we should not lose sight of the opportunity to make our own conduct of affairs more democratic and more efficient than it has been in the past.

There is evidently an attempt being made to overcome the confusion and delay that naturally result from having the same sort of supplies bought separately by two or more departments. In this case it is aircraft matters which are being centralized, or which evidently will be centralized if the bill becomes a law, as seems likely from present indications. A Senate bill has been introduced by Mr. Sheppard for the creation of an Aircraft Board with much more power than any of the boards now existing, unless it be the War Industries Board.

DUTIES OF PROPOSED AIRCRAFT BOARD

In common with most bills and other legal documents, this one can be interpreted in more than one way, but its object seems to be very clearly defined to facilitate the development of aircraft by coördinating the industrial activities relating to aircraft or their numerous parts. This board is to consist of the chief signal officer of the army, the chief constructor of the navy and not more than seven other members of recognized capacity and achievement along industrial lines. They are to be appointed by the President by and with the advice and consent of the Senate.

This board is to elect one of its civilian members as president. The tenure of office shall continue at the pleasure of the President, but in no case is it to exist more than six months after the closing of the present war. The civilian members of the board are to receive $7500 each per year, which is a perfectly proper and wise provision. Most of the really desirable men could not perhaps afford to serve without pay, as was at first proposed. Then, too, when a man accepts remuneration for services, you have a much better hold for a strict accounting at any time.

The bill further provides that the board is empowered to supervise and direct, in accordance with the requirements prescribed and approved by the Departments of War and Navy respectively, the purchase, production and manufacture of aircraft, engines and all ordnance and instruments used in connection therewith, and accessories and materials therefor, including the purchase, lease, acquisition or construction of plants for the manufacture of aircraft, engines and all necessary accessories.

This apparently places the power to purchase aircraft, engine and accessories for both army and navy in the hands of an Aircraft Board, which is a very desirable change from the existing method. But the last paragraph of the bill might be easily construed or operated so as to prevent this, as it provides "that, except upon the joint and concurrent approval of the Secretary of War and the Secretary of the Navy, there shall not be established under the board any office or organization duplicating or replacing, in whole or in part, any office or organization now existing that can be properly established or maintained by appropriations made for, or available for, the military or naval service."

Lack of Co-operation Between Departments of the Army and Navy

This clause could apparently be so worked as to prevent the new board from purchasing machines for both branches of the service, because both branches have an organization that now purchases aircraft and their accessories. In fact, these two branches have at times been rivals in the securing of aircraft and have shown little tendency to coöperate in some cases. As an instance of this, a manufacturer of airplanes tells a very interesting experience that shows the lack of coöperation before the war became a reality to this country, although it occurred long after the beginning of the war on the other side.

The maker was busy building planes for the army, but could not secure engines for them. Learning that the navy had a number of engines, but no planes to put them in, he naturally thought that the reasonable thing to do was to get these engines transferred to the army planes, as his engines would be coming along by the time the navy planes were ready to receive them. So he hastened to Washington and went to the proper officer to arrange for a transfer, only to be met with the reply that it could not be done, the engines were bought by and for the navy, and a transfer was impossible. It was not customary, and the army could buy its own engines, or words to that effect.

It so happened that this plane builder knew the ropes in army and navy circles, and he forthwith proceeded to hire a "taxi" and get busy in various ways, with the result that, after many interviews and several hours in the taxi, going from one building to another, he finally presented the astonished officer with an order for the transfer of the engines to be used in the army planes. But it took practically a whole day and 36 signatures to do the trick.

Necessity for a Buying Commission

It is probably safe to say that a much closer coöperation exists today on account of war conditions, but a central board that can purchase machines and accessories for both branches can undoubtedly render better and more efficient service to both than could possibly be done by separate purchasing bureaus for each branch of the service. The object of mentioning such an occurrent is not to throw discredit on any individual or on either the army or the navy, but to illustrate the need of a central body to make such delays impossible in future. The more we can eliminate duplication of effort such as occurs by having two or more men or committees doing the same work for different departments, the greater will be our efficiency as a whole and the more easily we shall win the war. Only by complete coöperation of all departments, by forgetting the glorification of oneself or of one's department can we hope to secure the results that we have a right to expect at this time.

There has been talk for some time of a buying commission to handle the purchases of all supplies for this Government as well as for all those allied with us in the prosecution of the war. This board has now been appointed and consists of Bernard M. Baruch, Robert S. Lovett and Robert S. Bookings. They are also members of the new War Industries Board of the Council of National Defense and can now coördinate the purchases for all the Allied powers so as to secure a more effective use of the combined resources of the various governments.

FRED H. COLVIN.

Treat All Alike

We are living in unprecedented times. Many things, the legality of which would be questioned under normal conditions, are now being done under stress of national necessity. The Government has commandeered the nation's shipping; it has virtually taken over the operation of the railroads; through the Priority Board it exercises control over most industries; it has sought to fix prices and is about to put into effect drastic food measures.

And it is right that the Government should do these things. The public has been quick to realize that national welfare is paramount to individual rights, and even those whose business has been most affected have, as a rule, gracefully acquiesced.

But if it is right to supervise the distribution of raw materials, to fix the price of the manufactured product, and in a sense to limit profits through the imposition of an excess profit tax, then is it not fair that labor which goes into the manufactured product should also come in for some measure of regulation? Of course it is to be expected that with greatly increased demand and a decreased supply of labor, the law of supply and demand will work toward higher wages. Whether this so-called law should be permitted full sway in war times is a problem that must be met, just as in the case of commodities.

However, when labor attempts to hold the Government by the throat, as it did last week by threatening to call a strike at all cantonments and navy yards because one of the contractors, in an effort to rush the work, had hired some nonunion carpenters, it is high time for stern measures. This was done in the face of the fact that many of these men, with double pay for overtime, are earning from $50 to $60 per week.

The prime consideration at the present moment is to get things done, and anyone who willfully obstructs such work is giving aid to the enemy. The law is specific as regards the punishment for such offenders; and if examples were made of a few of these obstructors, whether they be labor leaders or "willful" members of Congress, the general effect would be wholesome.

That any decisive measures will be taken is unlikely. In the instance referred to the contractor was compelled, presumably under pressure from Washington, to surrender completely to the demands of the union. Political pampering of labor in lieu of settlement of such problems on a just basis will serve only to aggravate the issues and breed still more trouble for the future.—*Power.*

Personals

C. P. MacArthur, master mechanic of the Bowen Manufacturing Co., Auburn, N. Y., has resigned to accept the position of general foreman with the Wagner Electric Manufacturing Co., St. Louis, Mo.

Edwin T. Jackman, of E. S. Jackman & Co., Chicago, Cleveland and Pittsburgh, has been appointed first lieutenant in the Ordnance Section of the Officers' Reserve Corps and is now on active duty.

P. M. Brotherhood, vice president and general manager of the machinery department of Manning, Maxwell & Moore, Inc., New York City, has been placed in charge of all buying of the machinery and supplies for the new plant of the Curtiss Aëroplane Co., in Buffalo.

H. E. Harris, of the H. E. Harris Engineering Co., Bridgeport, Conn., and **William A. Viall,** of the Brown & Sharpe Manufacturing Co., Providence, R. I., have been appointed on a committee to act with the National Bureau of Standards in regard to gages for use in the manufacture of munitions.

Business Items

The Hyatt Roller Bearing Co., Newark, N. J., has opened a branch office in Pittsburgh at 1272-73 Frick Annex. The new office will be in charge of E. E. Eby and J. M. Kelly.

The J. R. Stone Tool and Supply Co., Detroit, Mich., has opened an office at 30 Church St., New York City. The office will be under the direct management of J. R. Stone, president of the company.

Trade Catalogs

Carborundum and Aloxite Grinding Wheels. The Carborundum Co., Niagara Falls, N. Y. Catalog No. 6. Pp. 224; 6¾ x 9 in. This contains very fine illustrations, some colored data on the characteristics of these wheels and uses to which they are adapted.

Belt Buyers' Guide. Chas. A. Schieren Co., 30-38 Ferry St., New York. This is the title of a booklet containing data on the care of belting. Pp. 4 x 8½ in.; illustrated.

Spraco Pneumatic Painting Equipment. Spray Engineering Co., 93 Federal St., Boston, Mass. Catalog No. 10, folder showing application of paint gun.

J. H. Williams & Co., 35 Richards St., Brooklyn, N. Y., has issued a 42-page catalog printed in Russian illustrating and describing its line of drop forged tools which ought to be of value to those interested.

New Publications

Compressed Air for the Metal Worker—By Charles A. Hirschberg. Three hundred and fifteen 5½ x 8½-in. pages; 294 illustrations; board binding. Published by the Clark Book Co., New York City.

This book is a collection of examples of the application of compressed air to various branches of the metalworking industry. It brings together in one volume considerable material which heretofore has only been available in the form of a number of manufacturers' catalogs. While the apparatus described and illustrated largely sets forth the Ingersoll-Rand Co.'s practice, the book is nevertheless of interest to anyone desiring a nontechnical description of the uses of compressed air.

The subject has been classified under the following heads: Power Plants, Foundries, Machine Shops, Boiler and Structural Shops and Miscellaneous. The chief uses of compressed-air power in the industries cited are described, among these being the agitating, transferring and atomizing of liquids, the aërating of liquids and metals, the conveying, handling and hoisting of material, cleaning of machinery, drying, metal spraying, painting, enameling and whitewashing, pumping water and other liquids, starting, testing, operating various tools and operating heavy machines. A résumé is also given in Chapter 1, under the heading Historical, of compressed-air applications.

Electrical Machinery—By Terrell Croft. Published by McGraw-Hill Book Co., Inc., 239 West 39th St., New York City. Price, $2.

The author's aim in preparing this book has been to gather for the average man in industry, material in concise and condensed form which will tell him what he needs to know about electrical machinery, and without the use of difficult mathematics. The aim has also been to omit the unnecessary and stick to what is more likely to be essential to the average man. Following out this idea, much of the material has to do with installation and operation—trouble location and its correction.

Design has been purposely omitted, because a considerable special knowledge of mathematics is required for this subject, and also because electrical machinery has become so well standardized by prominent manufacturers that the average man needs to know more about application of this type of machinery than its design.

The book is divided into 14 sections, beginning with the principles, construction and characteristics of direct-current generators and motors, following with the management of direct-current generators, leading to a similar treatment of alternating-current generators, induction and repulsion motors, synchronous motors and conductors, and terminating in a section on motor generators and frequency changes. Aside from its excellent subject matter, the typography, general make-up and quality of illustrations are worthy of commendation.

Machine Drawing—By Ralph W. Hill, Instructor in Mechanical Drawing in the University Extension Division, University of Wisconsin. Ninety-two 5½ x 8½-in. pages; 119 illustrations; cloth bound. Published by McGraw-Hill Book Co., 239 West 39th St., New York City. Price, $1.

The material presented in this book is a collection of the instruction papers in machine drawing which have been developed and used by the Extension Division of the University of Wisconsin. The material and arrangement, however, make this book equally suitable for home study.

The subject matter is divided into six chapters under the following titles: (1) Principles of Mechanical Drawing; (2) Screws and Screw Fastenings; (3) Sections; (4) Technical Sketching; (5) Tracing; (6) Assembling and Detailed Drawing.

The contents and logical sequence in presenting and familiarizing the young student with the proper methods of making shop drawings are well conceived. The author restricts the subject of machine drawing to very elementary cases; and although the problems presented in this book are in full conformity with the text, it is thought that a more complete presentation would have accompanied the more thorough treatment of projection work.

It is somewhat to be regretted that the lucid language used in the text has not been supplemented equally well in some of the illustrations. On the whole, it is a useful book for those who wish something thoroughly understandable and the first step toward a working knowledge of mechanical drawing.

United States Artillery Ammunition—By Ethan Viall. Ninety-seven 8¾ x 11½-in. pages; fully illustrated. Published by McGraw-Hill Book Co., Inc., 239 West 39th St., New York City. Price, $2.

This book is by far the most complete description ever attempted of the manufacture of the United States artillery ammunition. The subject matter takes up shrapnel shells, high-explosive shells, and cartridge cases for both. The range of size is from 3- to 6-in. shells inclusive. As the author states in his preface, the purpose of publishing this material at the present time is to give shop men, engineers and manufacturers an accurate knowledge of the sizes, tools, shopwork and gages for the more commonly used United States shells and cases.

In the treatment of this subject, in which it is necessary to convey the maximum amount of information in the minimum space, the material has necessarily been condensed, and this has been effected in two ways: First, by special pictorial treatment; and second, by special typographical treatment. The illustrations given in connection with each operation are so comprehensive and so simple that they convey at once to the mechanically trained man the whole story of how the operation is accomplished. Not only is the work shown in position in the machine, but all of the tools, fixtures, gages, auxiliary apparatus and the like are fully illustrated and described with all dimensions and limits necessary to a full comprehension of the work.

In the typographical handling of the text matter to accompany these illustrations, the condensed and standardized form of operation sheets has been adopted which was found successful by the "American Machinist" in the treatment of foreign ammunition made in the United States previous to our entering the war.

Altogether, this book is invaluable to any manufacturer, executive, mechanic or engineer who desires to be posted regarding United States arsenal methods of manufacturing American ammunition.

Forthcoming Meetings

The twelfth annual exhibit of foundry and machine-shop equipment and supplies will be held under the auspices of the American Foundrymen's Association in the Mechanics Building, Boston, Mass., from Sept. 25 to 28, 1917. The officers of the exhibit committee are: President, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; vice president, Benjamin D. Fuller, Westinghouse Electric and Manufacturing Co., Cleveland, Ohio; secretary and treasurer, A. O. Backert, 12th and Chestnut Sts., Cleveland, Ohio; manager of the department of exhibits, C. E. Hoyt, 123 West Madison St., Chicago, Illinois.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

The annual congress of purchasing agents, under the auspices of the national association, will be held at Pittsburgh, Oct. 9 to 11. The program includes business sessions for the mornings and visitation and inspection of industrial works during the afternoons. Special features are: Tour of Pittsburgh's principal business districts by automobile during the late afternoon of the first day, and cabaret dinner in the evening, to be held at one of the country clubs. The banquet will be held at the Convention Hotel the evening of the second day, Oct. 10, with speakers of national prominence. All purchasing agents and others interested are welcome and expected to attend and participate in the activities of the convention. Special arrangements are planned for the entertainment of the ladies.

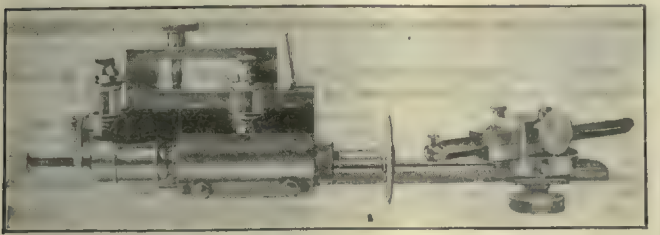
American and Canadian engineers and architects of Norwegian birth or descent will hold an informal congress at the Chicago Norske Klub, Chicago, Ill., Sept. 27 to 29. Correspondence should be addressed to Joachim G. Giaver, Railway Exchange Building, Chicago.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

THREAD-GRINDING ATTACHMENT

International Equipment Co., 1553 South 58th St., Philadelphia, Penn.



"American Machinist," Aug. 23, 1917

Adapted for grinding thread gages, taps and dies, and may also be used for regular cylindrical grinding by attaching to any engine lathe. The diamond dressing tool that is furnished may be quickly attached or removed. The attachment may also be used for grinding relieved taps and hobs or the teeth of formed cutters

GOGGLES (RESISTAL)

Strauss & Buegeleisen, 37 Warren St., New York City

"American Machinist," Aug. 30, 1917

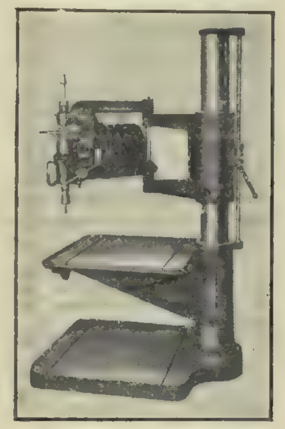
The lenses of these goggles are made up of two layers of glass between which is a layer of celluloid, all three being cemented together. The advantage claimed is the freedom from dangerous flying splinters or particles in case of breakage. Bare lenses supplied if desired

TAPPING MACHINE, RADIAL MODEL R

Rickert-Shafer Co., Erie, Penn.

"American Machinist," Aug. 23, 1917

Capacity in steel, ¼ to ⅜ in.; height over all, 79 in.; working surface of table, 30 x 30 in.; working surface of base, 36 x 36 in.; height of table, 28 in.; distance from table to chuck, 22 in.; distance from base to chuck, 46 in.; maximum distance spindle to column, 44¼ in.; minimum distance spindle to column, 8 in.; spindle travel, 4¼ in.; spindle speed, 250 or 500 r.p.m.; horsepower required, 1; net weight, 2000 pounds



GRINDER, UNIVERSAL NO. 1

Grand Rapids Grinding Machine Co., Grand Rapids, Mich.

"American Machinist," Aug. 30, 1917

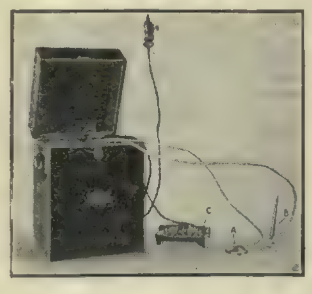
Table swivels through 360 deg. and is provided with scale reading to $\frac{1}{16}$ in. taper per foot of length. Knee carrying saddle, table and subtable swivels entirely around the main column. Traverse and elevating movements accomplished by means of Acme thread screws operating in bronze nuts, graduated dials indicating movements to 0.001 in. Bronze self-oiling bearings are used which are adjustable for either radial or end wear. Saddle, table, subtable, headstock, tailstock and all attachments are a duplicate of those on the No. 2 machine

ETCHING MACHINE, ELECTRIC

William Brewster & Co., Inc., 30 Church St., New York City

"American Machinist," Aug. 23, 1917

Used for etching names or other marks on articles of steel or iron, the advantages claimed being the low cost of operation, freedom of the work from acid spots and rust, and speed of operation. The desired work is traced with a pencil B, the desired depth of etching being controlled by means of the resistance block C. Weight of outfit is about 40 lb., the space occupied being 10 x 10 x 14 in. Furnished for either alternating or direct current, a direct-current alternating-current converter being used in the latter case

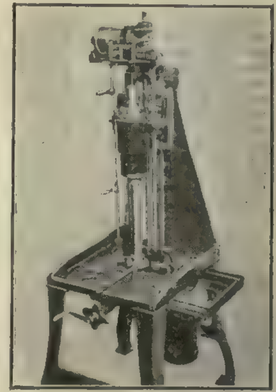


GRINDER, ENGINE CYLINDER (HY-GRADE)

Hy-Grade Machine Co., 5606 Curtis Ave., Cleveland, Ohio

"American Machinist," Aug. 30, 1917

Height, 6 ft.; travel of spindle head, 22 in.; length of grinding spindle, 16 in.; size of movable plate for supporting work, 16 x 22 x 2½ in.; working space under machine, 18 x 22 in.; floor space, 28 x 32 inches



SWITCH, OIL

Crocker-Wheeler Co., Ampere, N. J.

"American Machinist," Aug. 23, 1917

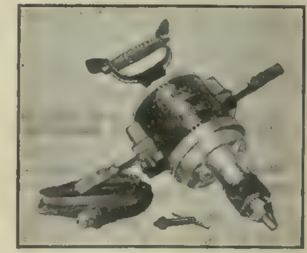
An oil switch designed for reversing small alternating-current motors. Moving contacts are mounted on a fiber rod and connect the center row of contacts with one outside row for forward movement, and the center row with the other outside row for reverse movement. Moving contacts are free to turn on their axes, so that new contact surfaces are continually presented to the fixed contacts. Furnished with or without latches for holding the contacts in the desired position and in a number of sizes for various voltages and currents

DRILL, ELECTRIC

Universal Electric Co., 9 Oliver St., Newark, N. J.

"American Machinist," Aug. 30, 1917

Manufactured in three sizes for drills up to ⅜, ½ and ¾ in., the two latter sizes being made in both single- and two-speed types. The two smaller sizes are equipped with Jacobs drill chucks, while the larger machine has a quick-release Morse taper socket. Acieral metal is used wherever possible to prevent excessive weight



Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations were current as follows at the points and dates indicated:

	Aug. 31, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$47.00	$47.00	$14.00
No. 2X Northern Foundry, Buffalo	53.00	53.00	19.75
No. 2 Northern Foundry, Chicago	55.00	55.00	18.00
*Bessemer, Pittsburgh	52.95	55.95	21.95
*Basic, Pittsburgh	50.95	53.95	18.95
No. 2X, Philadelphia	53.00	53.00	19.50
*No. 2, Valley	53.00 to 55.00	53.00	18.25
No. 2, Southern Cincinnati	49.90	49.90	16.90
Basic, Eastern Pennsylvania	50.00	50.00	19.75

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.

STEEL SHAPES—The following base prices in cents per pound are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Aug. 31, 1917	One Month Ago	One Year Ago	Aug. 31, 1917	One Year Ago	Aug. 31, 1917	One Year Ago
Structural shapes	5.25	5.25	3.25	5.00	3.25	5.00	3.10
Soft steel bars	5.00	5.00	3.30	4.50	3.30	4.50	3.10
Soft steel bar shapes	5.00	5.00	3.25	4.50	3.25	4.50	3.10
Plates, ¼ to 1 in. thick	9.00	9.00	4.00	7.00	4.00	9.00@10	3.50

BAR IRON—Prices in cents per pound at the places named are as follows:

	Aug. 31, 1917	One Year Ago
Pittsburgh, mill	4.75	2.60
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Aug. 31, 1917	One Month Ago	One Year Ago	Aug. 31, 1917	One Year Ago	Aug. 31, 1917	One Year Ago
*No. 28 black	8.50	10.50	10.50	3.65	9.00	3.20	10.00	3.20
*No. 26 black	8.45	10.40	10.40	3.55	8.90	3.10	9.90	3.10
*Nos. 22 and 24 black	8.40	10.35	10.35	3.50	8.85	3.05	9.85	3.05
Nos. 18 and 20 black	8.35	10.30	10.30	4.45	9.20	3.70	9.80	3.00
No. 16 blue annealed	8.60	10.20	10.20	4.45	9.20	3.70	10.20	3.60
No. 14 blue annealed	8.60	10.10	10.10	4.35	9.10	3.60	10.10	3.50
No. 12 blue annealed	8.55	10.05	10.05	4.30	9.05	3.55	10.05	3.45
No. 10 blue annealed	9.50	10.00	10.00	4.25	9.00	3.50	10.00	3.40
*No. 28 galvanized	10.25	12.00	13.00	5.00	10.75	4.70	11.50	4.75
*No. 26 galvanized	9.95	11.70	12.70	4.70	19.45	4.40	11.20	4.40
No. 24 galvanized	9.80	11.55	12.55	4.55	10.30	4.25	11.05	4.30

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring fair-sized lots, the following quotations hold:

	Aug. 31, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	40%	45%
Cleveland	40%	45%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—This material per 100 lb. sells as follows:

	Aug. 31, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	13.30	6.30
Chicago	13.00	5.50

In coils an advance of 50c. usually is charged.
Note—Stock scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in fair-sized lots:

Welding Wire*

3/8, 11/64, 5/16, 1/4, 7/32, 3/16 No. 8, 5/32 and No. 10 1/8 No. 12 3/32, No. 14 and 1/16 No. 18 No. 20	21.00@30.00

* Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
1/4 by 19 in. long	14.00
3/8 by 19 in long	12.00
1/2 by 21 in. long	12.00

*Special Welding Wire

1/8	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Aug. 31, 1917	Cleveland Aug. 31, 1917	Chicago Aug. 31, 1917
Tire	5.00	5.00	4.50
Toe calk	5.00	5.50	4.75
Openhearth spring steel	7.00	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
1/8, 1/4 and 3/8	42%	15½%	3/4 to 1½	33%	17%
1/2	46%	31½%			
LAP WELD					
2	42%	29½%	2	26%	12%
2½ to 6	45%	32½%	2½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
1/8, 1/4 and 3/8	38%	20½%	3/4 to 1½	33%	18%
1/2	43%	30½%			
3/4 to 1½	47%	34½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4	43%	31½%	2¼ to 4	29%	17%
4½ to 6	42%	30½%	4½ to 6	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
3/4 to 3 in. steel butt welded	38%	22%	38%	25%	38.8%	24.8%
3½ to 6 in. steel lap welded	26%	7%	23%	39%	42.8%	27.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound:

	Aug. 31, 1917	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	26.00	24.00	28.00
Tin	61.75	62.50	38.87¼
Lead	10.50	10.50	6.50
Spelter	8.00	8.50	9.50
ST. LOUIS			
Lead	10.25	11.75	5.87½
Spelter	7.75	8.25	9.50

At the places named, the following prices in cents per pound prevail:

	New York			Cleveland		Chicago	
	Aug. 31, 1917	One Month Ago	One Year Ago	Aug. 31, 1917	One Year Ago	Aug. 31, 1917	One Year Ago
Copper sheets, base	36.00–40.00	42.00	37.50	38.00	38.50	37.50	38.00
Copper wire (carload lots)	38.50	39.50	32.00	38.00	33.00	39.50	33.50
Brass pipe, base	43.00–45.00	47.50	46.50	46.00	45.00	44.00	45.00
Brass sheets	40.00	39.12½	44.50	36.00	42.00	40.50	39.00
Solder ½ and ½ (case lots)	39.25	39.50	24.62½	39.50	24.75	39.25	24.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse: 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Aug. 31, 1917	One Year Ago
Mill	$42.00	$42.00
New York	38.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

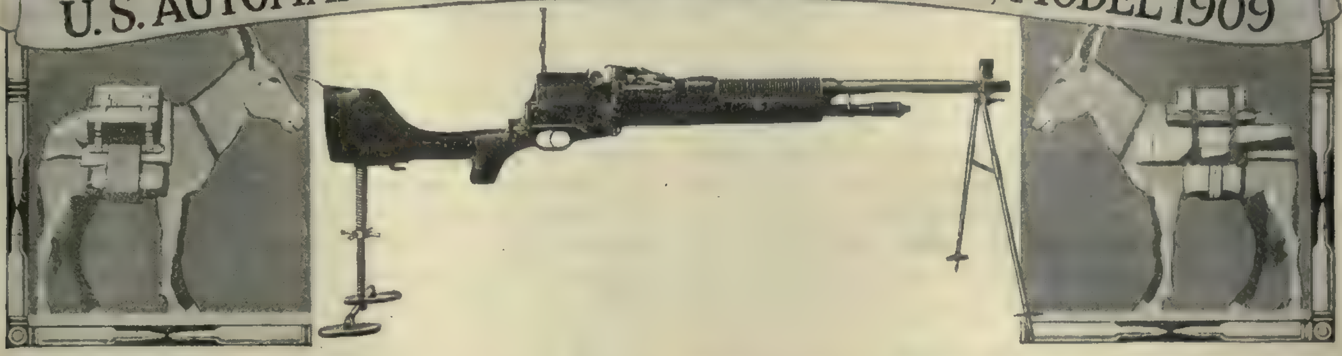
Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Aug. 31, 1917	One Year Ago	Aug. 31, 1917	One Year Ago
New York	21.00	17.00	21.50	18.00
Cleveland	23.00	16.75	23.25	17.50
Chicago	22.50	17.00	23.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound for spot delivery, duty paid:

	Aug. 31, 1917	One Year Ago
New York	14.50	13.50
Cleveland	17.50	14.50
Chicago	16.50	13.50

U. S. AUTOMATIC MACHINE RIFLE—CALIBER 30, MODEL 1909



SYNOPSIS—*This type of automatic rifle is air-cooled, but the radiating surface is not covered as in the Lewis gun. The feeding strips also differ from most others, which as a rule use belts. Sufficient details are given to insure a clear understanding of the mechanical action.*

THE automatic machine rifle, caliber .30, model of 1909, belongs to that type of automatic arms known as the gas operative. The power that is used to operate the mechanism is obtained from a small portion of the powder gases that enter through a port in the barrel after the bullet has passed. After the first shot the rifle is self-operative, until the ammunition in the feed strip is exhausted or until the trigger is released.

The ballistics of the automatic machine rifle, caliber .30, model of 1909, are similar to those of the service rifle. The bullet suffers a slight decrease in muzzle velocity due to the gas used in operating the rifle, but for general purposes the data quoted for the service rifle are sufficiently accurate.

In firing, the action of the mechanism is as follows: When the rifle is fired and the bullet has passed the gas port in the barrel a part of the powder gas passes into the chamber of the gas-nozzle ring, and enters the gas cup of the actuator, forcing the latter to the rear. The actuator in recoiling compresses the actuator spring, the cam surface cut in its upper portion engaging the lug of the fermeture nut, causing the latter to rotate so as to disengage its threads from those of the breechblock. At this part of the recoil the firing pin, which has been drawn back by the actuator, engages its upper lug in the ramp of the receiver. The firing pin then rotates on its axis and its upper lug comes to rest in the transverse cut of the breechblock, thus locking the latter to the actuator. The large lug of the actuator strikes against the shoulder of the breechblock, drawing the latter to the rear and thereby completing the opening of the breech. The claw of the extractor engages the groove of the cartridge case and draws it from the chamber. During the recoil of the breechblock the head of the cartridge case strikes against the ejector, throwing the case out of the rifle through the ejection opening in the receiver. When the actuator is partly recoiled the cam surface cut on its right side engages the upper lug of the feed piece, causing the latter to rotate from right to left on its axis. The feed arm of the feed piece engages its feed lug in the central opening of the feed strip, forcing the latter into the rifle and placing a cartridge in the loading position in front of the chamber. The pawl of the feed-piece spring engages in the lateral openings of the feed strip, thereby holding the latter in place and preventing it being drawn to the right when the feed arm of the feed piece, having advanced the feed strip one notch, returns to its original position by sliding over the feed strip in order to engage in the next hole. Finally, when the actuator is almost recoiled (supposing the rifle to be set for single shots), the sear engages in the cocking notch of the actuator and the latter is held back ready for the next shot.

THE TRIGGER ACTION

When the trigger is pulled the sear is disengaged from the actuator, which, now being free, is thrown forward, due to the force exerted by the actuator spring. During this movement the actuator carries forward the breechblock, to which it is connected by means of the large lug of the firing pin. The breechblock strikes the cartridge, forces it into the chamber, and the claw of the extractor engages the groove of the cartridge case. As soon as the breechblock engages the fermeture nut the large lug of the firing pin engages in the ramp of the receiver, causing the firing pin to rotate so as to disengage this lug from the transverse cut of the breechblock. The firing pin is then free and may move forward. The actuator continues its forward movement and its cam face engages the lug of the fermeture nut, rotating the latter so as to cause its threads to engage with those of the breechblock. The breech is now closed and locked. The firing pin striking the primer fires the piece. During this forward movement of the actuator, the small cam surface cut on its right side engages the lower lug of the feed piece, causing it to rotate from left to right. The feed arm is actuated by this movement, and its feed glides over the feed strip and engages in the next opening of the latter, ready to feed the feed strip another notch into the rifle when the actuator again recoils.

The maximum fire obtainable with this arm is about 400 shots per minute. The rapidity of fire can be regulated to some extent by the regulator. The weight of the complete rifle is 30 pounds.

The ammunition used in this rifle is the same as that provided for the United States rifle, caliber .30, model of 1903. It is fed into the rifle by means of feed strips,

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holding 30 cartridges each. The cartridges are located in the feed strips by means of a loading tool. The feed strips are made of sheet steel, spring tempered. On each strip are punched three rows of large clips, which hold the cartridges longitudinally, and one row of small clips, which align and hold the cartridges transversely. Ten feed strips are packed in each ammunition box.

The parts of the rifle are assembled into the following groups: The barrel group, the receiver group, the firing-mechanism group, the feed-mechanism group, the locking-mechanism group, the guard group, the stock group, the elevating-mechanism group, the hand-guard group, the barrel-rest group and the rear-sight group.

The Barrel Group

The barrel group contains the barrel, radiator, gas-nozzle ring, front-sight carrier, gas-cylinder support, regulator and front sight, front-sight cover, front-sight screws and cover-screws.

The barrel is chambered and rifled the same as the barrel for the United States rifle, caliber .30, model of 1903. The rear portion of the barrel is turned down to provide seats for the radiator and the gas-nozzle ring, and the front end for the seat for the front-sight carrier. In rear of the radiator seat are the locking lugs, two interrupted annular rings divided into three sectors, which engage in similar lugs of the locking nut and secure the barrel to the receiver. On the lower exterior surface of the barrel and in the rear of these locking lugs is a small lug which fits in a slot in the receiver. This small lug assures the alignment of the receiver and the barrel, also of the gas-nozzle ring and the actuator. The rear end of the barrel is turned down for the fermeture nut, which fits over the end of the barrel in assembling. On the upper surface of the rear end of the barrel is a small bevel cut which guides the cartridge into the chamber, and on the left side is the clearance cut for the claw of the extractor and extractor housing on the breechblock. A gas orifice or port is drilled through the underside of the barrel at the seat for the gas-nozzle ring.

The radiator is about 7½ in. in length and has cut on its exterior surface a series of deep grooves. The center of the radiator is bored out to a diameter somewhat less than that of its seat on the barrel and is shrunk in place and secured by the radiator pin. The bottom of the radiator is slabbed off for clearance. To its rear end, near the bottom, is assembled the locking-nut stop. The purpose of the radiator is to aid in the rapid radiation of the heat developed during firing.

Details of Gas-Nozzle Ring

The gas-nozzle ring is assembled to the barrel in front of the radiator and is shrunk in place and secured by the gas-nozzle ring pin. A small hole is drilled from the bottom of the gas-nozzle ring to connect with the gas port in the barrel. The exterior of the hole is closed by the orifice screw. The rear end of the lower portion of the gas-nozzle ring is shaped to form a nozzle and the front end is shaped to form a gas chamber. The nozzle is of circular shape to fit the gas cup of the actuator, and through its center is drilled a small hole into the gas chamber, intersecting the vertical hole drilled from the bottom of the gas-nozzle ring to the gas port in the barrel. The interior of the gas chamber is bored out and tapped near the front end for the regulator piston, and its exterior is graduated to aid in adjusting the regulator sleeve. On the rear upper face of the gas-nozzle ring is a horizontal lug on which the front stiffening piece of the hand guard rests when the latter is assembled.

The front-sight carrier is secured to the front of the barrel by the sight-carrier pin. On the upper part of the front-sight carrier is a dovetailed transverse slot for the front sight. In front of this slot is drilled and tapped a hole for the front-sight screw. On the underside of the front-sight carrier is a pivot which provides the means for the attachment of the barrel rest. On the front of the pivot is a recess into which the plunger of the barrel rest enters and secures the latter in position.

The gas-cylinder support, designed to prevent injury to the gas-nozzle ring during transportation, is assembled to the gas chamber of the gas-nozzle ring, and is secured by the gas-cylinder support pin, the ring on its lower part slipping over the gas chamber and the U-shaped upper part resting against the barrel.

Regulator Has Several Parts

The regulator consists of the regulator sleeve secured to the regulator piston by the regulator sleeve pin. The regulator piston is a cylindrical bar having on its rear end three annular piston rings which fit the gas chamber of the gas-nozzle ring. The purpose of these rings is to check the escape of gas to the front and to collect dirt, etc. The center section of the regulator piston is threaded to fit the thread in the gas-nozzle ring; its front end has a square head to aid in adjusting, disassembling and assembling. The regulator sleeve fits the cylindrical part of the regulator piston in rear of the square head and is pinned thereto. The regulator sleeve covers the piston back to and including the thread on the center section, sufficient space being had between the regulator piston and the regulator sleeve to permit the front portion of the gas-nozzle ring entering with a reasonably close fit. A tongue is milled in the barrel of the regulator sleeve and provided with a small projection on the inside, near the rear, which engages in a longitudinal groove on the underside of the gas-nozzle ring and prevents the sleeve from rotating after adjustment. The front end of the regulator sleeve is knurled, so that it can be more easily turned by the hand.

Purpose of the Regulator

The purpose of the regulator is to increase or decrease the size of the gas chamber of the gas-nozzle ring, thus controlling the velocity of the rearward movement of the actuator in order to allow for adjustments for various powder pressures, or for a desired increase or decrease in the rapidity of fire.

The front sight has on its upper portion a thin leaf slightly beveled to the front, and on each side is cut a circular groove to better define the sight proper. On the lower portion is a dovetail lug which engages in the dovetail groove of the front-sight carrier. This method of assembling the front sight and front-sight carrier permits of adjustment for deflection, and after the rifle is targeted the hole in the front-sight carrier for the front-sight screw is extended into the front sight and the front-sight screw inserted. Over the front sight is placed the front-sight cover, secured by the cover screws.

The receiver group consists of the receiver, ejector bushing, rear feed guide, front feed guide, bottom plate, feed-piece housing cover and rear-sight fixed base; these parts constitute a receiver when issued, and are permanently attached to the receiver by rivets or screws. In assembling, components are assembled as follows: Closing spring, ejector, ejector spring, ejector cap, cartridge stop, cartridge-stop spring, cartridge-stop holder, cover plate, cover-plate washer, cover-plate screw, feed piece, feed-piece spring, windage screw, rear sight, telescopic sight bracket, fermeture nut and locking nut.

The Receiver

The receiver is a large steel forging, which contains the firing, feed and locking mechanisms, and also provides means for the assembling of the barrel, the guard, the hand guard and the rear sight. In the front end of the receiver is drilled a large hole which is the seat for the fermeture nut and the barrel. A slot on the lower side of this hole is for the purpose of locating the barrel and for assembling the fermeture nut. In rear of this slot is a recess for the lug of the fermeture nut. The front end of the receiver is threaded on the exterior for the locking nut, which secures the barrel to the receiver.

In rear of the threaded section is drilled a small hole, into which the end of the locking screw enters. On the top and directly in the rear are permanently assembled, by means of the feed-guide assembling screws, the front and rear feed guides, between which slides the feed strip during the firing. The front feed guide contains a narrow slot, in which the feed strip slides, and a large opening on the right for the cartridges. On top and at the right are two undercut slots, slightly beveled, into which is assembled the feed-piece spring. On the left is drilled and tapped a hole for the cover-plate screw. The rear feed guide has a narrow slot for the feed strip and also the cartridge opening on the right. On the left is a dovetailed groove for the cover plate and on the right the seat for the feed piece. This seat consists of a hole drilled vertically in the rear feed guide with an opening in its rear for assembling the feed piece. A large lug to the left of this hole, on which the feed piece slides during the firing, and a smaller lug on the right inclose the seat. On top to the right of dovetail groove is an opening under large lug through which the feed-piece spring pawl passes in assembling.

Cover Plates and Screw

The feed guides are braced on the left by the cover plate, which is secured to the front feed guide by the cover-plate screw and to the rear feed guide by the dovetail slot. The cover-plate screw is held securely by means of a split washer under head of screw, preventing its working loose from vibration in firing. On the front of the rear feed guide, just below and to the right of the dovetail slot, is assembled the cartridge base stop, which limits the movement of the cartridges to the left. In front of the rear feed guide is a tongue which enters between the feed strip and the cartridge and forces the latter downward. To the bottom and the front half of the receiver is securely riveted the bottom plate. The latter has on its lower surface two locking lugs, into which fit the trunnions of the guard. On top of the receiver and directly in rear of the feed guides is an undercut dovetail groove, in which is assembled the rear-sight fixed base, the latter being secured in position by the fixed base screw. The rear-sight fixed base contains the pivot lug for the movable base, the undercut for the windage screw and the lip on the front end of the movable base, and a lug on the rear end, which forms the undercut for the lip on the rear end of the movable base.

Wind-Gage Graduations

Upon its rear upper surface are two zero marks for the wind-gage graduations. On the left side of the receiver is the ejection opening. Above this opening is drilled and tapped the seat for the cartridge stop. In the rear of the ejection opening is the dovetail seat for the telescopic sight bracket, the latter being secured to the receiver by three sight-bracket screws. On the right side of the receiver is the feed-piece housing cover, which is attached to the bottom plate by the hinge pin. The former is held in its closed position by the closing spring which is inserted in the housing of the bottom plate. In the bottom of the housing of the bottom plate is drilled a small vertical hole in which is inserted the lower end of the feed piece. The ejector bushing is driven into a seat directly below the rear feed guide and has an opening on its left end for the ejector, while on the right are four small lugs, recessed to receive the lugs of the ejector cap.

The interior of the receiver has in its front section the seat for the fermeture nut, which is beveled in the rear to insure that the fermeture nut is always centered.

Within the rear section on the sides are the breechblock guide slots, while on the top and to the left is the guide for the firing pin which, ending in two cams, causes the firing pin to rotate in and out of its recess in the breechblock.

In the rear and bottom part of the receiver are the locking-lug seats for the guard. On the left of the receiver near the rear end is a small hole, drilled and tapped, into which is screwed the locking screw for securing the guard to the receiver. A small slot in front holds the locking screw in place. Two beveled undercut grooves in the front of the receiver provide seats for the assembling of the hand guard.

The Firing-Mechanism Group

The firing-mechanism group consists of the actuator, actuator spring, breechblock, firing pin, extractor and extractor spring. The actuator is located below and parallel to the barrel and is the piston which drives the mechanism of the rifle. It has on its upper surface a long straight cut and in the rear two diagonal cam cuts in which moves the lug of the fermeture nut. In the rear of these cams is cut a deep recess in order to reduce the weight of the actuator. In rear of this recess is a large lug, the center section of which is cut away for the lower lug of the firing pin. On the front end of the actuator is the gas cup, which fits over the nozzle end of the gas nozzle ring. On the right side of the actuator are two cam surfaces, upon which move the upper and lower lugs of the feed piece in recoiling and counter-recoiling. Near the front end of the upper cam surface is a dismounting notch for the feed piece. On the left side of the actuator is the clearance cut for the trigger and on the bottom is the sear notch in which the sear engages when the rifle is cocked. On the lower surface, at the rear end is a slight ramp on which the sear rides near the end of recoil. On the right and left sides, and also on the lower surface of the actuator, are guides or bearing surfaces to control the movement of the actuator during recoil and counter-recoil.

THE ACTUATOR AND SPRING

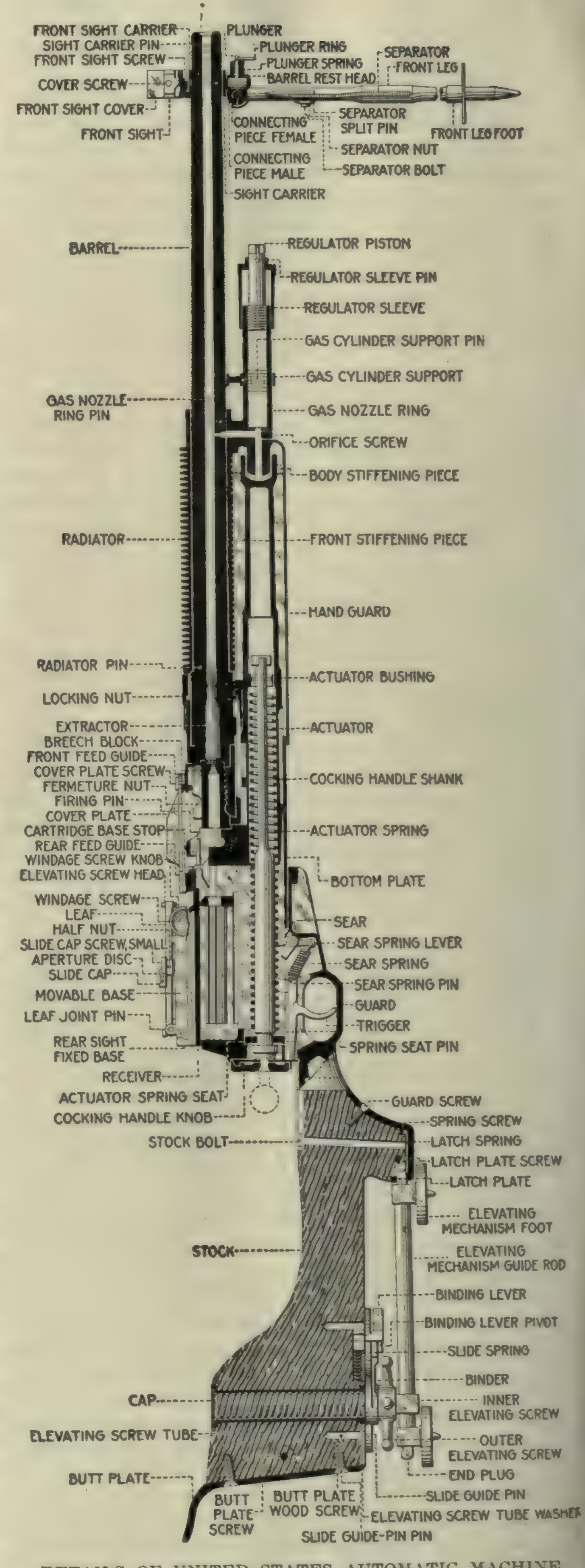
The actuator is hollow nearly its entire length, the rear portion forming a housing for the actuator spring. About midway between the ends of the actuator is secured the actuator bushing. This bushing, which is threaded and screwed in position and secured with a pin, serves as the front seat for the actuator spring and also forms a seat for the lugs on the front end of the cocking handle when the latter is used to retract the actuator.

The actuator spring is a long spiral spring located in the interior of the actuator, with its front end resting against the actuator bushing and its rear end against the actuator spring seat in the guard. As the actuator recoils, this spring is compressed and the energy stored up is used to move the actuator forward at the end of the recoil.

The breechblock contains the firing pin, extractor and extractor spring. The breechblock rests on the bottom of the guide slots in the receiver, the large lug on the actuator entering a long longitudinal slot in the rear part of the breechblock. At the rear end and left side of this long slot is a deep recess into which the upper lug of the firing pin rotates whenever the breechblock is in motion. In front of this long slot the breechblock is cut away as clearance for the cartridge stop, while at the top and rear end of the slot is a small ramp to aid in disassembling and assembling the firing pin. On the right and left sides of the breechblock at the rear are guides that move in the guide slots of the receiver. On the front section of the breechblock are interrupted threads divided into three sectors, which engage those of the fermeture nut and securely lock the former to the latter during firing.

EXTRACTING MECHANISM

On the right side of the breechblock is a long clearance cut for the ejector. On the left-hand side of breechblock at the front end is the housing for the extractor; under this housing at the end of the breechblock is a stud, which acts as a seat for the curved surface on the bottom of the extractor at the rear of the extractor claw, preventing extractor from pitching too far toward center of breechblock to readily pass over cartridge case. On the inside of the housing a bevel cut is the working point for the bevel cut on top of the extractor when firing the rifle. The rear end of the housing forms a seat for the shoulder on the extractor after the extractor is worn on the bevel surface and on the bottom, thus increasing the life of the extractor. At the rear of the housing is a slot for the extractor and extractor spring; at the rear end of this slot is the extractor spring seat. On the left side back of the extractor spring seat the breechblock is cut away to fa-



DETAILS OF UNITED STATES AUTOMATIC MACHINE RIFLE, CALIBER 30, MODEL 1909

The view above shows the details of the principal working parts, with the proper name for each cilitate the assembling and dismounting of the extractor and extractor spring.

At the front end of the breechblock on the upper rim a shallow seat is cut for carrying the cartridge into the chamber. The ends of rim on each side of ejector groove are slightly closed toward center of the breechblock to insure a good grip of cartridge case. The front end of the breechblock is counterbored for the head of the cartridge, and in the center of this head space is drilled a small hole for the firing-pin point. The interior of the breechblock is bored out for the barrel of the firing pin.

The firing pin is seated within the breechblock. The front portion is cylindrical, terminating at the front end of the firing-pin point, and has on its rear end a small and a large lug. The small lug is on the underside and rests, when assembled, in the recess of the large lug on the upper part of the actuator. This small lug causes the firing pin to move to the rear in the first motion of recoil. The large lug is on the upper side and has on its top two cam cuts, which move in the cam cuts in the receiver and serve to rotate the firing pin in and out of the recess in the breechblock. The front shoulder of this upper lug rests against the front of this recess during counter-recoil and carries the breechblock forward, the upper lug on the actuator bearing against the rear end of the barrel of the firing pin. The bottom and rear end of the upper lug is beveled to permit assembling and disassembling.

The extractor is an irregular bar having on the underside of its forward end a claw and on the upper side of the forward end an incline which seats against the underside of extractor housing of the breechblock, when passing over rim of cartridge case. At the rear end of the extractor is a pivot on which the extractor spring seats and forces the extractor downward over the cartridge head. When the breechblock strikes the cartridge in loading, the extractor is forced backward until the claw drops into the cannelure of the cartridge.

The extractor is assembled to the breechblock by slipping the extractor spring over the pivot on the rear of the extractor, inserting the front end of the extractor in the opening in rear of the extractor housing and gradually forcing the extractor and spring into place with the dismounting tool. The position of the extractor is determined by the small bevel cut on top of the extractor, the convex cut on underside of extractor housing and shoulder on the extractor. When in action the pivot on the extractor is bent slightly, so the pressure of the extractor spring forces it into proper location. The extractor and spring may be dismounted either by use of the dismounting tool or by engaging a small screwdriver behind the extractor spring in the small slot provided in the extractor seat of the breechblock.

THE FEED-MECHANISM GROUP

The feed-mechanism group consists of the feed piece, the feed-piece spring, the cartridge stop, the cartridge-stop spring, the cartridge-stop holder, the ejector, the ejector spring and the ejector cap.

The feed piece is of irregular shape, having at its upper end a feed arm, on the end of which is a pointed lug which engages in the central opening of the feed strip. On the top of the feed piece is a small lug, which holds the feed-piece spring in position. On the feed arm, near this lug, is a small cut into which the feed-piece spring stud drops when the feed arm is moved to the left. Near the lower end on the shaft of the feed piece are two lugs, one above the other, that move on the cam surfaces of the actuator and give rotation to the feed piece. When the last cartridge in a feed strip has been fired the feed piece drops down, due to pressure of the feed-piece spring, and the lower lug then prevents forward movement of the actuator. The lower end of the feed piece is cross-milled to prevent the finger slipping when the feed piece is raised. Between the lugs and the feed arm a portion of the shaft is made flat, in order to facilitate assembling. The feed piece when assembled in the rifle is held in a vertical position by the opening in the bottom of the housing on the bottom plate and the circular opening in the rear feed guide on the receiver.

FEED-PIECE SPRING IS MADE OF SHEET STEEL

The feed-piece spring is an irregularly curved spring of sheet steel. On its front end is riveted the feed-piece spring button, for use in the disassembling and assembling of the spring, and at the rear and left side is riveted the feed-piece spring pawl. The latter is pointed on its left side; and as the feed strip moves to the left, the feed-piece spring pawl engages in the rear openings of the strip, thus preventing the feed strip from moving to the right. At the same time the pawl forces the cartridge slightly downward out of the feed strip. On the right side, near the rear, is riveted the feed-piece spring stud, while directly in rear of this stud is a small opening through which passes the small lug of the feed piece. As the feed piece rotates, the upper surface of the feed arm strikes against this spring stud and slightly raises the feed-piece spring, thus allowing the pawl to ride over the feed strip. The feed-piece spring is assembled to the receiver by forcing it into the under-cut grooves on the right side of the front feed guide.

THE CARTRIDGE STOP

The cartridge stop is a short cylindrical piece with a blunt conical point, and is seated in the receiver just above the ejection opening. It is held in position by the cartridge-stop spring and the cartridge-stop holder, the latter containing a small opening through which the end of the cartridge stop projects. The holder is also threaded for the purpose of assembling it to the receiver. The principal function of the cartridge stop is to limit the movement of the cartridges to the left and to properly align them. It also indicates, in loading, whether or not the feed strip has been fully inserted.

The ejector is assembled in the ejector bushing of the receiver and is held in position by the ejector spring and the ejector cap. The ejector cap is circular in shape, having on its circumference four small lugs which engage in corresponding slots in the ejector bushing. Special attention should be paid to the assembling of the ejector cap, being sure the small lugs on the sides of the cap are properly located in the slots provided for them in the ejector bushing; failure to properly locate these lugs will result in the ejector cap being forced outward against the feed piece and prevent the forward movement of the firing mechanism. On the top of the ejector cap are cut two slots at right angles to each other, into which fit the ejector key used in dismounting and assembling. In the center of the cap is a small hole which allows the end of the ejector to protrude.

The Locking-Mechanism Group

The locking-mechanism group is made up of the locking nut, the fermeture nut and the locking screws. The locking of the mechanism by the locking nut is more permanent in its nature, while that of the fermeture nut is a continuous locking and unlocking for each round fired.

The locking nut is cylindrical in shape, having two interrupted annular rings of three sectors each on the inside to provide means for locking the barrel to the receiver. In rear of these locking rings is cut the thread for assembling the locking nut to the receiver. Two small recess cuts are made on the front end of the locking nut for dismounting wrench, and also a large cut for clearance and stops for the locking-nut stop on the radiator.

After the barrel is locked in position, the locking nut is secured by one of the locking screws, which is inserted in the small hole drilled and tapped on the left side near the rear end of the locking nut, the end of the locking screw entering a small hole on the left side of the receiver directly in the rear of the threads. The other locking screw is used for locking the guard to the receiver. In front of the locking-screw seat in the locking nut is a small lug with a shallow slot which secures the locking screw in position. On the right side of the locking nut is the hand-guard stud, which holds the hand guard in place while the barrel is being removed. The rear of the locking nut has seven slots, which insure a tight fit on the receiver.

The fermeture nut is cylindrical in shape and has on its underside a large lug which moves in the cam cuts on the upper surface of the actuator. The front end of the fermeture nut is counterbored to receive the barrel, while directly in rear are interrupted threads divided into three sectors for locking the breechblock. The left sector of the fermeture nut is enlarged to allow passage of the extractor housing of the breechblock. An enlarged recess is provided as clearance for the extractor housing as the fermeture nut rotates. Between the lower and right-hand sectors is a deep cut which provides a cavity into which primers may drop should they become dislodged from the cartridge case during firing.

Function of the Fermeture Nut

On the top of the fermeture nut there is a long longitudinal cut from the rear, providing clearance for the cartridge in loading; near the left rear end is a semicircular cut, providing clearance for the front clip of the feed strip; and on the top and right is the clearance for the feed strip. The rear shoulder of the fermeture nut is beveled to enter the corresponding bevel in the receiver. The function of the fermeture nut is to lock the breechblock at the instant of firing and to unlock it immediately after firing. The fermeture nut is located in the forward part of the receiver, directly in rear of the barrel, and is held by a shoulder on the barrel and a similar shoulder in the receiver, so as to prevent any longitudinal movement but to permit of rotation about its axis.

The guard group consists of the guard, actuator-spring seat, latch spring, cocking handle, sear, sear spring and trigger. The guard, when assembled, closes the rear end of the receiver and supports the stock. It is secured to the receiver by trunnions on its front end which enter the locking lugs on the bottom plate, and also by locking lugs on each side in the upper part of the guard near the rear, which enter seats on the interior of the receiver. It is secured in its seat by one of the locking screws, which enters the guard through the locking-screw hole of the receiver. Within the guard are the recess and seat for the sear, and in rear of this a long slot for the trigger. Under the latter slot is the trigger bow. In the upper part of the guard is a longitudinal hole in the top and bottom of which are two slots, in which the actuator-spring seat is placed. The latter is held in position by two large lugs on its perimeter and by two spring-seat pins which are assembled to the guard directly in front of the actuator-spring seat. Through the center of the actuator-spring seat is drilled and slotted a small hole with two small lugs 180 deg. apart. Through this hole passes the shank of the cocking handle, the lugs sliding in the longitudinal grooves of the latter. Three semicircular grooves cross the rear surface of the actuator-spring seat, by means of which the cocking handle is locked into its three positions. In rear of the actuator-spring seat is the locking-lug seat of the cocking handle. Under the opening for the actuator-spring seat is a rectangular opening for the tongue of the trigger. An arrow is stamped over the cocking-handle opening to aid in setting the latter in the desired position. On the rear of the guard are a short tang and a long tang, by means of which it is assembled to the stock. The latch spring is a flat steel spring assembled near the bottom of the long tang by the spring screw.

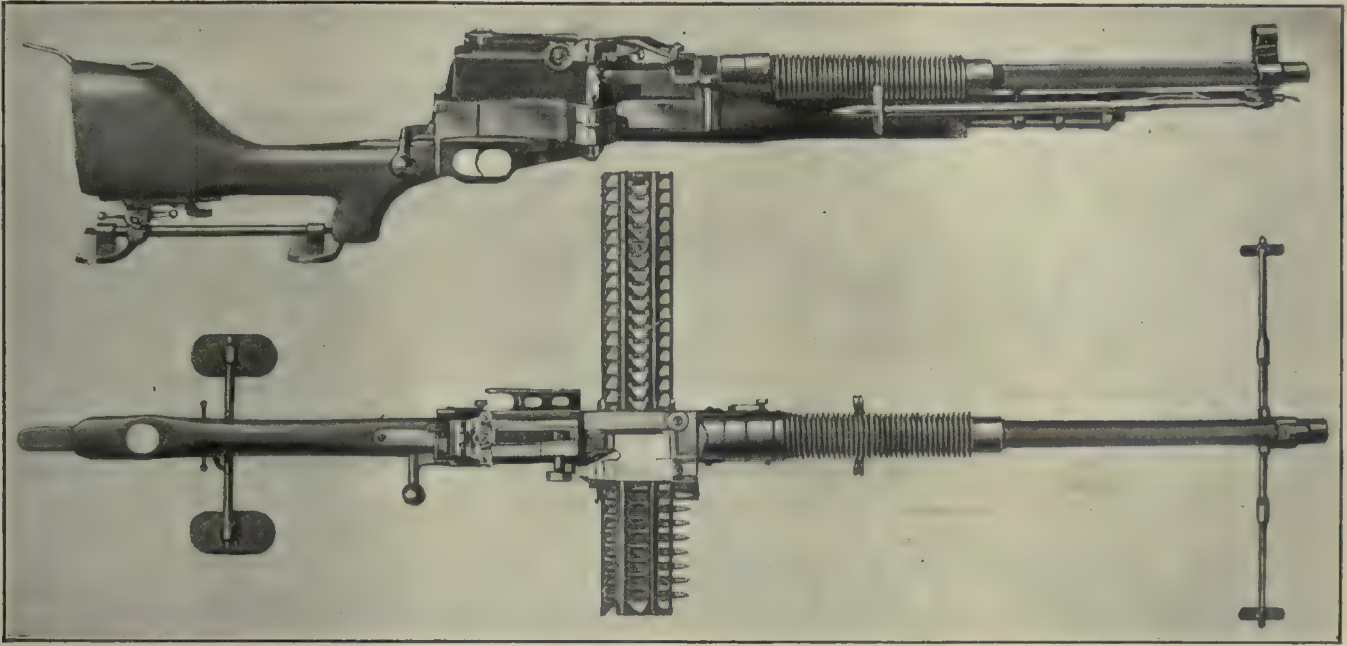
Cocking Handle Is a Member of the Guard Group

The cocking handle, consisting of the shank and knob riveted together, is located within the actuator and extends to the rear through the actuator-spring seat opening of the guard.

The front end of the cocking-handle shank extends into the actuator and terminates in a double-locking lug. In retracing the actuator by hand this lug bears against the actuator bushing. The rear portion of shank is provided with grooves which engage the two lugs on the interior of actuator-spring seat.

The cocking-handle knob has two locking lugs which serve to lock the guard to the receiver. These locking lugs are made with two projections which engage in the notches of the actuator-spring seat and thereby determine the position of "safety" or the kind of fire desired. On the rear of the cocking-handle knob is a circular disk, on the face and near the perimeter of which are stamped arrows which show the various firing positions. The position for firing automatically is marked "A," that for firing semiautomatically is marked "R," and that for safety is marked "S." An arm extends out from this disk with a ball handle by means of which the cocking handle is rotated into these positions and also assists in dismounting and assembling. The disk of the cocking-handle knob is retained in position by means of two conical surfaces on its front face which engage in corresponding surfaces on the rear end of receiver. The disk of the cocking-handle knob has two notches cut therein. With the knob set at A, the position of the lower notch permits the tongue of the trigger to pass through, thereby allowing the trigger to be pulled directly to the rear. The hook on the forward end of the trigger engages the cocking arm of the sear, holding the cocking toe on the sear below the sear notch on the actuator. This position of knob will therefore give continuous or automatic fire.

With the knob set at R, the position of upper notch, which is provided with a cam surface, forces the tongue of the trigger downward as the trigger is pulled to the rear, thereby causing the trigger to release the sear for each shot. This position of knob will therefore give single shots. With the knob set at S, neither of the notches is opposite the tongue of trigger, and the latter can not, therefore, be pulled, and this position of knob is therefore known as the "safety position." With the knob set at C and D, the cocking handle can be drawn to the rear. This position of knob is used when it is desired to cock or draw back the actuator by hand and is also used when the mechanism is to be dismounted. To set for the different positions, the cocking handle is rotated until the particular letter corresponding to the position desired comes opposite an arrow marked on the guard.



SIDE AND TOP VIEWS OF THE UNITED STATES AUTOMATIC MACHINE RIFLE

The sear is made with a knurled button head and a spindle on which is the cocking toe, which engages in the sear notch of the actuator. The cocking toe has on its under side a deep recess; the spindle is made hollow and the head countersunk in order to reduce its weight. Underneath the cocking toe, assembled and riveted to the spindle, is the sear-spring lever, by means of which the sear spring is attached to the sear. Between the cocking toe and the knurled button head is the cocking arm, which stands in an upright position when the sear is assembled in the guard. On its top is a small cut in which the hook of the trigger arm engages. On the spindle are two flat cuts by which the sear is dismounted and assembled.

The trigger is of irregular shape, having a trigger arm with a hook on its forward end which engages in the cut on the cocking arm of the sear. This arm extends to the rear sufficiently far to limit the motion to the rear of the trigger, and is connected to the body of the trigger by a curved arm which offsets the trigger arm to the left, so that it will clear the actuator. The body of the trigger has a circular bevel cut in the front end where the sear-spring pin is assembled. From the bottom of the body extends the finger piece which passes through the slot in the guard. On the rear of this body is a tongue having on its upper surface a small ramp. This ramp, when the trigger is pulled to the rear, slides into slots cut in the disk on the cocking handle, which permits the trigger to move straight to the rear or causes it to tilt slightly downward or prevent it moving at all. These are the positions of automatic A, semiautomatic R, and safety S, respectively.

The Stock Group

The stock group consists of the stock, latch plate, elevating-screw tube and butt plate. The stock is made of well-seasoned black walnut, cut down in front so as not to interfere with the sighting. It has a pistol grip and is recessed in front for the tangs of the guard, a small hole being drilled at an angle about midway in the recess for the lower tang of the guard for the guard screw, and a larger hole being drilled perpendicularly through the stock near the rear end of the recess for the upper tang for the stock bolt. In the bottom and rear of this grip is a small recess for the end plug, a shallow groove for the latch spring, and the seat for the latch plate, the latter being secured by the latch-plate screw, a transverse hole being drilled for that purpose. In the rear end of the stock is assembled the elevating-screw tube with cap, in a hole drilled for this purpose, and the lower end then spun out over the washer. In the bottom and rear of the stock are drilled two holes for the slide-guide pins and two smaller transverse holes, through the above holes, for the slide-guide-pin pins. Between the large holes and in front of the elevating-screw-tube opening is cut a small recess for the slide spring. On the front end of the stock is a small tenon which extends into the guard, taking the shock of recoil in firing.

The butt plate has two side tangs and is secured to the butt of the stock by two butt-plate wood screws and one butt-plate screw which passes through the tangs, holes being drilled in the rear end of the stock for the wood screws and a smaller hole drilled through the stock near its rear end for the butt-plate screw. On the upper end of the butt plate is a long tang for supporting the weight of the rifle on the shoulder when firing without the elevating mechanism.

THE ELEVATING-MECHANISM GROUP

The elevating-mechanism group consists of the inner elevating screw, the outer elevating screw, and the elevating-screw slide. The inner elevating screw consists of the elevating-mechanism guide rod, the end plugs, the elevating-mechanism feet and the inner elevating screw. The elevating-mechanism feet are flat pieces, oblong in shape, having on the top a large lug to which the elevating-mechanism guide rod is assembled. On the underside is a large recess, in the center of which is a small conical lug to prevent slipping. The end plugs are notched on the top so as to engage in the latch plate on the stock and thereby secure the elevating mechanism when in the traveling position. On the elevating-mechanism guide rod is assembled the inner elevating screw, and to its ends are riveted, by means of the elevating-mechanism foot pins, the end plugs and the elevating-mechanism feet. The body of the inner elevating screw is hollow, in order to reduce its weight, and has cut on its exterior a right-hand thread. At the lower end is a square head, through which a small hole has been drilled for the elevating-mechanism guide rod.

The outer elevating screw has on the exterior of its body a left-hand thread extending nearly to the bottom. On the lower end are four radial arms by means of which the outer elevating screw is rotated. On the interior of the body, near the bottom, is cut a right-hand thread to fit the corresponding thread on the inner elevating screw. Below and above this thread the interior is counterbored for clearance.

The elevating-screw slide is designed to lock the elevating mechanism when firing, and consists of the elevating-screw slide, the binder, the binder lever, the binder-lever pivot and the binder spring. To the elevating screw slide are assembled the parts just mentioned. Slightly in the rear of its center is the elevating screw opening, the rear end of which forms a half nut, which engages in the thread of the outer elevating screw. In front of this opening is a dovetail groove for the binder. In the rear end of this groove is assembled the elevating screw slide pin against which rests the binder spring, while in the front part is drilled a small hole for assembling the spring. In front of the binder slot is also drilled a hole into which is driven the binder lever pivot. Near each end of the elevating screw slide are the slots for the two slide guide pins, which secure the elevating screw slide to the stock. After the slide guide pins have been assembled the slide guide-pin pins are driven transversely through the stock and through a small hole in the slide guide pins, thereby securing the latter in position. In the recess of the stock under the elevating screw slide is assembled the slide spring.

The binder has on its upper side a dovetail lug containing a recess for the binder spring and the rear end is made to fit the body of the outer elevating screw. The binder is assembled to the elevating screw slide by means of the dovetail lug engaging in the corresponding groove on the slide.

The binder lever has on its left side a circular cam surface which moves against the front end of the binder. In the center of the circular cam surface is drilled a hole for the binder lever pivot, and to the right extends the lever arm, which is curved to the front so as to fit the finger. The rear of this arm is cross-milled to aid in operating the clamping device. A small lug on the upper surface of the binder lever limits the motion of the lever arm to the rear.

The binder lever pivot is the axis for the binder lever, and has its upper end turned down so as to have a driving fit in the pivot hole of the elevating screw slide, while its lower end forms an eccentric about which the binder lever rotates, the purpose of the eccentric being to take up the wear between the binder and the binder lever. On the bottom or head of the pivot is stamped an arrow which indicates the high point of the cam.

The outer elevating screw can be quickly inserted into or removed from the stock by drawing the elevating screw slide to the rear by the binder lever. In the traveling position the elevating mechanism is secured in front by the end plug engaging the latch plate on the stock and in the rear by the clamping device.

THE HAND-GUARD GROUP

The hand-guard group consists of the hand-guard body, front and body stiffening pieces, assembling plates, leg catches, and leg catch springs. The hand-guard body is made from a drawn-steel tube or from sheet steel pressed to shape and brazed. It is reinforced at the front end by the front and the body stiffening pieces which are securely riveted and brazed to the hand-guard body. In the forward part of the hand-guard body are punched a number of small holes which permit the powder gases to escape after impinging on the actuator. On the rear end of the hand guard are riveted the two assembling plates which seat in the undercut grooves in the front of the receiver. On each side of the hand guard are riveted the leg catches, under which the leg-catch springs are assembled. These catches support the front legs of the barrel rest when in the traveling position. When assembled the hand guard is held in position by the undercut grooves in the front of the receiver and the horizontal lug on the upper part of the gas nozzle ring. The purpose of the hand guard is to protect the gunner from escaping gases and also to provide protection from the moving actuator, thus insuring that all moving parts of the rifle are inclosed.

The barrel-rest group is made up of the following principal parts: The barrel-rest head, the plunger, the connecting piece male, the connecting piece female, the front legs, the front-leg feet, and the separators. The barrel-rest head is a steel piece which serves as a sleeve to the connecting pieces, male and female, and into which the plunger, plunger ring and plunger spring are assembled. In the body of this head are two holes, one being a small, vertical hole for the pivot on the front sight carrier and the other a larger transverse hole for the male and female connecting pieces. On the top at each side the body of the head is cut away for the lug on the top of the front leg. In front of the pivot hole is drilled a longitudinal hole in which are assembled the plunger and plunger spring. The plunger secures the barrel seat to the pivot at the bottom of the front sight carrier. The plunger is held in place by the plunger ring, the latter being assembled through a hole in the front part of the plunger.

The connecting piece, female, is drilled and tapped on one end to match the thread which is cut on the body of the connecting piece, male. The outer ends of both connecting pieces are slotted for the front legs. The connecting pieces are assembled in the barrel-rest head, the front legs are then inserted into the slots and riveted in position by the front-leg axis.

The front leg is a long bar having at the top a flat lug. A notch is cut across this lug which bears against the connecting piece, and the barrel-rest head when the front legs are extended, and a hole is drilled through this lug for the front-leg axis. Above the center of the front leg is a section, larger in diameter than the remainder of the bar, in which is cut a deep slot for the separators, and at right angles to this slot is drilled the separator axis hole. At the lower end of the front leg is riveted, by the foot rivet, the front-leg foot, the latter being made with a flat plate, which prevents the front leg from sinking in soft ground.

The separators which hold the front legs in the extended position are riveted to the front legs by the separator axes. The separators are secured to each other by the separator bolt. The separator bolt is secured by the separator nut and the latter by the separator split pin. A small lug on the end of each separator enters a slot in the other separator and holds the legs extended.

THE REAR-SIGHT GROUP

The rear-sight group is made up of the following principal parts: The movable base, the base spring, the leaf, the elevating screw, the slide, the half nut, the slide cap, the drift slide, the aperture disk and the windage screw. The movable base has on its upper surface two ears in which are the holes for the joint pin which serves as a hinge for the leaf. On the rear end of the movable base are the wind-gage graduations, each point of which corresponds to a lateral deviation of 4 in. for each 100 yd. Both ends have lips which fit the undercuts of the fixed base, the front lip having also a worm gear for engaging the thread of the windage screw. The base spring fits in the spring seat of the movable base.

The leaf is graduated from 0 to 2800 yd. On the right side of the sighting opening in the leaf are the groove and seat for the elevating screw; which is a long, thin screw, extending from the bottom of the sighting opening to the top of the leaf, where it is secured in the elevating screw head by the elevating screw pin. This elevating screw allows minute corrections for elevation and also holds the slide in position on the leaf by means of a half nut which is seated in the slide and the half-nut spring, the latter forcing the half nut against the thread on the elevating screw. The outer end of this half nut is knurled, and by pressing in on the knurled head the half nut can be released from the elevating screw and the slide quickly raised or lowered.

The rear face of the slide is cut out for the leaf, and the drift slide and the right half are made with a seat for the half-nut spring and the half nut. The right and left ends are drilled and tapped for the small slide-cap screw and the large slide-cap screw, which secure the slide cap to the slide. The front face of the slide is slotted and recessed for the pivot.

The slide cap has a circular cut in its upper surface which forms a recess for rotating the aperture disk, and also apertures for sighting and for reading the graduation on the leaf. The center is slotted for the pivot. On the right and left sides are drilled the holes for the small and large slide-cap screws. On the rear face at the bottom of the slide cap is the open sight.

The drift slide moves in the drift slots in the leaf. At the top is a small open sight, while just below are two openings, the upper for the pivot and circular lug on the aperture disk and the lower for a sighting aperture. The drift slide is held in place by a lug on its front face, which bears against the slide and by the lug which contains the open sight. This latter lug extends to the rear and bears against the top of the slide cap. On the lower edge of the open-sight lug is another small lug, which engages in the notches on the perimeter of the aperture disk, locking the latter in the desired position.

The aperture disk is a circular piece containing five sight openings, namely: Four peepholes, 0.04, 0.06, 0.08, and 0.10 in. in diameter, and one large aperture which contains an open sight. A circular lug on the front face engages in the central opening of the drift slide, thus causing the aperture disk to conform to the movement of the former. This lug is drilled and tapped for the pivot spring and the pivot. The purpose of the pivot spring is to force the aperture disk to the rear, so that one of the notches, which are cut on its perimeter, will engage in the small lug and prevent rotation.

The windage screw consists of the windage screw, the windage screw knob, the windage screw collar, the windage screw spring, and the windage screw pin. It is seated in the front part of the fixed base.

PREPARING THE RIFLE FOR FIRING

1. Remove rifle from the pack.

2. Free the front legs from the leg catches on the hand guard. Carry the legs forward until they are at right angles to the barrel, and then by a quick movement separate the legs to their full extent. Place the legs so that the muzzle points in the desired direction and force the feet into the ground.

3. Disengage the elevating-mechanism feet from the latch plate on the stock and turn them so that they will lie at right angles to the direction of fire.

4. Raise the rear-sight leaf. Cock the rifle by rotating the cocking-handle knob to the vertical position and then drawing the latter to the rear until the sear engages in the sear notch of the actuator.

5. Push the cocking handle forward, turn to the right and set at S, safety, until ready to fire.

6. Remove the feed strips from the ammunition box and place conveniently for loading.

FIRING

1. Set rear sight for range and deflection.

2. Raise the feed piece to its highest position.

3. Load by inserting the loaded feed strip into the feed guides and push the former to the left until the first cartridge is against the cartridge stop, which is shown by the protrusion of the left end of the cartridge stop from the holder. Under normal conditions the rifle will be operated by two men, one doing the firing and the other doing the loading.

4. Unlock the elevating mechanism by rotating the binder lever to the right and rear. Raise or lower the stock to approximately the proper elevation. Release the elevating-screw slide, adjust the outer elevating screw to the proper elevation, and clamp by pushing the binder lever forward.

5. Turn cocking handle to R, repeater, or A, automatic, and fire the piece by drawing the trigger directly to the rear. By releasing the trigger while firing, with the cocking handle set at A, the firing can be stopped. The rate of fire can be controlled to some extent by the proper adjustment of the regulator. Upon normal conditions and for accurate firing the regulator should be so adjusted that there will be a minimum vibration. The maximum effect of the gas on the actuator occurs with the regulator set at O.

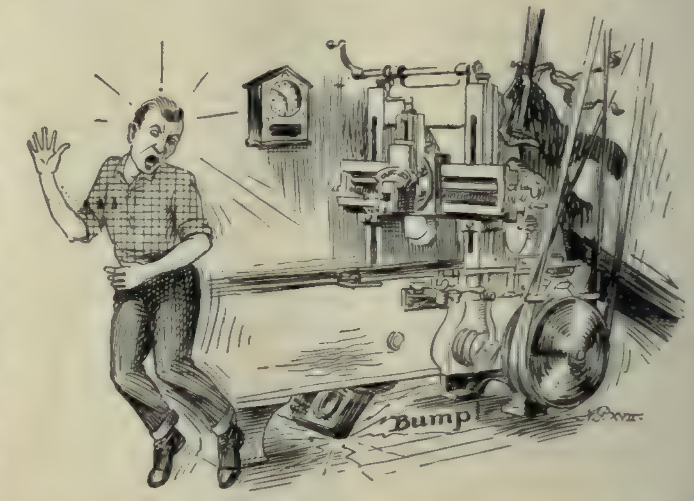
There is no normal setting for the regulator in the sense that settings for all guns under any conditions may be alike. The amount of lubrication, wear of parts, stiffness of springs, resizing of feed strips, temperature and various other conditions demand that varying adjustments for gas be made accordingly, regardless of settings for other guns or even of previous settings for the same gun. *Use only sufficient gas for the proper operation of the mechanism, and no more.* The proper setting will ordinarily be found anywhere between (first) the smallest setting that will give sufficient ejection of fired cases without cutting of the ejector into their heads, and (second) the largest setting which will still give enough travel to the actuator to prevent automatic firing with the cocking handle at R.

6. The barrel should be cooled by means of the cooling sponge after about 300 rounds of continuous firing. The rifle may be fired 1000 rounds without cooling, without serious injury to the barrel, but this should be avoided as far as possible.

Becoming a Planer Specialist—A Letter from Jack to Bill

Deer Bill—Do you no enny forren talk? Ile tell you wy I asts you. You remember in the old shop wot we calls the hogg trawf ware we yused to wosh our hands, well thares one like it hear and the uther day some gink puts a card on it with a hand pointin at the fassit and sum words rote, and an uther hand apointin at the durty wotter in the trawf and sum moar words. Ive copid them and hear thay are all but the last word I dident rite that Bill becaus yure wife she mite see this leter. The fassit talk was *eau fraiche* and the uther was Oh, H—— that uther word you no Bill. The bos and a lott of geezurs laffed but I cant see no sens in it can you Bill.

Well Bill Ive began to be a plainer speshlist and of got balld out about it. The guy wots lurnin me he puts a big jigg on the plainer taibl not fasnd none but lade thare and he gose off and says hes cummin bak soon. Bymeby I looks at the clok and its fifteen minutes to wisl time so I gose to wosh up and I hadent went far wen I hears a big smash and wot do you think Bill the plainer had went and started itself and the taibl had fell of bakwuds onter the flore and the jigg had went inter the bowils of the plainer. The bos balld me out and I hadent dun nothin but only hang my overhalls on the shiper how could I no that wud start the plainer? The bos he says the uther man, the lurnin guy, Bill, he ort to of fasnd the dogg. I hadent seen no dogg, no nur hurd none, and wen I ses to the lurnin guy, "The bos is mad becaus you dident ty your dogg," he laffs but I dont see no joak do you Bill?



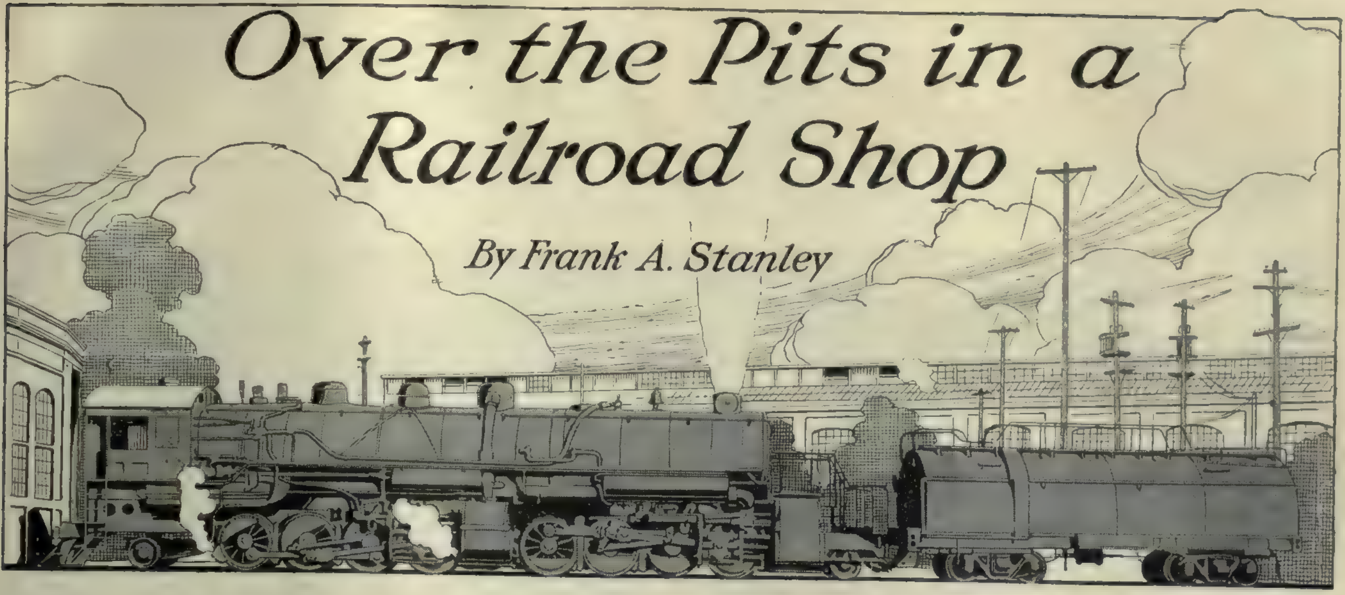
Well Bill affter diner a gang cum with a chane takl and puts bak the taibl and the jigg and thay want hurt none. Then the lurnin guy he shose me how to wurk the jigg and put peaces in it and sett the toole by a shiney plaice on top of the jigg then he gose off. Well the plainer I gess its old for it sqweaks evry time it starts to go the uther way so I loosens one of the things the lurnin guy scrude up on the side of the taibl and the toole hits a nedge of the jigg ware it ortent to of went and brakes the toole and a boalt thing that hoalds the clampin doodad and the bos cum and dont say nothin but just look feerse and I tels him axidunts wil happn eavn to skild mecanniks like I be and he says, "Mecannik, skild mecannik—" that wurd you no Bill that was on the hogg-trawf card, and he gose off and kiks the dore wen he went throu.

Well Bill I has a good smoak wile thay mends the jigg then I plains allmost a peace a nour til nite and the lurnin guy tels me I dun noble and praps Ide beter stik to peacework wen I gets to be a speshlist. Ime glad hes found out Ime a real mecannik. It maiks a man feal good to no hes apreshated. Well Ime ded tired and cant rite no moar now. JACK.

P S—Bill one of the men thats allreddy speshlists he says the peacework gazabose gets sevn sents for plainin a peace like them I dun but I dont bleev no speshlist wurks for sevn sents a nour do you Bill?

Over the Pits in a Railroad Shop

By Frank A. Stanley



SYNOPSIS—*The initial cost of a modern locomotive is considerable, and every idle moment means loss of its earning capacity; hence it is repaired, when necessary, with the greatest possible speed. A large amount of work must be done by hand.*

STRIP a big, powerful, modern locomotive of its side motion and valve-gear; remove driving wheels and boxes from under the frame; open up cylinders, steam chests and boiler front; remove the cab from the rear end and the burnished steel casing and its underlying lagging of asbestos from the entire length of the boiler. Then drop the naked boiler and the exposed frame upon 10-in. cribbing placed across a shop pit, and you have before you the skeleton of a huge machine that under the efforts of a crew of mechanics and helpers will gradually be overhauled, repaired and refitted until it assumes once more its spectacular appearance and, restored to its full working capacity, is again ready for service on the road.

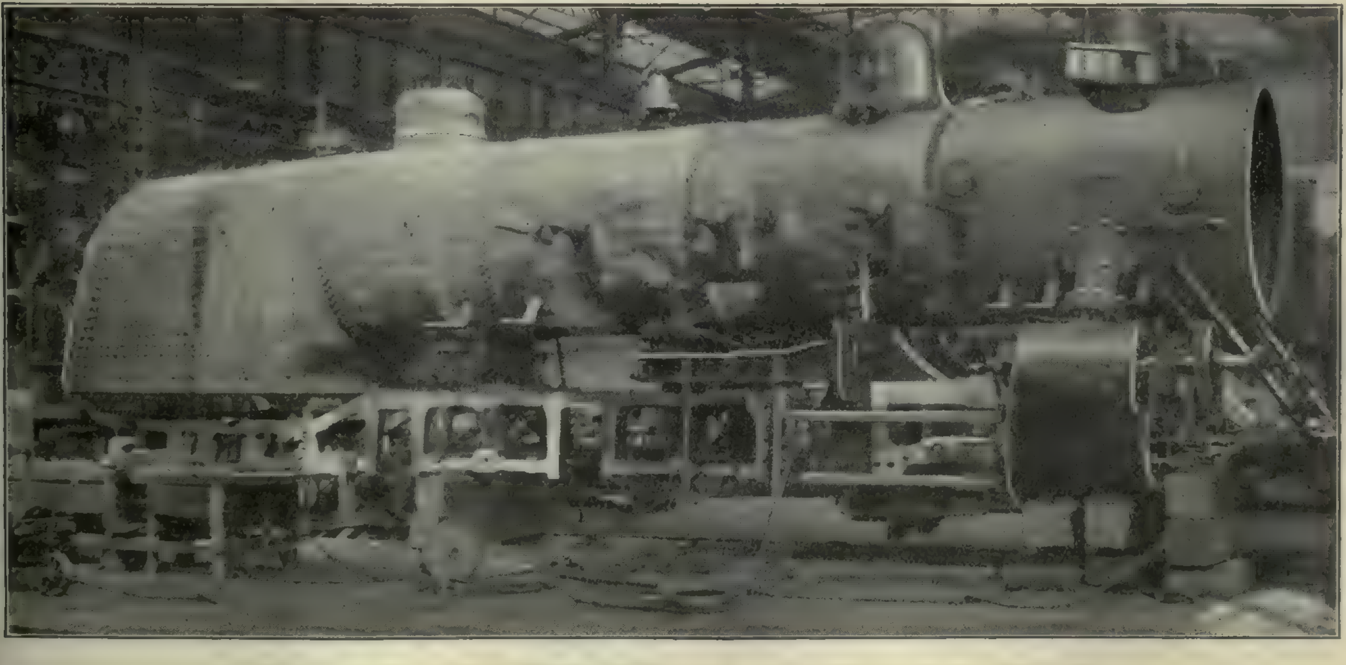


FIG. 1. A BIG LOCOMOTIVE UNDERGOING THE OVERHAULING PROCESS

Almost anything may happen to a locomotive in use. As a matter of fact, the things that usually do happen are due to the natural wear and tear brought about by conditions of regular service. They necessitate such shop operations as re-turning or re-tiring of wheels; the re-fitting of boxes, side rods, pistons and so on; the replacing of a boiler tube or a firebox sheet and the repairing of a multitude of details. Most of these matters are taken care of at short notice and with little loss of time, until eventually an accumulation of necessary repair items causes the engine to be sent into the shops for a real stripping down and a genuine overhauling from one end to the other and inside as well as out. This, as may be imagined, is quite a piece of work.

Now this subject of upkeep of rolling stock, including both locomotives and cars, is one of wide importance and interest, not only from an engineering angle, but because of the magnitude of the repair industry as carried on in the railroad shops of the United States. The last time I had occasion to investigate the data pertaining to the subject—that is, about the time of the outbreak of the present war—it was found that railroad-shop repair operations as gaged by the value of the work turned out constituted an undertaking standing as seventh in our list of great national manufacturing industries. Measured by the number of men employed, the industry ranked as fourth in order of importance.

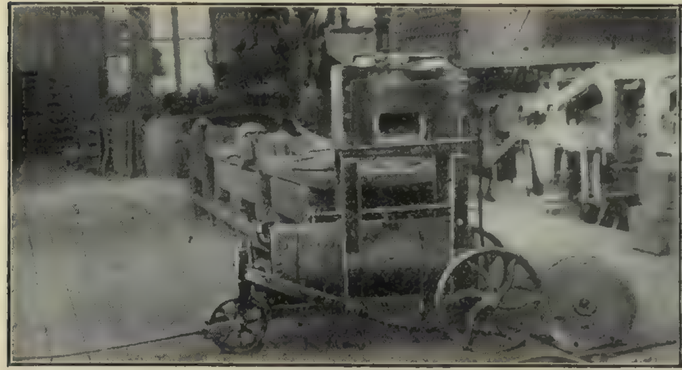


FIG. 2. PORTABLE OIL FORGE AND HEATER

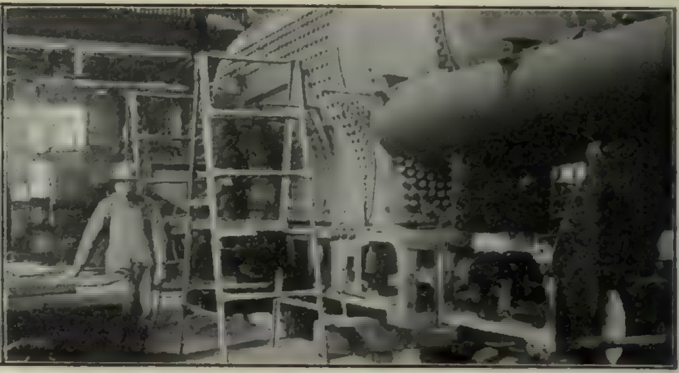


FIG. 3. SHOP TRESTLE MADE OF OLD BOILER TUBES

Consider for a moment what is accomplished by the 1200 or more railroad repair shops in this country, over half of which are establishments of considerable magnitude: Employing more than a third of a million mechanics of varying degrees of skill, who keep in order some 65,000 locomotives and over 2,500,000 freight and passenger cars, the plants referred to expend annually on the maintenance of this rolling stock approximately $400,000,000, a sum equivalent to that required for the construction of the Panama Canal. Expressed in another way, the upkeep of this equipment, as operated over the 250,000 miles of railway lines of the United States, represents a rolling-stock repair bill of practically $1600 for every mile of track in the country.

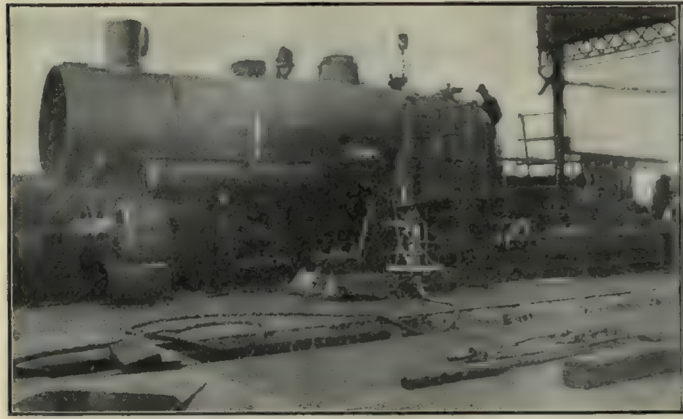


FIG. 4. ENGINE READY FOR WHEELING

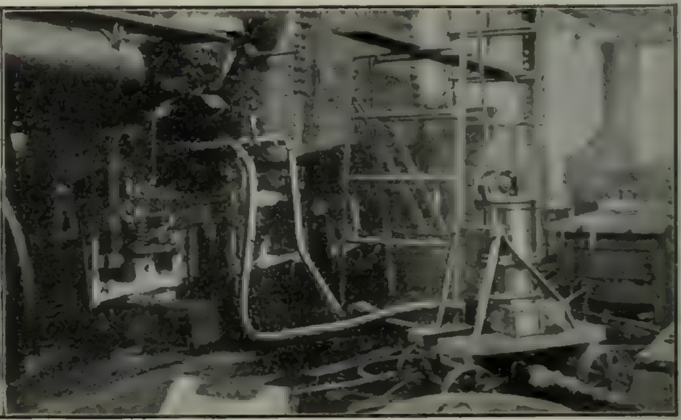


FIG. 5. PUMPING OUTFIT FOR BOILER TEST

A modern locomotive is no inexpensive piece of machinery. In the common types, such as the Pacific, Mikado, Atlantic, etc., the original cost will average from $20,000 to $30,000, while the great articulated Mallet machines so generally operated over the Far Western and Southwestern lines cost from $40,000 up to $75,000 or more. Engine crews carry a heavy burden of responsibility in the direction of holding to a minimum the wear and tear on the costly machines in their charge, but even under the best of operating conditions the annual repair account for the average locomotive is sufficiently high to astonish people not versed in the upkeep of transportation equipment.

As an example may be cited the experience of one of the best-organized railway systems in America. Data secured some years back from the shops of this system showed that the average annual cost of repairs at that time was over $3000 per locomotive, and in view of the increased material and labor costs since that period there is little reason to doubt that at the present moment the above figures have advanced to at least $4000 for each engine.

In addition to the actual costs of repairs there is still another serious item to be considered in connection with the locomotive-overhauling proposition, and that is the attendant tying up of a valuable piece of equipment during the repair period and the consequent loss of earning power for the time the engine is in the shops. This is fully realized by the mechanical department of the railway system, and it goes without saying that, even under ordinary conditions of business, locomotives undergoing repairs are, on a well-organized division, hustled out of the shops with the greatest possible dispatch. The great amount of work handled also necessitates all possible dispatch.

Engineers familiar with the progress in methods of manufacture have seen such advance in machine operations and so marked a tendency toward elimination of handwork in many directions that oftentimes they look forward to a day in the future when the old handicrafts of the shop shall have disappeared completely. Possibly such a day and such a condition may be marked on the calendar of the years to be; but for the present moment, if anyone whose observations in this direction have been based upon experience in certain highly organized plants manufacturing some small, light product will devote his attention for a brief period to the operations conducted in any of our typical railroad shops, he will be led to the conclusion that in these establishments, at least, little diminution in the hand processes there followed is to be expected for a long time to come.

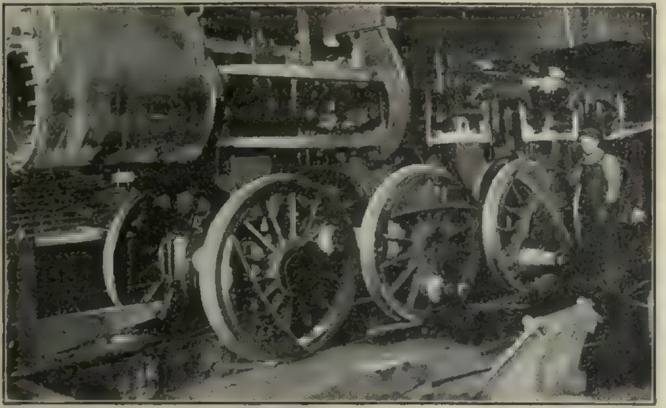


FIG. 6. WHEELING A LOCOMOTIVE

And this is not because there has not been marked and regular progress in the general methods of such repair shops, but because of the peculiar character of the work there handled, which necessitates the retention of many of the fundamental processes of the metal-working plant, in which skill of hand and brawn of arm are quite as essential as in the day when machine tools were as yet unknown.

Let the visitor pass through the machine department of the railroad shop and he will find in many instances the specialized methods of the manufacturing plant. He will see wheels and axles dismounted, new wheels and axles machined and assembled under the time-saving, intensive system of a well-conducted factory. He will see boxes poured, bored and faced, shoes and wedges planed, and other parts that are required in quantities machined in the methodical manner that would be characteristic of any up-to-date shop manufacturing similar parts as a specialty. And he will find modern equipment in the line of wheel lathes, turret machines, boring mills, radial drills and the like.

Now let him cross over to the erecting floor and observe the character of the work to be done on the locomotives over the pits. Examine, for instance, the engine shown in Fig. 1. Stripped to the very bones, obviously a tremendous amount of hand labor is required in refitting and putting the machine into working condition. To be sure, the crew of machinists, boilermakers and helpers who do this work make extensive use of pneumatic drills, air hammers, chisels and riveters, and to a degree there has been marked advance in the substitution of such tools for the simpler appliances of earlier times; but after all, these are virtually hand tools depending for results upon the old personal skill of the workmen, who must still hold the tools to their work and guide them properly for drilling and chipping cuts and for riveting blows. Moreover, many of the operations required in the overhauling process are of such nature, or are performed on such part of the engine, as to render impossible the application of any tools other than the time-honored simple appliances swung or rotated by the human hand and arm.

And still, on the other hand, there are various important operations on engines on the floor, which are now taken care of by means of mechanical devices, in most cases developed by individual shops for their own use and found to be valuable time and labor savers. These appliances are usually for some special purpose only; and while facilitating greatly the accomplishment of the work of which they are constructed, they cover only a very small fraction of the total work involved in the overhauling of a locomotive. It is in respect to these very appliances that the methods of one railroad shop often differ widely from those of another doing similar work, and frequently these special devices are an accurate measure of the degree of ingenuity developed by executives and workmen in the various departments of a given plant.

SOME SPECIAL APPARATUS

A number of appliances of this nature as devised and used at the Southern Pacific shops at Sparks, Nev., are here illustrated. Referring again to Fig. 1, there is of course nothing novel in the portable machine shown in the operation of reboring the steam chest for the piston-valve gage, but this view does illustrate the method of applying the boring outfit while simultaneously a multitude of other things are being done toward putting the engine into shape and getting it ready for wheeling.

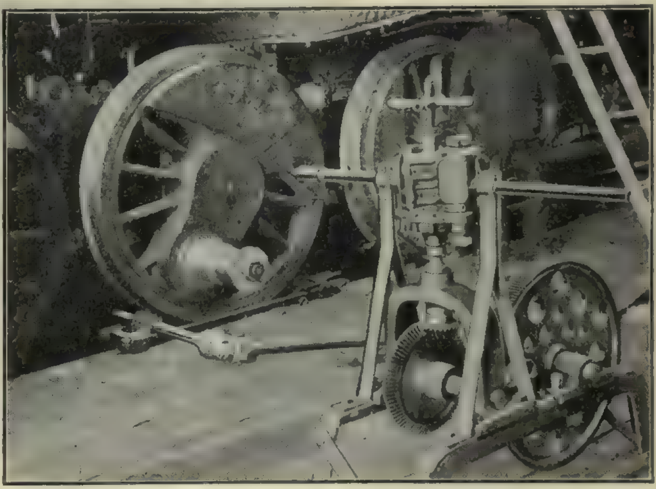


FIG. 7. WHEEL-TURNING APPARATUS FOR VALVE SETTING

At the extreme left will be noticed a portable oil forge or heater, which will be referred to in detail a little later. Near the middle of the boiler will be seen several lengths of air hose, which are carried across under the frame to operate pneumatic tools at the far side of the engine. The portable forge and rivet heater is shown clearly in Fig. 2. It is one of a number of similar pieces of heating apparatus used in various departments of the plant. It carries on a three-wheel truck a fuel-oil tank with a capacity of about 30 gal., and from the truck sides rise a set of standards for supporting the forge proper. The pipe connections for carrying the oil fuel to the heating chamber are shown at the top of the supply tank, and the air pipe will be seen at the right. The air connections are made by hose to any service pipe in the department.

A very dependable and convenient form of shop trestle for holding work platforms and enabling the men to stand at any desired height alongside the engine is shown by Fig. 3. The structure is of steel throughout and is in fact constructed entirely of old boiler tubes. The tube lengths for the uprights of the trestle are first swaged along one side to flatten and force the tube inward for nearly one-half its diameter, so that a section through the re-formed tubing would resemble a crescent. This treatment provides stiffness in the member and at the same time forms a convenient shape for the riveting on of the shorter crosswise lengths of tube which tie the uprights together in A-form and provide steps for supporting the planks or scaffold for the workmen. Another one of these arrangements will be noticed beside the firebox of the engine in Fig. 4, the locomotive here shown being almost ready for replacing the driving boxes and wheels—ready for wheeling, as the shop expression goes. Immediately in front of the trestle and to the left is another handy appliance, a portable pumping outfit for testing boilers.

This outfit is represented more clearly in Fig. 5, which shows the apparatus itself as mounted upon a small truck and also the pipe and hose connections from air and water supply and to the boiler. The pump proper is an old air pump, the cylinder of which is bolted securely to base blocks across the truck body and to upright braces, as indicated in the photograph. The boiler ready for testing is filled with water, and steam is then turned on through the pipe connection to heat the water. Then the air pump is set in operation for pumping up the pressure in the boiler.

FIG. 8. APPRENTICE-CLASS GROUP ON ENGINE OVER PIT

Fig. 6 illustrates the wheeling of this same locomotive. In the photograph the engine has been picked up bodily by the big overhead crane, the heavy slings for the purpose being hung from the two hooks of the double crane hoists and passed under front and rear ends of the locomotive, although only the sling for the rear of the frame is visible in the engraving. The four pairs of driving wheels and axles have been rolled into position under the engine and blocked in correct position on the track. The driver boxes have been placed upon the axle journals, so that when the locomotive is lowered by the crane, the boxes will enter the corresponding jaw openings in the frame.

The machine in Fig. 7 is another home-made device of the kind that helps along the work on the pits. It is used when operations on the locomotive have progressed to a point where valves are to be set and consequently a pair of driving wheels must be turned over. The rollers, placed under the wheels as shown, are adjusted by nuts on the bolts through the brackets.

The cross-shaft and toothed rolls are actuated through universal joints by means of a gear-driven shaft on the machine proper. This shaft is connected by spur and bevel gears with an air drill held in vertical position at the top of the outfit.

Reference has been made in earlier articles to the apprentice school maintained at these shops. In this description relating specifically to work on the overhauling pits, Fig. 8 should be of interest, as it shows last year's class of apprentice boys in a group.

Application and Use of the Booking Type of Core Box

BY J. V. HUNTER

SYNOPSIS — *The principle of the common type of molding machine is here shown to be applicable to the production of various kinds of cores. Enough examples and clear descriptions are given to leave no doubt as to the practical applications.*

IN GENERAL foundry practice for molding light snap-flask work on squeezer molding machines, the use of the hinged snap flask in connection with a similarly hinged pattern match plate has become quite common. The ease with which unskilled operators of squeezers can roll up this type of cope and then roll off the pattern has proved its merit to those who have adopted the system.

The underlying principle of this method can be applied to distinct advantage in the production of corework, if sufficient thought is only given to its development. This particularly applies to those small cores that must be made in two parts and pasted together after baking. This operation, in order to insure a nice job, is always a tedious one, requiring in some cases as much time to do the pasting as was originally taken in making up the two parts. Then, too, there is danger of breaking delicate portions of the cores while handling in performing this operation; and if the joint should come at some point where it is necessary to have a smooth surface, the joint between the parts of the core must be smoothed out with a daubing of plumbago paste.

QUESTION OF COST

All such operations requiring time are adding to the cost of cored castings; and although often core boxes are made in sections that are separable, so that sides or rims may be removed to facilitate the removal of odd-shaped cores, it is my idea that in many cases the hinged type of box could be applied to making many of these cores and not only speed up their production, but eliminate the pasting and other operations as well.

One of our earliest developments in hinged boxes is shown in Fig. 1, which produces the core shown in section at *B*, Fig. 5. This core is used in large quantities in making light cast sheave wheels, of 7-in. inside diameter. There are two of these patterns on a match plate, so that to get good draft the outside of the print is tapered on each side of the plate, as will be noticed from the section view. Otherwise, the box could be made with a single straight tapered side and a loose center plate, but this method would be slower for the coremaker on account of the time lost in ramming the sand under the center plate.

Referring to Fig. 1, the two halves of the box, which are of cast iron, are turned up from a center to insure the accuracy of dimensions. They are then faced together in perfect alignment, and the arms are drilled for the hinge pin. The small piece at *X* is provided to cut a gate through the outside rim of the core to permit the metal flowing into the rim of the wheel, as the section is such that the gate could not readily be provided for elsewhere. This gate piece is removable and is held in place by a single screw, so that it may be removed from either half of the box, one at a time, to make either the right- or the left-hand core.

The sequence of operations of the following figures shows the object of hinging the boxes on brackets at a little distance, about 9 in. above the surface of the work bench. One of these brackets, shown at *A*, Fig. 1, must be hinged so that it can be swung out of the way for lowering the right-hand box for the final operation.

Small handles are provided at the outside ends of the boxes to facilitate swinging them. We have found that these stand up better in service if forged up out of steel, the ends polished to remove the scale and rust to prevent "blowing," and placed right in the mold at the time of making the casting.

MAKING A CORE

Following now the sequence of operations in making a core with these boxes, the operation of filling is performed while in the position of Fig. 1. They are then rammed and struck off level with the top of the box, as in ordinary practice. Common foundry flour is kept at hand in a bag of coarse material, which permits it to sift through readily, and from this it is sifted in a coating over the surface of the two halves of the core, to afford sufficient bond. This naturally takes the place of the daubing of paste that would be necessary if the cores were made and baked separately, but requires only a fraction of the time.

The two boxes are then swung together in the vertical position, as shown in Fig. 2. Still held tightly together, they are lowered to the supporting bracket on the left-hand side. The right, or top, half of the box is then rapped smartly with a mallet and swung up and away, as shown in Fig. 3, leaving the two halves of cores resting together.

In Fig. 4 it will be seen that the swinging bracket that was supporting the right box has been momentarily swung out to permit the lowering of this box. A small core plate was placed on the top of the core as it lay in the position of the previous figure, and box, core and plate were swung over to the opposite side until the plate rested upon that bracket; then the box was rapped and swung off, as this figure represents. There is a possibility of the weight of a plate crushing a thin core, so sometimes a light ring of wood, of the exact height of the half of the core with a fair amount of clearance around the edges, is placed upon the edges of the box before laying on the core plate. This carries the weight of the plate and prevents any crushing, no matter how tightly the coremaker holds the plate in place while rolling it over to the final position.

After baking, the flour will have been found to have formed as solid a bond between the parts as if it were all one solid rammed core. Sometimes it is found that the boxes will leave a tiny opening at some of these jointed edges that might cause a very thin fin on the casting. To avoid this, before the core is placed in the oven, run your finger very lightly along this parting, and the sand will be pressed together without distorting the core.

Saving in Reinforcing Wire

Another saving is in the amount of wire reinforcing required to prevent the core from breaking when handled. Often, light core halves must have reinforcing in each half to prevent breakage while being handled for pasting, while the completed core would have been strong enough in itself so that all the work of making and placing the wires might have been avoided by the booking method of making cores. In other cores, such as the ring core illustrated, one wire placed in one half of the core while it is being rammed up furnishes plenty of strength to prevent breakage by the molder, whereas previously two wires were needed so that it would not be broken while being pasted by the coremaker.

Although there is very little heavy lifting with this style of core box, still all parts should always be made as light as possible. At *A*, Fig. 5, is a section view through this box, which shows all parts kept as thin as possible.

Cast-Iron Hinges

As some of the later boxes were of white metal, which is too soft and weak to be dependable for the hinges, and as these hinges require very accurate work and take considerable time to produce, several pairs of standard hinges of cast iron were made up, as shown in Fig. 6. They are planed off on the side that is to face the box, and are drilled for capscrews, as will be readily noticed by referring to the illustration showing the hinge.

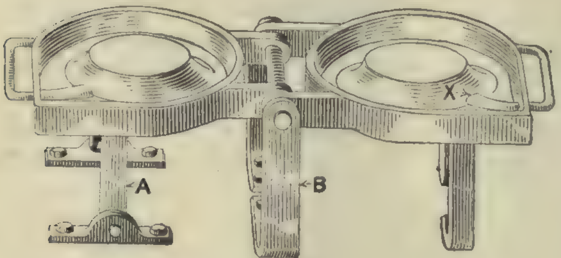


FIG. 1

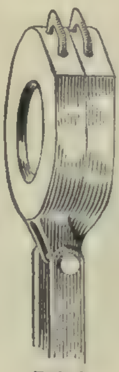


FIG. 2

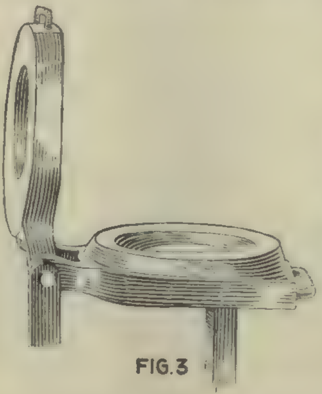


FIG. 3

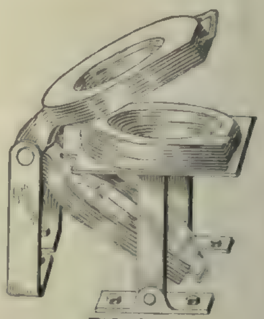


FIG. 4

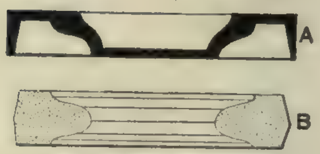


FIG. 5

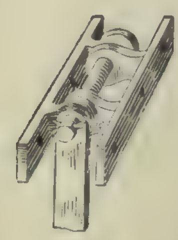


FIG. 6

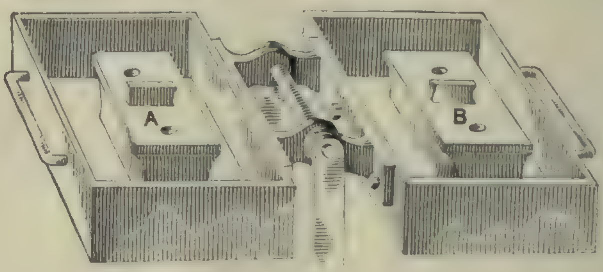


FIG. 7

FIGS. 1 TO 7. ILLUSTRATING TYPE AND USES OF BOOKING CORE BOXES

Often it is desired to produce pasted cores that have a hollow center, somewhat larger in size than the two openings that will appear on the outside of the finished core. In ordinary core practice this is accomplished by removing a loose piece from the box after the core is rammed and before rolling it over on the plate. This same method can be applied with a booking core box, and a specimen of this type of box is sketched in Fig. 7. The two loose pieces, in this case *A* and *B*, are held in correct alignment while the core is being rammed by dowel pins, the holes for which are drilled through to the surface on top to permit ready removal of all sand that might crowd into them. After ramming they are rapped slightly to loosen and then lifted out by the small knobs on top. A dusting of flour on the tops of the cores will permit them to be closed together the same as in the method previously described.

Another method to avoid the necessity of rapping the core box before swinging it off the core is to attach a pneumatic or electric molding-plate vibrator to one of the center vertical-hinge supports; by controlling this by a knee valve, the workman can have it vibrating the box at the same time that it is being lifted from the core.

The Sand Mixture

There are always several troubles that develop before any new device is in successful operation. One that occurred with this was that the first sand mixture we tried to use in our boxes was an oil-sand mixture, which, of course, contained little or no water—nothing in fact that would make the dry flour that had been sprinkled on develop any binding power. This trouble was avoided by spraying the top surfaces of the cores lightly with molasses water before dusting with flour, and no further trouble was experienced. Lately, the core sand has been limited almost entirely to core-compound mixtures that contain some water or dampness that is sufficient for making the flour binding.

The Care and Upkeep of Band-Saws

SPECIAL CORRESPONDENCE

SYNOPSIS—*Machinists and engineers are prone to think of woodwork as being of little interest from the shop point of view. This is sometimes due to the fact that manufactures of wood are not often held to sufficiently accurate dimensions to appeal to the man accustomed to high-grade metalworking processes. There are many lines of woodwork, however, that require very close limits, and the tendency nowadays is toward more accurate machinery and more attention to details in this field. The upkeep of the equipment is a branch that should attract the attention of mechanics in general, and this is as true of sawmill machinery as of wood-finishing shops. The care of band-saws, for example, is an art by itself, and one that ought to interest machinists of all grades of skill.*

TIME was when a saw filer in a lumber mill filed saws. Today he sharpens them and keeps them in order, but he certainly does not file them; and it is many a year since he has had occasion to make use of the file on saw teeth in any up-to-date mill. The machine process has entered here, as it has into all other departments of mechanical endeavor, and saw filing is now saw grinding. The saw filer (we shall still call him by this title in spite of the disuse of the file) nowadays places a dulled saw on the automatic grinder, and while this machine proceeds with its work of sharpening one tooth after another without human intervention, he goes about his business of preparing another saw for the operation of grinding.

The growing demands upon many classes of woodworking machines, demands affecting both quantity and quality of output, have led in numerous instances to the complete redesign and rejuvenation of various well-known types of apparatus, and to the consequent elevation of this equipment in construction and operation to a par with machine tools for working metal. The requirements as to limits of accuracy on certain productions of wood are today as exacting as was the case yesterday with metal products, and the demands for speed of output are keeping pace with the insistence upon quality in finished material. The old day, when any kind of woodwork was good woodwork, disappeared long since, and the wideawake designer and machine constructor realizes now that he must put forth his best efforts on woodworking machinery, just as he has long been doing in the building of machine tools. A little consideration of the problems that enter into the successful handling of woodworking machinery under present-day conditions will show that many of the details of upkeep in this line are really within the province of the skilled toolmaker and high-grade machinist.

The band-saw is without doubt the fastest cutting tool in existence. I do not know just when it was invented, nor do I recall the inventor's name; but it is quite safe to say that the man who first conceived the idea of putting cutting teeth on the narrow edge of a steel belt never realized at what terriffic speed this belt was destined eventually to be driven, nor how many thousand cutting teeth on this belt would pass in a moment's time through a log on the carriage of a modern sawmill.

Consider a typical instance—a head saw with teeth spaced, say, 1¾ in. apart. Cutting yellow pine, fir, cedar, etc., the saw is operated at 9000 ft. per min., which means that nearly 63,000 teeth pass through the log in that time—that is, over a thousand teeth per second and the saw blade moving at the rate of nearly two miles per minute! How does it do it and still hold to a true path through the rough log, without twisting out of shape and without whipping away from its flat-faced driving pulleys?

Here is where the skill of the saw filer and the alertness of the head sawyer are displayed. The one keeps the saw in proper condition and the other controls its actual operation and with careful hand regulates the carriage movement and the feed of the log to the cut. Both must have an intimate knowledge of the physical characteristics of different kinds of timber, and coöperation between the two is essential if high output and economy of production are to be attained.

PERSONAL SKILL AND KNOWLEDGE

The saw filer must know to what angle of hook to grind the teeth to give proper cutting qualities in various woods; what amount of swage, or upset, to give the points of the teeth to assure the right width of cut to clear the body of the saw; what curvature to provide on the backs of the teeth to give adequate strength; what degree of tension to give the cutting edge and the back of the saw, and what amount of stretch in its center, in order that the saw may draw tight over the pulleys along the entire length of both edges.

The sawyer is the man who, with his gang, gets out the lumber. Knowing the peculiarities of the material he is cutting and the constantly changing condition of the saw as it loses its keenness of tooth and becomes more and more dulled in its successive passages through the logs, he must control the rate of feed to the cut with all the skill and judgment at his command if he is to maintain the maximum rate of production throughout the day's run.

The speed with which the log is advanced to the saw—or, in other words, the cutting rate—may range from say 48 in. per revolution, or cycle, of the saw in pine and cedar with 12-in. depth of cut down to 10 or 12 in. per revolution of saw when cutting larger and tougher material. Taking a saw 46 ft. long with seven teeth to the foot, or roughly 300 teeth on the entire length of saw, the cutting feeds given mean a cut per tooth of from 0.15 in. down to 0.033 in., or approximately $\frac{5}{32}$ in. down to $\frac{1}{32}$ inch.

As already indicated, the regulation of these feed details is under the control of the sawyer's hand. In addition to keeping up the best rate of cutting possible, he must further save every moment he can in running his carriage back for each cut at the maximum speed compatible with safety, and no time must be unnecessarily lost in the operations of rolling fresh logs upon the carriage and throwing the log over for successive quartering cuts.

At Verdi, Nev., within a half mile of the California state line, is located a well-known steam sawmill, the plant of the Verdi Lumber Co. At the rear is the usual mill pond into which are discharged each day the big sticks brought by the logging trains from the camps away over on the California side of the Sierra Nevada slope. None of the giant redwoods or other famous timber of great growth is to be found in this section, but yellow and sugar pine, red and white fir, and cedar are in abundance.

Two of my friends, C. P. Stoffal and "Bill" Thompson, are respectively saw filer and sawyer at this mill, and in numerous visits to the plant I have learned from them various details of interest and value in connection with the upkeep and operation of band-saws.

One of these saws, 46 ft. in length, 13 in. wide and with teeth spaced 1¾ in. apart, is shown in working position in Fig. 1, the carriage with a 28-in. log in place being seen to the left.

The logs are hauled up into the mill from the pond by a chain and truck conveyor on an incline, and are then rolled onto a receiving rack from which they are transferred to the carriage for sawing. The question may arise in the minds of some as to the reason for dumping logs from a train into a mill pond instead of unloading them directly in the mill itself. The idea is to soak and clean the logs, for whether they remain in the water for a week or for two months or more, as the case may be, the effect of the soaking they receive is beneficial in preparing the fiber of the timber for sawing and in freeing the bark and outside surface of the logs from grit, gravel and, in many instances, fair-sized stones that are picked up in the fall of the tree or in the yarding and loading processes. These obstructions, and metal spikes that are sometimes driven into trees and logs, form a constant source of trouble in the sawing operation and are sure to break out one or more teeth from the saw unless discovered in time to avoid this accident.

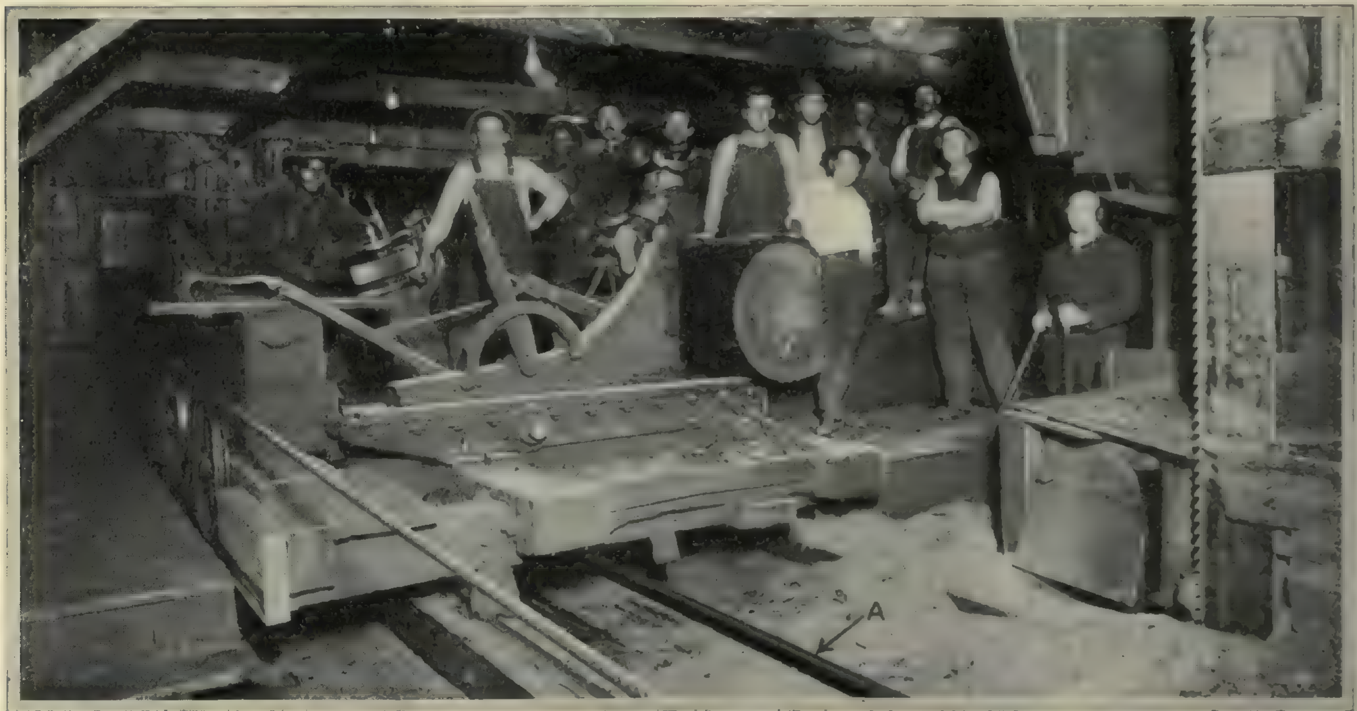


FIG. 1. A TYPICAL BAND-SAW INSTALLATION

If we refer now to Fig. 1, we shall see at *A* a long piston rod which governs the feeding of the log to the saw. This rod is actuated by a piston operating in a 10-in. steam cylinder which is nearly 35 ft. long and gives a piston stroke and clear carriage travel of well over 30 ft., so that logs of that length may be handled readily. The cylinder is supplied with steam through a 5½-in. pipe, and cylinder and piston combined make up what is known as a "shotgun feed." This term is probably derived both from the long slender proportions of the apparatus and the rapidity of operation. For although the feeding movement for the cut may be held down to a reasonably slow rate of travel if expressed in feet per minute, the return trip of the carriage after each cut is accomplished at nothing less than spectacular velocity. It would seem that the only limiting factor in determining the speed on the back run is the ability of the men on the carriage to retain their positions. Of the two men who ride the carriage regularly, one is the ratchet setter, who by revolving the crank handles about the ratchet wheel at the front of the carriage controls the cross adjustment of the log for each pass along the saw and thus regulates the thickness of each plank; the other dogs and clamps the log, sees that it is secured in place for sawing, and at the signal from the sawyer releases it for the turning-over operation.

The band-saw is very clearly shown in Fig. 2, together with the wheels on which it runs. Some of the dimensions are also given. It was originally the custom to provide these pulleys with high crowned centers and to face them with rubber or other material of somewhat similar character. The crowns were supposed to be essential to keep the saw running true and to prevent it from being forced back off the face of the pulleys; and the rubber or other special surface on the rim was thought necessary to keep the steel saw band from slipping under the cutting and frictional-retarding action when the saw was in the log.

But later in the history of the band-saw bare rimmed pulleys were adopted, and today these pulleys are finished straight across the face. Every effort is made to keep them perfectly true, a condition that is maintained at some mills by applying a portable grinding device to the pulley while the latter is running with its shaft in its own bearings.

Also, the saw is nowadays stretched and tensioned in such a manner by the saw filer as to secure true running qualities by the fact that the cutting edge and back edge are both made to draw tight over the pulleys while the middle of the width is loose enough to clear the pulley face. The two edges of the saw, however, are not the same length, for the back is stretched slightly more than the cutting edge, for reasons that will appear later. At least it is the custom at the Verdi mill to give this additional "back" to the saw, although it may not be universal practice among saw filers throughout the country.

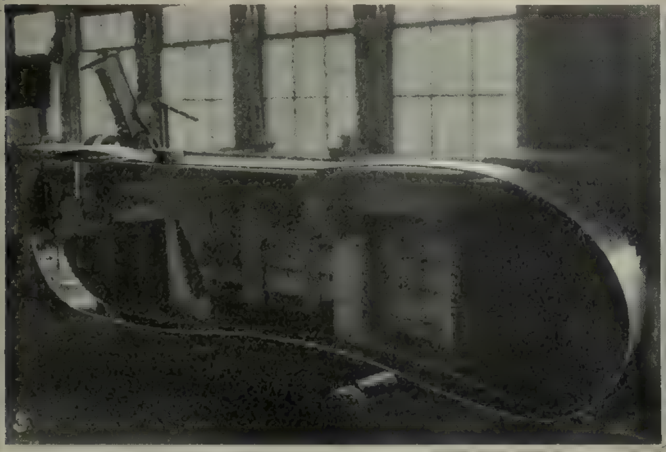


FIG. 3. THE SAW STRETCHER OPEN

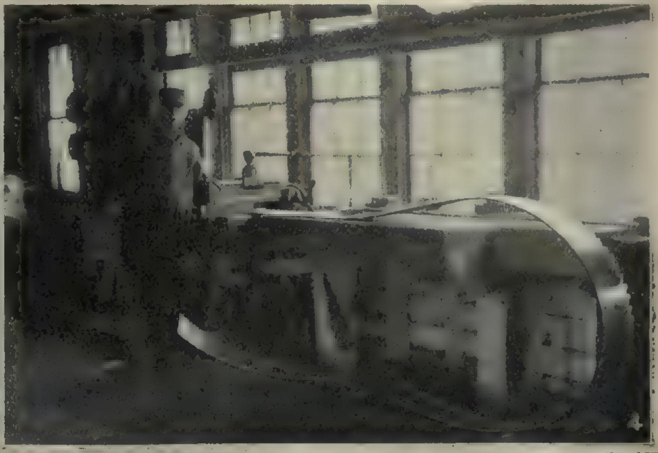


FIG. 4. THE SAW STRETCHER CLOSED

The saw pulleys at this mill are placed as shown in Fig. 2, with the upper pulley of the pair tilted slightly toward the toothed edge of the saw, giving a shorter center distance between shafts at the front of the pulleys than at the rear. This has been found to aid in maintaining the truth of the running of the cutting edge and to eliminate any tendency of the saw toward crowding back on the pulley. At the same time it compensates in a degree for the increased length of the saw back. It is evident from the operation of this drive that the steel band does not exhibit the tendency displayed by belts in general to climb to the high side.

SOME SAW DATA

The dimensions in Fig. 2 show the diameter of the pulleys to be 8 ft. and the width of face 11½ in. The saws used on this mill are 46 ft. long, and when new are 13 in. wide, the width gradually decreasing with each grinding of the teeth. There are eight saws in the battery used on this mill, one being in use and the others in reserve or being sharpened or tensioned.

Ordinarily, one of these band-saws while operating in pine, fir, spruce and the like will run for about five hours before requiring resharpening; that is, if no obstruction in the shape of stones or metal is encountered to injure the teeth and necessitate premature removal of the saw. Occasionally a saw has been run for eight hours without change. When the saw is removed, a freshly ground one is put in place at once. Usually not more than 10 min. time is required to change saws. After a saw has been resharpened three times, or perhaps it would be better expressed to say after it has had three runs on the mill, it requires retensioning. This is an operation that occupies the greater portion of the saw filer's time and attention, as the sharpening process is usually delegated to his assistant, who puts the work on the automatic grinder, swages the tooth points and watches the operation of the machine as it finishes one tooth after another.

The method followed in sharpening teeth on the grinding machine will be referred to a little later in this article. For the moment, let us take up a few details of the stretching, tensioning and gaging operations accomplished by the saw filer to assure correct running of the saw after it is again placed in service in the mill.

In Fig. 3, at the left-hand end of the bench, will be noticed a machine shown open and in Fig. 4 the same machine closed. This is the saw stretcher, which carries under its head a 4-in. roll $\frac{5}{8}$ in. wide, for working the flat surface of the saw as required.

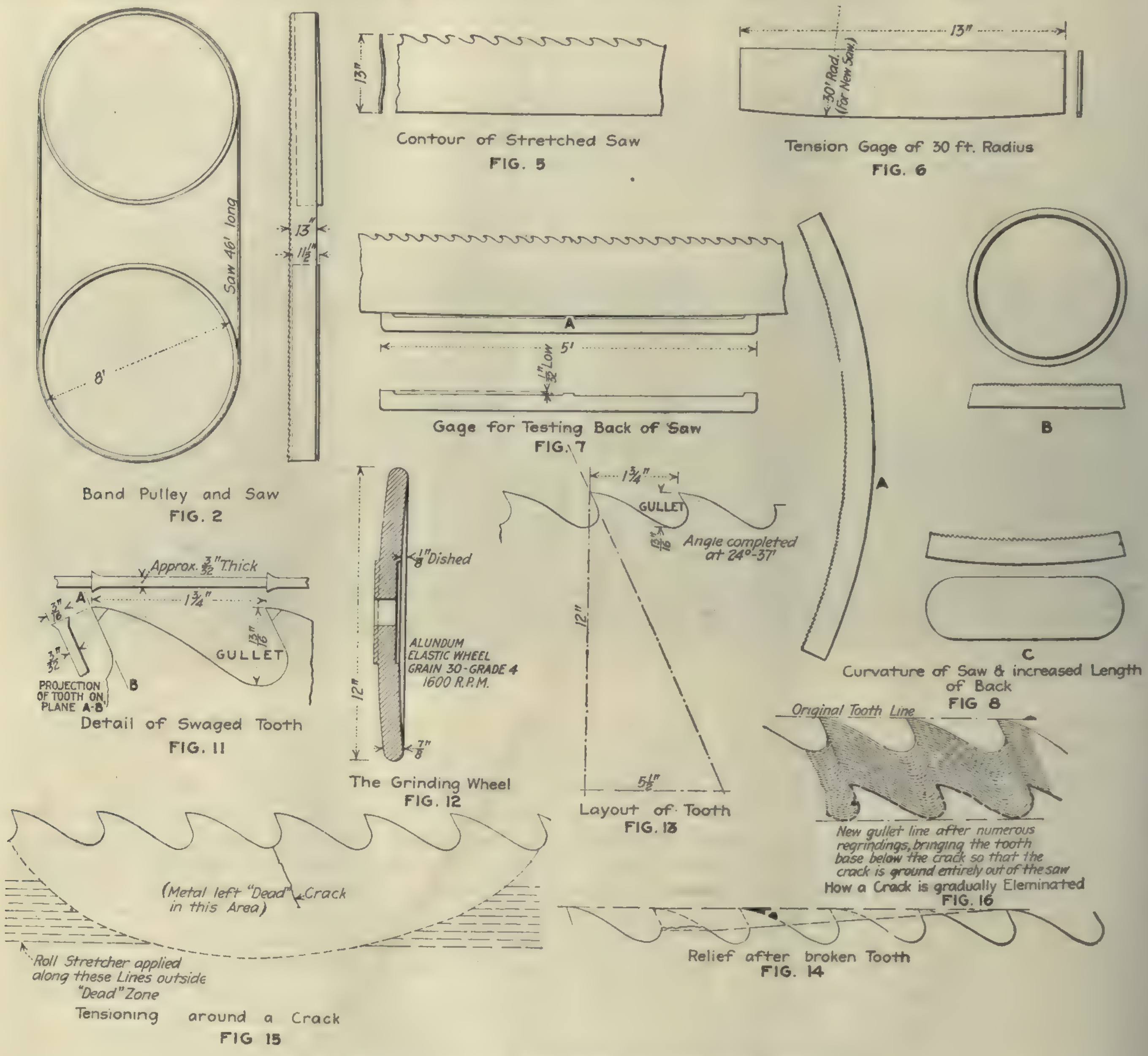
The head is pivoted at the rear, and when swung up it opens the machine for the reception of the saw. When closed the head is locked firmly in horizontal position, permitting the roll to be forced down upon the work with any desired degree of pressure through the medium of the adjusting screw and lever at the top, and also allowing the filer to feed the saw back and forth under the roll by manipulation of the handwheel under the machine.

Starting in with the roll pressing upon the saw at a point near the bases of the teeth, the filer moves the saw back and forth under the roll, a few feet at each stroke, and gradually works toward the center of the blade, increasing the pressure somewhat as the middle of the width is approached. Then, working along similar lines from the back of the saw, he accomplishes the stretching of the material along the entire length of the saw until the middle portion when tested crosswise with a gage applied at close intervals along the whole length of the work shows that the desired degree of convexity, or looseness, has been secured. The stretching effect across the middle of the width exhibits itself by causing the saw body to bulge upward along the center, as indicated by Fig. 5, but in testing the curvature for uniformity at numerous points a convex gage, Fig. 6, is applied crosswise, this gage being pressed down to spring the bulged, or stretched, surface downward so that in cross-section it is concave. If it then corresponds to the convex templet, it is satisfactory.

In the drawings the degree of curvature representing the stretch of the saw has been exaggerated to illustrate this feature more clearly. Actually, the amount of curvature, or deflection, from a flat plane is very slight. Thus the templet, or gage, has a radius of 30 ft. There are four gages in the set used at this mill, the radii of the other three being respectively 25, 20 and 15 ft. As the saw narrows down in width due to regrindings of the teeth, a gage of shorter radius is used, until eventually, or after about four months' run, the 15-ft. radius gage is applied and is the one utilized until the saw has been ground to the minimum permissible width, or say 9 in., and disappears from service.

Now, while the effect of the rolling of the surface of the saw is to stretch the middle, as stated, there is also produced under the same operation the tensioning of the two edges—that is, the closing up or tightening of the texture of the metal near the cutting edge and the back. The work of the roll in this direction may be supplemented by the use of the hammer in treating local spots of small area which appear to be "dead" and require "tightening" up.

With the body of the saw stretched as explained, to stand up and away from the flat plane of the two edges, the latter are sure to draw tight and smoothly over the two pulleys when the saw is put in place for operation, and the pull of the lower pulley which does the driving is then directly on the edges of the saw, so that


Saw 46' long
8'
13"
11/2"
13"
30' Rad. (For New Saw)
13"
A
5'
1/32" Low
A
B
C
Approx. 3/32" Thick
A
13/4"
3/16"
3/32"
13/16"
GULLET
B
PROJECTION OF TOOTH ON PLANE A-B
1/8" Dished
ALUNDUM ELASTIC WHEEL GRAIN 30-GRADE 4 1600 R.P.M.
12"
7/8"
13/4"
GULLET
Angle completed at 24°-37'
1/16
12"
51/2"
Original Tooth Line
New gullet line after numerous regrindings, bringing the tooth base below the crack so that the crack is ground entirely out of the saw
(Metal left "Dead" in this Area)
Crack
Roll Stretcher applied along these Lines outside "Dead" Zone

Band Pulley and Saw
FIG. 2

Contour of Stretched Saw
FIG. 5

Tension Gage of 30 ft. Radius
FIG. 6

Gage for Testing Back of Saw
FIG. 7

Curvature of Saw & increased Length of Back
FIG 8

Detail of Swaged Tooth
FIG. 11

The Grinding Wheel
FIG. 12

Layout of Tooth
FIG. 13

Relief after broken Tooth
FIG. 14

Tensioning around a Crack
FIG 15

How a Crack is gradually Eleminated
FIG. 16

FIGS. 2, 5 TO 8, 11 TO 16. A NUMBER OF BAND-SAW DETAILS the teeth will run in a true, straight path while the work is being done.

It has already been pointed out that at this mill it is customary to "stretch" and "tension" the saw in such manner that the back edge shall be slightly longer than the front. This is to provide for a firmer pull on the cutting edge than would be secured with both edges of exactly equal length. At the same time the increased length of the back must not be enough to allow the back to whip away from the pulleys when run at the customary high rate of speed, for any tendency of this nature would cause the cutting edge to be sprung, or deflected, in the opposite direction, or toward the axis of the pulley, and the saw would then tend to run out from the log and cut its way out through the plank instead of hold to the prescribed straight course for the entire length of the log.

On the other hand, were the back too tight as compared with the cutting edge, the latter would be buckled, or deflected, away from the pulley and would then tend to run toward the center of the log.

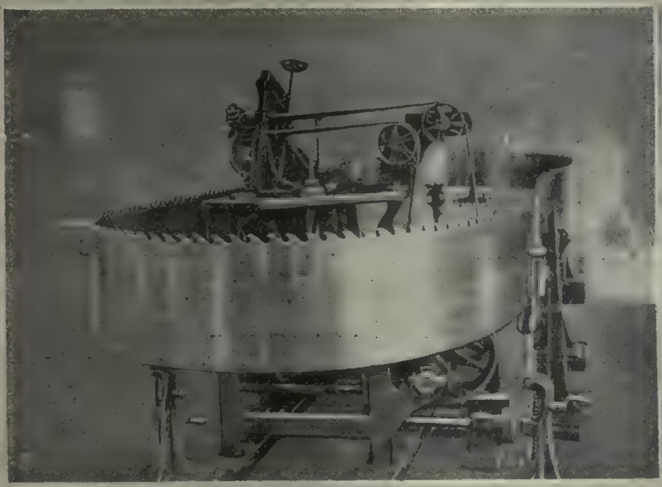


FIG. 9. THE SAW-GRINDING MACHINE

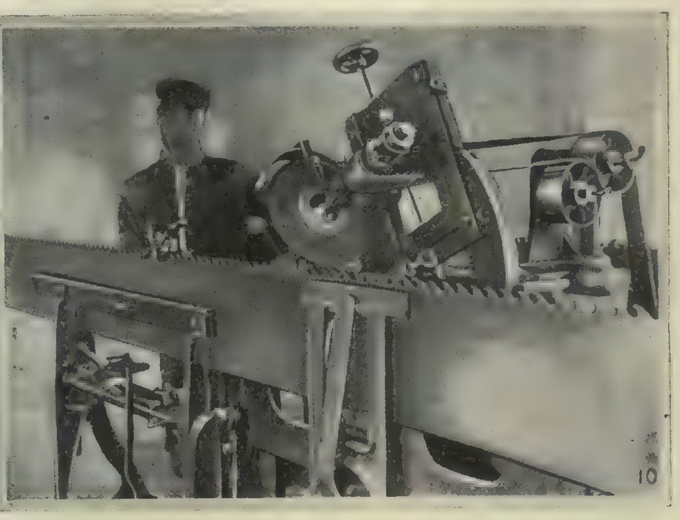


FIG. 10. A CLOSE VIEW OF THE GRINDING WHEEL

The working of the back of the saw to the proper relative length, or the "putting in of the back," as it is termed, is gaged as in Fig. 7. The gage is 5 ft. long, and the central one of the three bearing spots is $\frac{1}{32}$ in. low, so that the device forms an arc, or radius, gage. The back edge of the saw is worked under the bench roll as described until it conforms in curvature to the gage, which, as will be seen, is a measure of the increased length given the saw back by the process referred to.

The effect of this elongation of the saw back can best be appreciated by an inspection of Fig. 8. At *A* is shown a saw with an exaggerated degree of curvature to more clearly illustrate the point. If we cut out a paper templet to this form and join the ends, the flat arc now becomes a conical ring, like *B*, the taper being due to the difference in length between the two edges. If, again, we place this ring on one side as at *C*, to give it the same position the band-saw occupies when on the filer's bench, the convex arc assumed by the back of the saw in the horizontal plane becomes most conspicuous. It is with the saw in this position that the filer gages the back for convexity, as in Fig. 7, and by application of the gage along the whole length maintains a uniform degree of curvature for the entire back of the saw.

Two views of a band-saw on the grinding machine are reproduced in Figs. 9 and 10, the first showing the entire machine with saw inclosing it, the other bringing out more clearly certain important details of the wheel head. The saw is carried upon roller supports, adjustable to suit various widths, and is guided between long jaws at the front of the head to steady it under the action of the grinding wheel.

The hand device shown at the left of the wheel in Fig. 10 is for swaging up the points of the saw teeth to shape and width preparatory to grinding.

The essential features of this apparatus are an open block with anvil for dropping over the saw tooth and resting against the edge of the tooth, and an eccentric swaging jaw which is operated by the hand lever to swing up past the tooth edge and work the end of the tooth to the required form and width. The swager is readily set for one tooth after another, and the work requires comparatively little time for each tooth.

Fig. 11 is referred to now to illustrate the form of the tooth, particularly the shape of the swaged, or upset, portion at the top and front. This sketch, which is from a standard head saw of $1\frac{3}{4}$-in. pitch, shows the saw blade to be approximately $\frac{3}{32}$ in. thick and the point of tooth $\frac{3}{16}$ in. wide. The swaging process forms a prismatic section at the top of the tooth, and this has approximately equal slope in both front and top planes.

The face *AB* is the one that is sharpened for cutting, but in this sharpening process the entire tooth contour is ground as well. This method maintains a standard form of tooth along the whole length of the saw, and thus the entire series of teeth are kept to original contour until the saw has become too narrow for further service and is laid aside.

Details of Wheel Head and Wheel

As will be noticed upon looking again at Fig. 10, the wheel head is mounted upon a swiveling stand which may be swung through any desired angle in the vertical plane. This oblique setting of the head allows teeth with any required degree of slant, or "hook," to be ground, the front or cutting face of the tooth being sharpened by the travel of the wheel head in its inclined guides. The curved contour of the back of the tooth from the cutting point down into the gullet is taken care of by a cam movement which produces a combined action upon the part of wheel head and saw, so that the wheel while rising from the gullet grinds the curved back on the tooth. That is, as the wheel reaches the bottom of the tooth face and finishes the gumming cut, it starts upward at the instant the saw begins its forward movement, and the shape of the feeding cam which determines the relative movements of wheel and saw tooth determines also the shape of the tooth back. Modification of this cam and adjustment of the wheel slide can be made to suit any conditions in tooth form.

The indexing of the saw to bring one tooth after another into position for grinding is accomplished by a reciprocating feed finger which acts directly against the face of the tooth.

The grinding wheel used is a Norton alundum elastic wheel, grain 30, grade 4. It is 12 in. in diameter when new, and as shown by Fig. 12 it is slightly dished. It is ⅞ in. thick for the saw under discussion, and its speed on the grinder is 1600 r.p.m., which gives it a peripheral velocity of a little over 5000 ft. per minute.

The saw teeth are indexed under the wheel at the rate of about 60 teeth per minute, and the entire saw is ground once around in about 10 min. It is usually passed through the grinder three times for each resharpening, a total of $\frac{1}{64}$ in. being removed.

TOOTH DETAILS

The shape of a saw tooth, and particularly the angle of hook, is made to suit the kind of wood to be cut. Also the pitch, or space between the teeth, is determined by the same consideration. For the timber handled at this mill, the spacing of 1¾ in. has been adopted for head saws, and the hook angle works out at about 25 deg. The hook is laid out, however, as in Fig. 13. A line is scribed square across the saw and against the tooth point, and at a distance of 12 in. from the tooth another line is drawn at right angles on which a point is marked off just 5½ in. from the perpendicular line across the saw. An oblique line is then drawn from this 5½-in. baseline to the top of the tooth, and this slanting line then represents the angle of hook to which the tooth is to be ground.

TAKING CARE OF BREAKS

There are various repair jobs in connection with band-saws, aside from the legitimate operations in grinding and tensioning. Once in a while a saw tooth will be broken out by striking an obstruction in the log, and sometimes several teeth will disappear under similar circumstances. It is the custom in such cases to grind off the tops of several teeth at an easy slope behind the broken tooth, as indicated in Fig. 14. This allows the teeth immediately following the break to enter the cut gradually, and the first complete tooth to take its cut easily without the possibility of jumping into the cut abruptly, as would otherwise be the case, with the attendant liability that it too would be broken off short. After numerous regrindings of the saw, the stubbed teeth eventually resume their original full height or depth, as the gullets of all are ground uniformly with the perfect teeth in the passage of the saw through the grinding machine.

Sometimes a small crack starts at the base of a tooth. When this is discovered, and such cracks are carefully sought for in band-saw inspection, a center-punch mark is made at the bottom of the crack on both sides of the saw. This procedure prevents the crack from extending further, but as it constitutes a weakness which may later cause a local break, the saw filer takes measures to remove the stresses due to working conditions from that portion of the saw.

He places the saw under the bench machine and rolls and tensions the metal outside a zone surrounding the crack and extending in either direction for a distance sufficient to include several teeth. This zone is indicated by the dotted lines in Fig. 15. The metal inside the zone he leaves "dead"—that is, without tightening it at all—while the metal immediately outside the zone is tightened and tensioned so as to form a strengthened arc around the break to transmit the pull of the saw and by carrying the stresses around the outside of the indicated area relieve that section from liability of further fracture.

In the course of time, repeated sharpening of the saw carries the tooth line down to a point where the crack is entirely ground out, as shown by Fig. 16, where the dotted lines represent the series of contours produced in successive grinding operations.

The Businesslike Requirements on Contract Work

By W. A. VERNON

It is time our Government work was put on a businesslike basis. As estimator for a machine shop doing a large contract business, I see many inquiries accompanied by specifications and drawings; and I must say that those from our Government are well calculated to cause high prices to be quoted.

A recent instance will show what I am driving at. We received an inquiry for a small quantity of machines with a long list of specifications. Among other requirements was a clause stating that every piece must be interchangeable with every other piece and also with a model machine that would be furnished the successful bidder. Whenever the model and drawing did not agree, the model was to be the standard, although only drawings were furnished for preparing estimates. Right here is where the estimator commences to figure on extra work, work that should be unnecessary, such as carefully measuring every part of the model to establish correct dimensions and putting these dimensions on the drawings wherever they differ with the model. What difference there may be and how much it will increase the cost is a matter for him to settle.

The prints submitted were, some of them, so badly blurred in printing as to be illegible; in some cases several parts were only shown assembled, and these prints were a mass of lines and pattern figures. Many holes were not standard. I recall three in one casting which were for bronze bushings. These were to be 0.850, 0.825 and 0.700 in. in diameter respectively—more unnecessary expense for special reamers and plug gages.

Many screw threads are of special diameter and pitch, even where any standard thread would answer; for instance, the hole in a cap to screw on the nozzle of an oil can is to be 0.300 in. in diameter by 24 pitch. Even Whitworth threads are used in some cases. Castings which have plenty of room when assembled and which are painted are marked "finish all over." Parts made of flat cold-rolled steel which could be a commercial thickness are given a size that necessitates grinding; "X" bronze was specified for some parts, but there was no attempt to inform bidders just what "X" bronze is.

Although strict interchangeability is required, thus necessitating a number of first-class jigs and other special tools, the quantity to be ordered is less than 50 machines; and of course, the cost of all special tools must be included in the price quoted.

There is a big field here for reform. A few practical men could save a huge sum, if they were permitted to redesign most Government machine work to put it on an economical manufacturing basis.

We recently received an inquiry for some gages. The limit allowed was plus or minus 0.000025 in. I wonder who is going to measure them and how long they will remain within this limit, even if they are correct when measured.

The machines referred to would be very necessary in case of war. Certain parts wear rapidly and sometimes break; but in spite of the talk about preparedness which has been in evidence for the last two years, I was told that the supply of spare parts was (in some cases) entirely exhausted, because appropriations had been so small.

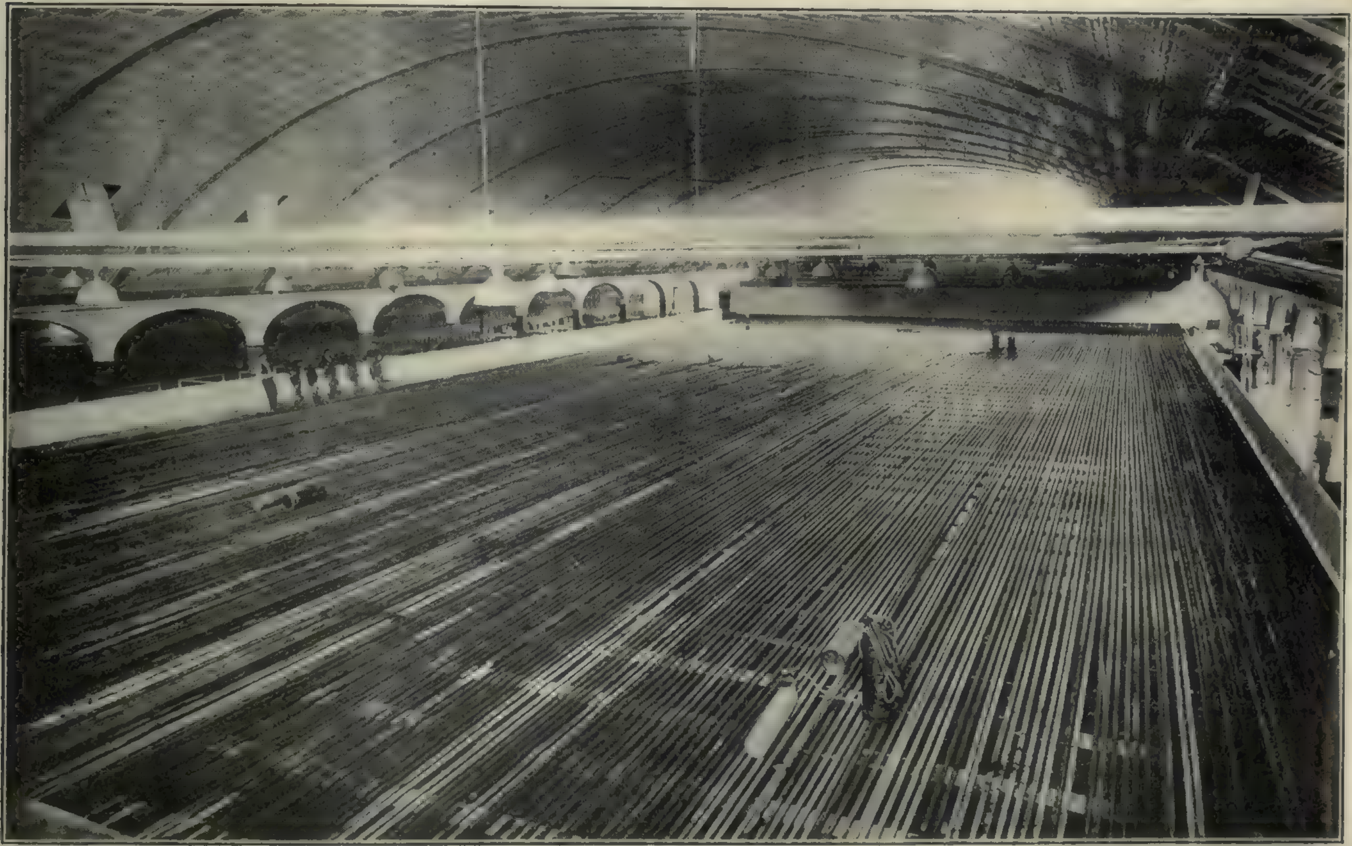
Regarding the close limits referred to above, one of the largest gagemakers in the country refused to accept a contract for gages specified to the fourth decimal place.

Ten Miles of Two-Inch Welded Pipe

To make 10 miles of pipe as one continuous pipe—make every joint leakproof and troubleproof when buried in ice—was the problem that confronted the builders of the Winter Garden ice rink at San Francisco.

Investigations had shown that, in many ice rinks where ammonia systems are built with screwed fittings, leaks frequently develop in the joints, necessitating shutdowns for repairs, to the financial loss of the management and displeasure of patrons.

Oxyacetylene welding not only made the San Francisco ice rink leakproof, but made possible a remarkable saving in the purchase of pipe. Instead of using new pipe, 55,000 ft. of 2-in. used boiler tubing was purchased at a saving of 20 per cent. over the cost of new galvanized pipe. Every joint in the system was then welded by the Prest-O-Lite process.



TEN MILES OF TWO-INCH WELDED PIPE

The floor is 210 ft. long and 90 ft. wide, and the welded joints number considerably more than 2000. The contractors assert that the work was done by average welders and that the cost per joint was approximately the same as that of an ordinary screw connection.

The rink has been in operation for about six months; and the management reports that not a leak has developed in the several thousand joints, which is considered a record among those familiar with skating-rink ammonia systems.

The material and workmanship of boiler tubes are of course better than those of wrought-iron pipe. The tightness of the job is no doubt to a great extent due to this fact, as ammonia-tube leaks are often caused by seams.

Building a Precision Lathe

By M. E. HOAG

SYNOPSIS — *This article is instructive as to the methods used in one of the large precision lathe factories. Many of the jigs and fixtures shown may be adapted in principle to other lines.*

At the present time, when so many shops are manufacturing lathes and other machine tools, some of the methods in use at Hardinge Brothers, Inc., Chicago, Ill., will no doubt prove of interest, especially so as this concern has been engaged in the manufacture of precision machinery for a number of years and knows the value of accurate tools and jigs to secure absolute interchangeability of parts. This means that a customer can replace any broken part or order any special attachment for one of the company's lathes and have the satisfaction of knowing that it will fit and not require any adjustments to put it in shape for work. These parts include not only screws, nuts, etc., but every element that enters into the construction of the lathe and its equipment, such as headstocks and tailstocks, carriage, lead-screw, raising blocks, etc.

Fig. 1 shows one of the firm's 9-in. lathes blocked up to swing 15 in. (This lathe was described in detail and fully illustrated on page 963, Vol. 41.) Fig. 2 shows a lathe bed in position on the planer, with the gage block, or templet, *A* for setting the planer tools and giving exact form and size to the finished lathe bed. This insures that all beds will be the same when finished. The usual methods of roughing, seasoning, finish-planing and scraping are followed on this work.

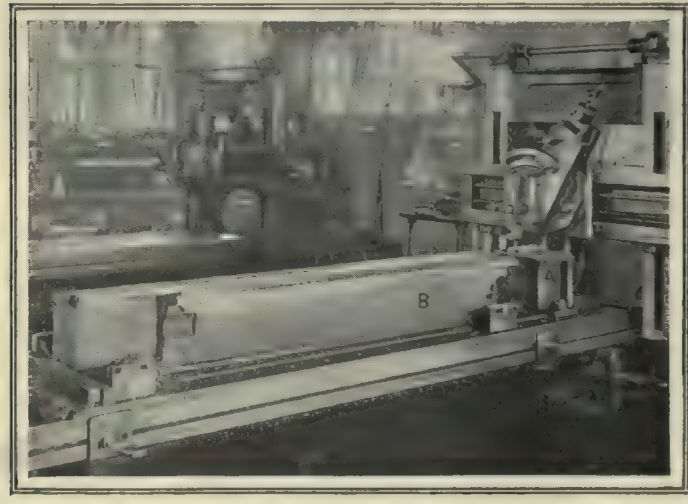


FIG. 2. LATHE BED IN POSITION ON PLANER

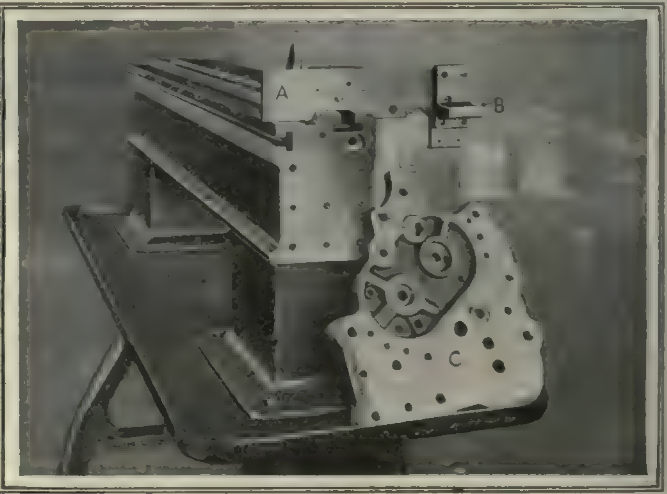


FIG. 3. JIG FOR END OF LATHE BED

Fig. 3 shows an end view of a lathe bed with gage and drill jig for drilling all screw, dowel and stud holes in the bed, head and gear case. This is a particular part of the work, for if these holes are not properly spaced and do not match with the corresponding parts in which the gear, etc., fit, there is sure to be trouble. The holes in this jig, as well as in most of the others used, are held to within 0.0005 in. for proper spacing. After the bed is finish-planed and scraped to standard, the gage *A* is clamped to the ways, the gage block *B* removed, and the jig *C* located by the two dowel pins. All holes are then drilled in the end of the lathe bed.

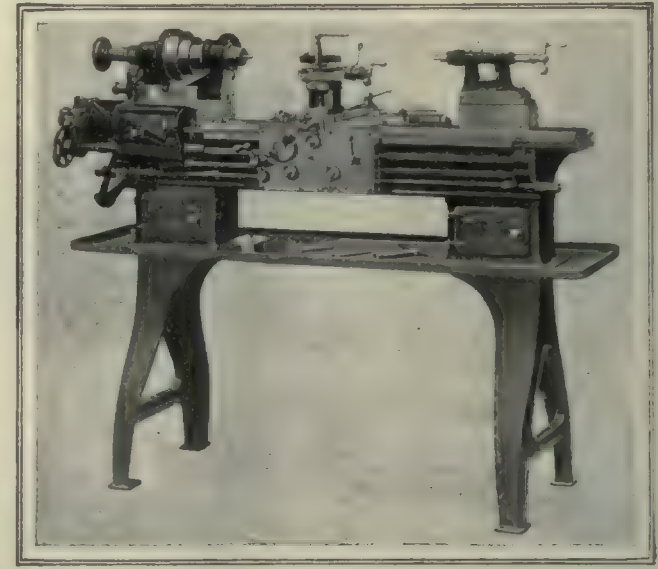


FIG. 1. LATHE WITH RAISING BLOCKS IN PLACE

This same drill jig is used for drilling the corresponding holes in the gear case, thus insuring perfect alignment. After the bearings of the carriage are scraped to the lathe, the gage *A*, with the gage block *B* in position as shown, is clamped to the lathe and a dial indicator set to the top of the gage block. By transferring this to the top of the carriage, the number of thousandths to be removed is indicated and marked. The indicator is then set to the under side of the gage block and the number of thousandths to be removed from the under side of the carriage is shown. The carriage is then taken to the planer and the proper amount of stock removed. This point is quite important, for the apron secures its location from these planed surfaces; and if they are not correctly located with relation to the ways of the lathe, the feed nut, studs and gears will not align properly with the screw and other parts of the lathe when the whole is assembled.

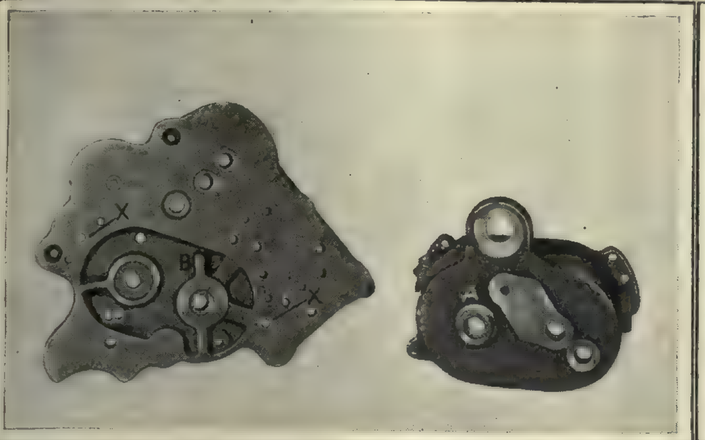


FIG. 4. GEAR CASE BORING AND DRILLING JIG

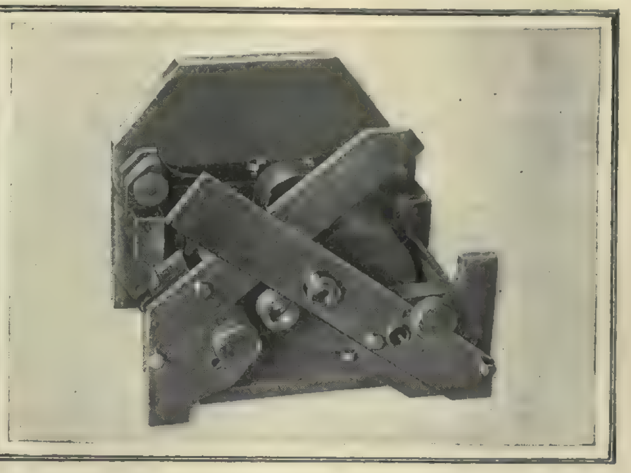


FIG. 5. GEAR CASE DRILLING AND REAMING JIG

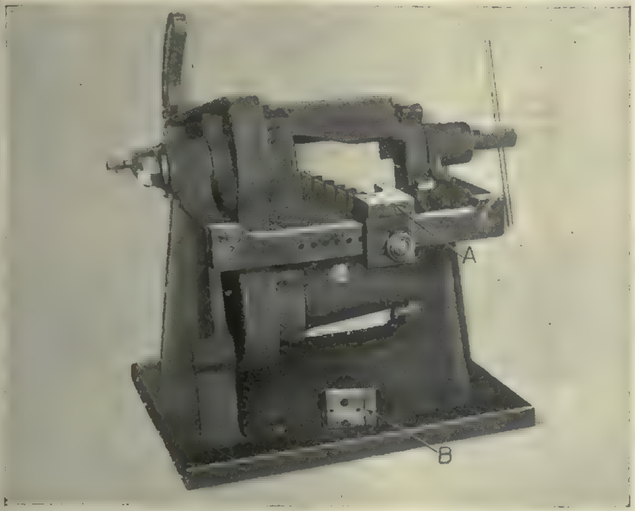


FIG. 6. INDEXING JIG FOR GEAR BOX

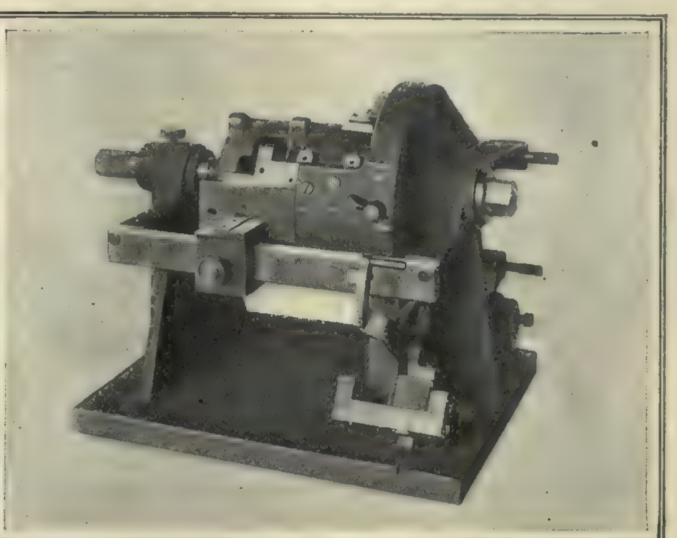


FIG. 7. ANOTHER GEAR BOX INDEXING JIG

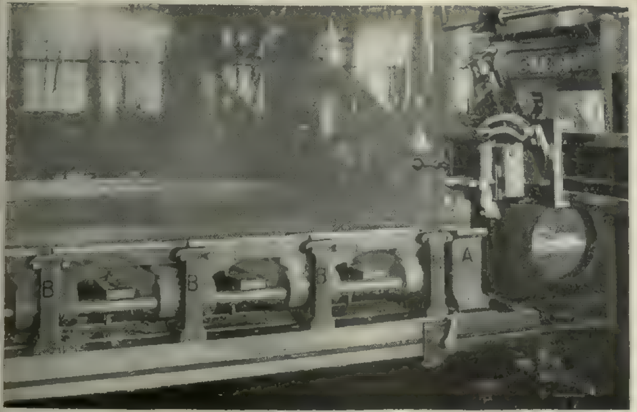


FIG. 10. PLANER FITTED FOR MACHINING HEADSTOCK

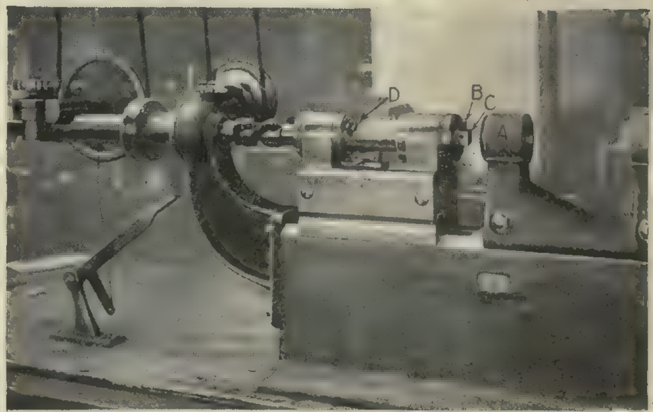


FIG. 11. HEAD AND TAILSTOCK BORING MACHINE

Gear cases, like the one shown at *A* in Fig. 4, are first faced to thickness and then bored on a lathe, using the templet *B*. This plate is located on the lathe in the usual way, by the use of suitable plugs, the case being located on the master plate by the two dowels.

Fig. 5 shows a drilling and reaming jig for one of the gear cases. This jig permits the drilling and reaming of all holes with one setting, the jig being used in seven different positions to accomplish the necessary operations.

The indexing jig shown in Fig. 6 is used first on the shaper for planing the nine steps for the change-gear lever. For this operation, the block *A* is removed and the block *B* substituted. The milled portion of this block is used as a depth and position gage for the planing tool. The jig is indexed for each step and the gage block moved one hole. After planing, the entire bar that carries the gage block is removed, and a thin milling cutter is used to cut the slots between the steps. Then the bar is replaced and the plate *A* with drill bushings is replaced as shown in the illustration and the screw holes in the steps drilled and tapped.

Fig. 7 shows a similar milling and drilling jig that is used on the three-step gear case. Fig. 8 shows the two indexing milling and drilling jigs for the nine-step and three-step locks that fit the gear cases just described. Suitable gage blocks, as shown at *C* on jig *A*, are used for setting the milling cutter. After milling, these locks are again set in the jigs, and with the drill plates in position the screw holes are drilled and tapped.

Fig. 9 shows a box jig used in drilling the holes in the carriage apron. This jig and other similar ones look very simple, but when one stops to consider that all the numerous holes are located to within 0.0005 in., it will be readily seen that they required a great deal of time and careful work in building; and they cost a considerable sum. Mr. Hardinge figures that money spent for accurate jigs and fixtures is money well invested and pays back the original outlay many times over.

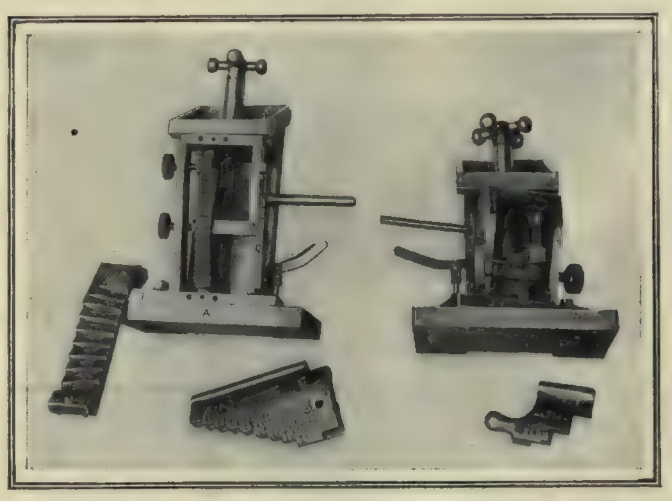


FIG. 8. TWO INDEXING AND MILLING JIGS

Jigs Used for Several Sizes of Lathes

The manufacturer of this precision lathe makes a number of bench lathes of various sizes, and on a number of common parts the same tools, jigs and fixtures are used, thus saving a great deal in expensive fixtures. This is well illustrated in Fig. 10, which shows a line of headstocks being planed up. The planer bed and the locating supports *BBBB* form a jig of themselves for holding the heads in position. Similar ones are used for the tailstocks, and the size and form gage *A* is used as in planing up the beds. After roughing, the heads are finish-planed and scraped to standard, and the rough-boring and finish-turning and threading are done in the lathe, after which they are taken to the special boring machine shown in Fig. 11 and the taper holes finish-bored.

The same boring machine is used for all headstocks and tailstocks, a straight boring bar and suitable supports being used for the tailstocks. The head shown in the illustration is the one used to bore out the taper hole for the spindle journals. *B* is the cutting tool, *C* is the toolholder and *D* is the star-wheel feeding device. After the cut is started, each revolution of the boring head turns the star wheel a part of a revolution, and this in turn feeds the toolholder *C* forward a few thousandths of an inch. This holder is set in the head at a 3-deg. angle and produces the required taper for the journal. The finish is so smooth that no scraping is required.

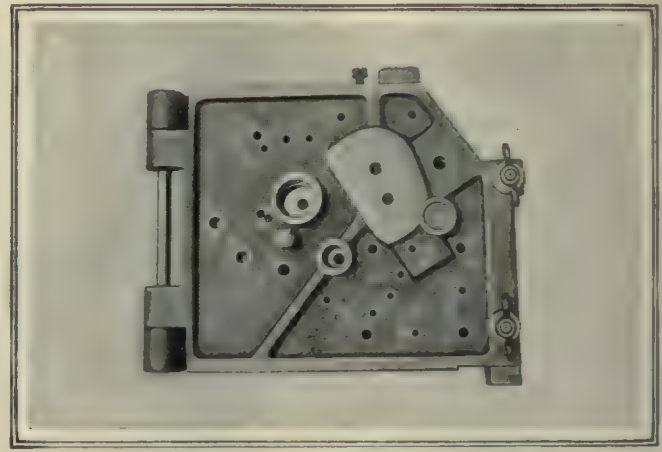


FIG. 9. BOX JIG FOR CARRIAGE APRON

Spindle Construction

The steel spindles for these lathes are made from a special oil-hardening steel, which insures freedom from warp and cracks in hardening. They are first rough-turned and drilled in a screw machine, then finish-turned and bored, after which they are hardened and heat-treated and then finish-ground on the outside. After finish-grinding on the outside, each spindle is fitted to its own respective head and placed on the special grinding machine shown in Fig. 12. Here the straight bearing for the draw-in spindle is ground out, then the straight bearing for the collets and lastly the taper bearing inside the nose which locates and closes the collets, and the outside of the spindle which takes the chuck closers and faceplates or other parts that may be advantageously used.

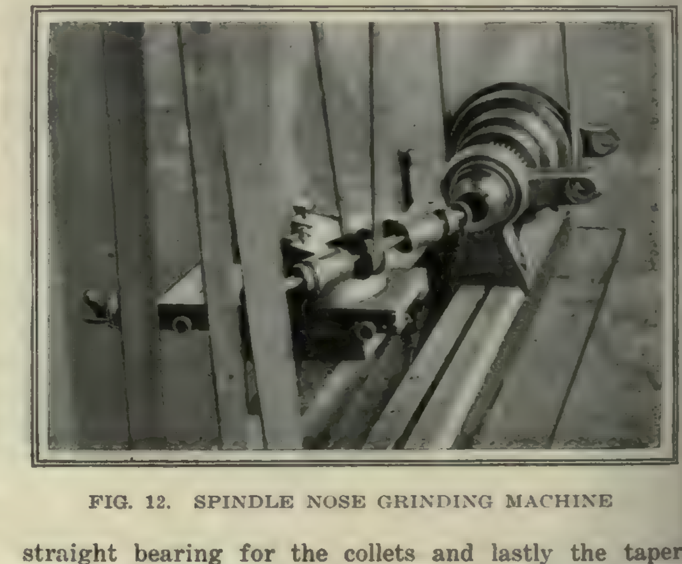


FIG. 12. SPINDLE NOSE GRINDING MACHINE

Safety Bulletin Boards

By E. B. Morgan

A bulletin board is one of the most effective means of reaching workmen with lessons in safe practices and of obtaining and retaining their interest in accident prevention. However, the value of a bulletin board depends entirely upon the attention that is given to the "get up," arrangement of notices, and the general order and care in which it is kept. Someone in the safety organization should be appointed to take care of this matter, preferably an inspector who can do so on his regular inspection rounds. The boards should be kept "alive" by changing the bulletins daily. If you do not do this, the men will say, "Oh, I saw that yesterday," and will give no attention to the notices and bulletins.

The boards should be located in the most conspicuous places in the various departments, so that every employee will be sure to see them. A good place is near a time clock, where men congregate for lunch, or near a locker and washroom entrance.

Good light is absolutely necessary. Do not place the board too high, as the bulletins will not be legible in such a position. The center of the bulletin board should be on the level of an average man's eye.

Bulletin boards should be well-built, good looking and covered with a glass door so that the bulletins will not become soiled. This also prevents mutilation of the bulletins and prevents the work of the practical joker. The glass door should be kept clean and, if necessary, washed periodically. The type of bulletin board used by the Norton Co., Worcester, Mass., is shown in Fig. 1, and a sample bulletin in Fig. 2. We feel that the most effective way of posting a bulletin is to put one bulletin only in the center of the board. We first tried posting four bulletins at a time, but soon found it better to change our scheme and drive home one lesson at a time. Where there is more than one bulletin board in a department or district, the bulletins should be circulated so that the same one is not on display on all the boards at the same time. A good way to regulate this is to have a bulletin file, number your bulletin boards and simply mark on the back of the bulletin the number of the board in which it has been exhibited.

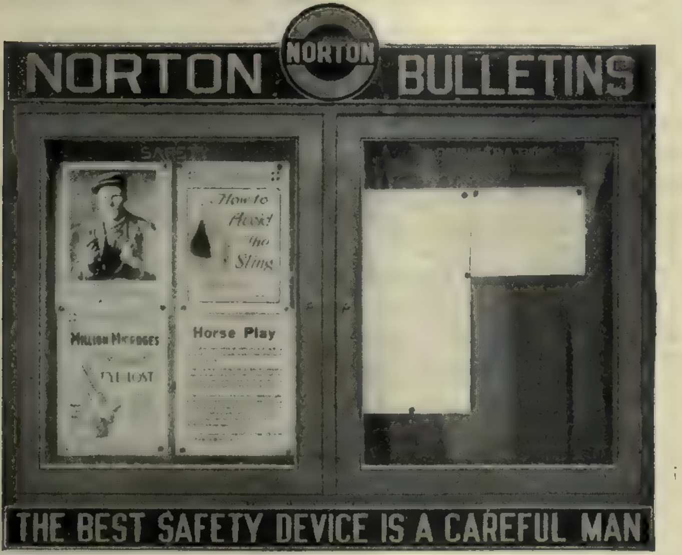


FIG. 1. SAFETY BULLETIN BOARD

In addition to the safety bulletins, notices of accidents in other plants, accident score sheets, newspaper clippings on accidents, cartoons, photographs of accident causes and such material should be used. This breaks the monotony. We use a stiff-back bulletin sheet on which are posted photographs illustrating the cause of an accident. The picture of an accident, showing the cause and effect, that has occurred right in the plant adds "local color" to the message. An example appears in Fig. 2, which was accompanied by this comment:

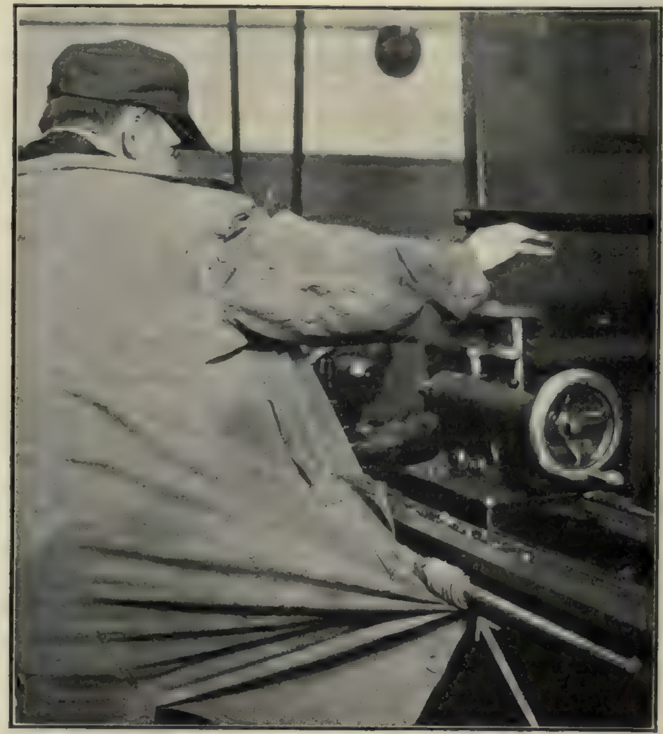


FIG. 2. SAMPLE BULLETIN

Loose Clothing around moving machinery is very dangerous. This shows how quickly a dangling end of a "duster" wound up in the lead screw of a lathe. The man is reaching for the belt-shifting lever, but cannot reach it as his arm is being pulled down.

Don't allow loose ends of clothing such as neckties, jumpers and dusters, to hang out when around moving machinery.

Who Pays the Damages?

By C. J. Morrison

J. P. Brophy makes inquiry, on page 946, Vol. 46, as to "Who Pays the Damages?" This question is one of the variety which is apparently settled and then pops up again at regular intervals. However, its solution can be definitely determined by a very simple analysis.

In the simplest form of merchandising a customer goes to a vendor and receives his purchase direct. Naturally the responsibility of the vendor ends when the goods are handed over to the customer.

In the next case the vendor does not hand the goods directly to the customer, but delivers them by means of his own vans or trucks, and his responsibility does not end until the merchandise has reached the customer.

In the final case the vendor is unable to deliver to the customer by his own conveyances and therefore turns the purchase over to a common carrier. The common carrier then becomes the agent of the vendor, is responsible to the vendor, and in turn the vendor is responsible to the customer until the goods are turned over to him at destination.

As practically all manufacturers are purchasers as well as shippers, it would seem that transferring responsibility from the shipper to the purchaser would be simply a change of evils and not a correction. If the purchaser was responsible for incoming goods, he would have to trace shipments and take up questions of damages with the common carrier, while if he is responsible for deliveries, he has to trace shipments from his own plant and look for reimbursements for any damages from the agent to whom he has intrusted delivery.

In most cases the purchaser suffers more than the manufacturer from delays in delivery. When a man orders a machine and it is delayed in delivery or is damaged, he is losing production, while the maker of the machine simply has some money tied up in an investment which is paying him no interest.

Regardless of the question of right and wrong, it would certainly seem poor business policy for any manufacturer to simply wash his hands of any shipment as soon as it is turned over to a railroad. Many years ago large department stores and mail-order houses adopted the policy "The Customer Is Always Right," and adjusted complaints on this basis. They found the average man's honesty to be so high that such a policy paid.

One of the large mail-order houses discovered that the amounts paid out in claims for damages were far less than the expense of maintaining a department to investigate such claims. In addition to this it established a reputation for square dealing which has made it one of the biggest and most profitable concerns in the country.

A specific case that would be of interest to Mr. Brophy comes to mind. Some little time ago a builder of a well-known machine made a shipment to a distant customer. Shortly after the machine was delivered he received a telegram stating the machine would not run. Instead of simply washing his hands of the matter and stating it must be up to the railroad, as the machine was delivered to them in perfect condition, he immediately sent a representative to see the purchaser and forwarded a telegram to do nothing with the machine until the representative arrived.

The manufacturer in question tests every machine in his own plant before it is shipped and was reasonably certain that the machine in question had left his plant in perfect condition. However, the representative found that the machine would not turn over, and when he started to dismantle it he found a tool locked in the driving gears. An inspection of this tool showed that it belonged to the manufacturer, and an investigation at the plant showed this tool to be charged up to an old and reliable employee whose interest in the welfare of the concern was above question.

It is still a mystery as to how this tool got into the machine, and it is reasonably sure that the manufacturer would never have believed it was there had not his own representative found it.

The purchaser was pleased with the attention received from the manufacturer, and the latter protected the reputation of his shop.

Of course, there are other cases where the purchaser is altogether at fault and expenses incurred in making investigations and adjustments are exceedingly annoying, but these expenditures all go to building up the intangible asset of good will.

There are many concerns whose product is protected by no patents and whose ability to sell enormous quantities of their goods is based almost entirely on good will.

It would only take a few cases of throwing the blame on the railroad and refusing to investigate to destroy this good will and break down the business.

War Convention of American Business Men

The Chamber of Commerce of the United States has called a War Convention of American business men, to be held at Atlantic City, Sept. 18 to 21. In calling the meeting the president of the Chamber of Commerce stated: "It is the patriotic duty of every live business man who can possibly arrange to do so to attend this convention, not only to show emphatically where the business men of the United States stand in the present crisis, but also that each may gain from such a meeting all possible knowledge as to how he can plan more intelligently to be of greater service in the common cause."

Program of the Convention

The convention will consider: (1) The duty that business owes the Government in war; (2) how may the business of the country render greater service in winning the war? (3) ways and means by which business may most readily adjust itself to the conditions produced by the war; (4) for what readjustments after the war must business prepare?

At the meeting there will be discussed different phases of the problem of Government control of prices; the establishment of priority in requirements of the Government and of individuals for materials and products of limited supply. There will be discussed industrial relations during the war, how the Government can best procure the materials and supplies needed for the war and handle the great business problems which arise in connection with the war. There will also be discussed the problems of distribution, including those of the retailer.

This convention will give business men the opportunity to voice their support of the Government in this time of national trial. It will give them the opportunity of expressing to the Government what the experience of business men has been in problems similar to those which the Government is now facing. They can learn from Government representatives who will be at the meeting what the Government expects of business. But above all, the meeting will bring business men in contact with the problems of this great industrial war and give them the opportunity of thinking about these problems and of reaching conclusions.

It has been the experience of the Chamber of Commerce, with regard to several committees which have met recently in Washington, that the members of these committees had previously given relatively little thought to the problems which are so evident to those in touch with the situation in Washington. These men come to the meeting with open minds. In most cases they assume that certain work is being done in Washington and that certain conditions prevail there, assumptions often not in accord with fact. When the members of such committees learn the actual conditions and settle down to thoughtful consideration of the situation, the discussion results in little difference of opinion. The conclusions reached have often been helpful to Congress and to officers of the administration.

The general meeting of men from all sections of the country to consider the broad problems mentioned should likewise result in conclusions helpful to the Government, and in bringing business men in step with what is being done. Many of the most perplexing problems which Washington is facing in connection with the war are problems that arise from business. In solving these problems the knowledge and experience of business men are helpful to the Government. The War Convention will give business men an opportunity of voicing their thoughts and of putting in definite form the results of their experience. Business men are accustomed to quick thought, to analyzing situations and to reaching decisions. The convention of business men, facing the problems which confront our Government, should by experience and training be in position to reach conclusions helpful to the Government.

Standard Names for Gages

By Fred H. Colvin

All who are familiar with production on a large scale realize the importance of gaging and the way in which the work of gaging is handled. And those who have traveled in different parts of the country to study gages and gaging systems are impressed by the utter lack of a uniform nomenclature, which makes it very difficult to convey our meaning to others or to be quite sure that we understand exactly what others mean in talking to us. This lack of uniformity is more objectionable in writing than in talking. It causes endless delays and costly errors on account of the same term having an entirely different meaning to two people.

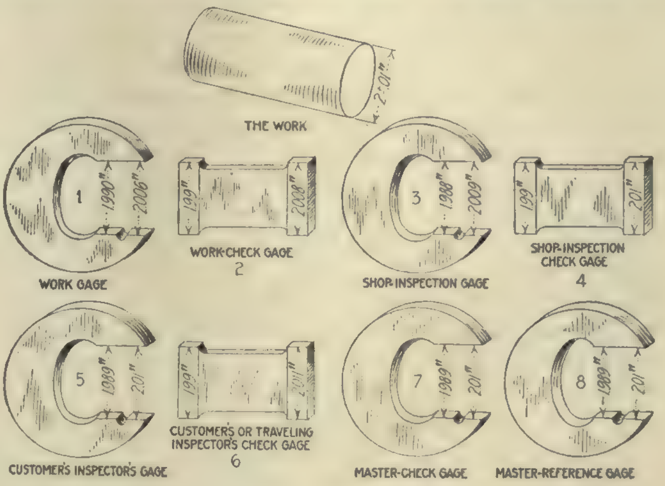
Without attempting to pose as an authority on the matter, but as the result of many conversations with men who make, use and live with gages, I have endeavored to set forth some of the more prominent gages in use, to tell how they are used and who uses them, and to suggest a name that shall be descriptive and definite. But this is done more in the hope that it will lead to the suggestion of better names and definitions from others than that those given here shall be adopted generally. The main thing is to get names and definitions, quite regardless of who suggests them, which shall mean the same thing to all men who handle gages, rather than to have names that shall be euphonious. Short names are always preferable where they can be satisfactorily used.

Omitting all definitions such as tolerance, limit, etc., which do not refer to gages more than to other methods of measurement, we may begin by defining a "gage" as an instrument for determining when a piece is a given size, with or without limits or tolerances. In other words, an instrument that, when in use, has fixed measuring points or surfaces, although these may be made to adjust for wear—this to distinguish it from a micrometer or other instrument that "measures" instead of gages.

First, comes the gage used by the workman, operator, tool setter, floor inspector or foreman, to see that the product is of the right size when it leaves the machine. This seems, by common consent, to be called a "work gage."

Second, a gage for checking the first or work gage. This would be used in the toolroom of the producing plant, if at all. In some shops the work gage would not be inspected until the gages in the inspection room showed the product to be incorrect. This second gage might well be called a "work check gage," as it checks the work gage. This gage and all check gages are here considered as being "opposites" or "complements" of the gages which they check; that is, a check gage for a ring gage would be a plug, and vice versa.

Third, a gage used in the inspection room of the producing plant, before the work leaves the shop or goes to the assembling department. This might be called "shop inspection gage."



GAGES AND SUGGESTED STANDARD NAMES

Fourth, a gage used in checking these third or shop inspection gages. These would also probably be kept in the toolroom or by the chief inspector, and might be called a "shop inspection check gage."

Fifth, a gage used by the customer's inspector, who passes on the product before it leaves the manufacturing shop and is accepted. This only applies when the work is manufactured on contract for outside parties instead of being assembled and used in the shop itself. It is most common in the case of government contracts, but to make it universal it is suggested that it be called a "customer's inspector's gage."

Sixth, a gage used by a traveling inspector to check the fourth or customer's inspection gages, although he would probably also check the shop inspection gages on request. This, except in the case of a very large manufacturer such as Henry Ford, would probably be confined to government work and might be called a "customer's inspection check gage."

Seventh, a gage at the gaging headquarters of the customer, for checking the sixth or customer's inspection check gages. This also would probably be needed only in the cases above mentioned and might be called a "master check gage."

Eighth, a gage for comparison and not for checking, supposed to be an exact duplicate of the drawings and kept in a vault for use only in settling differences as to standards. This is usually known as a "master reference gage," although there is a great difference of opinion as to its value or desirability. Some contend that this gage may well be omitted, as it is better actually to measure disputed gages from the drawing instead of using such a reference gage to measure from, for it is bound to contain some error, owing to the impossibility of attaining perfection in gage or any other work.

NUMEROUS GAGE TERMS

There are many other terms used for gages, some of the adjectives piling up until it reminds one of a list of high functionaries at a secret-society banquet. The British use three terms; but as these do not cover all the gages in use, it seems unnecessary to quote them at this time.

This article also ignores the fact that, in practice work and inspection, gages are often taken from the same lot, those with the least tolerance being used for work gages and the others for inspection. But their use puts them into the classes already named without regard to how they are made or where they come from.

To help make the gages mentioned a little more understandable, the accompanying illustrations have been prepared, each being numbered in accordance with the number of the gage in the text. These gages are supposed to be for measuring a round bar or shaft, 2 in. in diameter, with a tolerance of 0.01 in. either plus or minus. Snap gages are shown, although the same names would apply equally well to ring gages if they are preferred.

THE QUESTION OF TOLERANCE

There may well be difference of opinion regarding the amount of tolerance given in the different gages, but this does not affect the naming of them in any way. The work gage is shown with less tolerance than the shop inspection gage, in order to insure a larger percentage of the work passing the final shop inspection. This also allows for considerable wear in the shop gage before it prevents the work from passing the shop inspector. The work gage and the shop inspection gage are often made to the same drawings, the smaller gages being selected for the work gages and the larger given to the shop inspector. This practice would not be the case with such large tolerances as those shown, as any modern toolroom would work closer than 0.002 in. on gages for any purpose.

The check gages are all shown as flat gages, although plugs could be used equally well. The dimensions, too, may be open to criticism; but as these are not under discussion, they should not affect the main point at issue. They have been given to add reality to the illustrations. The last or master check gage is a duplicate of No. 7.

I shall hope for a wide discussion from gagemakers and users, with a view to reaching some uniform designation for gages of different kinds, so as to avoid the great confusion that now exists.

Needs of the Ordnance Department

The United States Civil Service Commission announces the following open competitive examinations for positions in the several ordnance establishments of the War Department or in or under the office of the Chief of Ordnance, War Department, Washington, D. C. The salaries named are for entrance.

Mechanical engineer, artillery ammunition, $3000 to $3600 per year.

Mechanical engineer, experimental work, $2500 to $3000 per year.

Mechanical draftsman, $1000 to $1400 per year.

Apprentice draftsman, $480 per year.

Inspector of artillery ammunition, $1500 to $2400 per year.

Inspector of field-artillery ammunition steel, $1500 to $2400 per year.

Assistant inspector of field-artillery ammunition steel, $3.50 to $5 per day.

Inspector of ammunition packing boxes, $3.52 per day to $1800 per year.

Inspector and assistant inspector of powder and explosives, $1400 to $2400 per year.

Inspector of ordnance equipment, $1500 to $2400 per year.

Assistant inspector of cloth equipment, $80 to $125 per month.

Assistant inspector of leather, $100 to $125 per month.

Assistant inspector of small hardware, $80 to $125 per month.

Assistant inspector of textiles, $80 to $125 per month.

Assistant inspector of leather equipment, $100 to $125 per month.

Clerk qualified in business administration, $1200 to $1500 per year.

Index and catalog clerk, $1000 to $1200 per year.

The examination for index and catalog clerk is open to both men and women; the other examinations are open only to men.

The Government urgently needs men for the work above indicated, and qualified persons are urged, as a patriotic duty, to apply for examination. Until further notice applications for the positions named will be received at any time by the United States Civil Service Commission, Washington, D. C. Papers will be rated promptly. Applicants will not be required to appear at any place for examination, but will be rated principally upon the elements of education, training and experience, as shown by their applications and by corroborative evidence.

Full information concerning examinations, application blanks, etc., may be obtained by calling in person upon the secretary of the local board of civil-service examiners at the post office in any city in which city delivery of mail has been established, or by communicating with the United States Civil Service Commission, Washington, D. C.

Checking from Master Gages

BY H. V. EISELE

In the manufacture of shells where piecework is established, one hears some unique excuses put forth when the operator has had a run of spoilt work. When a shift starts, the men lose no time in getting under way; and if the operator on the preceding shift has kept a faulty gage, it may be that several shells are turned out before the inspector checks the mistake.

We have found it profitable to place in the various departments in conspicuous places a set of master check gages for that particular operation, so that an operator can try his gages.

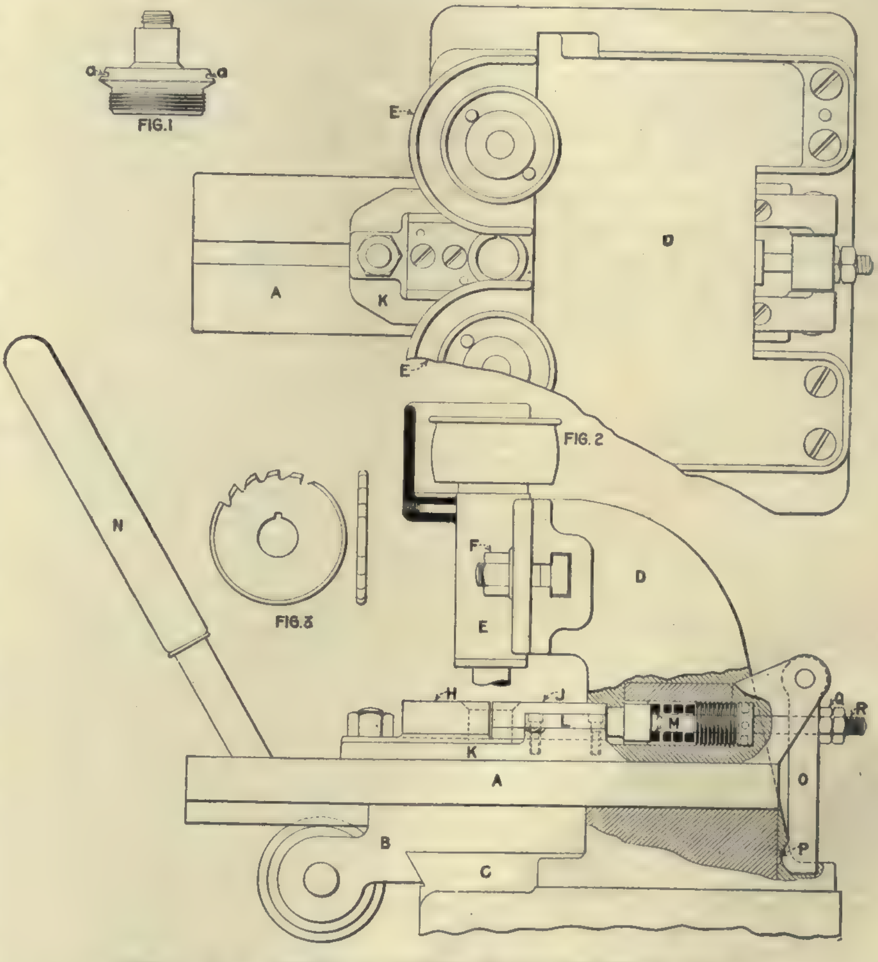
IDEAS FROM PRACTICAL MEN

Machine for Slots in Fuse Bodies

By Donald A. Baker

This special miller was designed for milling the wrench slots in the type 85 time-fuse body shown in Fig. 1, where *a a* are the slots, one on each edge of the brass body. The job was originally done one slot at a time on a small hand miller with an indexing fixture, giving us a production of about 1200 per day. Referring to Fig. 2, *A* represents the table and *B* the saddle of the original hand miller on which the work was formerly done. The rest of the machine was designed around these parts. The base *C* was planed to fit the saddle, which was gibbed, doweled and screwed fast to it. A housing *D* straddles the table and is bolted to the base on each side. This housing has a T-slot extending entirely across its face, to which are bolted the two spindle-carrying heads *E*. These are arranged so that they can be adjusted to any position on the crossrail, when setting the cutters. The bolts and nuts *F* hold them. The spindles, of hardened tool steel, run directly in the cast-iron heads. Sight-feed oil cups are provided to insure lubrication. At *H* is a hardened-steel stationary jaw, while *J* is a hardened-steel sliding jaw, both carried by the cast-iron shoe *K*. The jaw *J* is held in place by the pieces *L* and is kept under tension by the heavy coil spring *M*, made of square wire. In operation the machine works as follows: The handle *N* is pushed down by the operator until the lever *O*, which is carried by the rear end of the shoe *K*, strikes against the hardened-steel pin *P*, this pin being driven into the saddle of the machine. Considerable downward pressure is then applied to the handle *N*; and the lever *O*, striking against the two checknuts *Q*, which are on the end of the spring plunger *R*, releases the tension of the spring *M* from the sliding jaw *J* and allows the stem of the body to be dropped between the two jaws. Then as the operator brings the hand lever *N* up and carries it forward, the spring is again released and the sliding jaw placed under tension, gripping the body securely while the continued forward motion of the lever carries the table *A* with the work forward and between the two cutters.

The cutters, one of which is shown in Fig. 3, are made of high-speed steel and run at a speed of between 1500 and 2000 r.p.m. The production of the machine is about 4000 pieces per day; which is very good, all things being considered.



FIGS. 1 TO 3. SPECIAL MILLER FOR MACHINING SLOTS

A Countershaft-Drive Problem

By Andrew M. Butterfield

Mr. Martindale, page 484, Vol. 46, has written about some countershaft trouble he has experienced and says he would like to have some one explain why the conditions he speaks of prevailed.

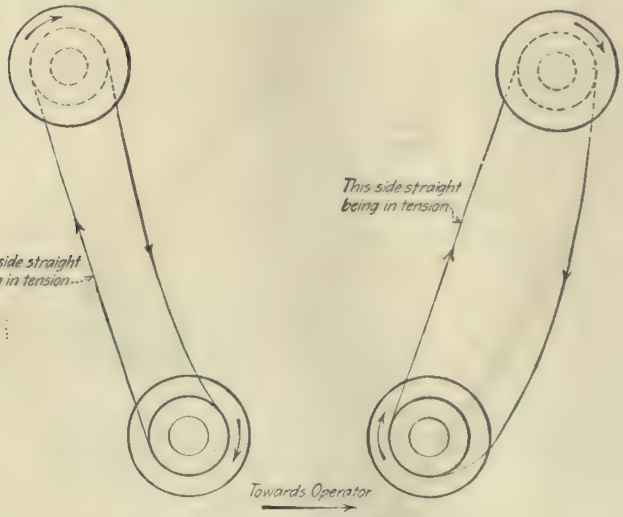
He states that theoretically either way of leading the belt is correct and that he could not see why the belt would not travel in one position as well as another.

First of all, he is not theoretically correct as he has evidently lost sight of the fact that the force of gravity plays an important part in the installation of belts as well as in anything else.

It is the force of gravity on the belt that has caused the trouble which he has experienced. By referring to the figure on the left, I think one can easily see how the weight of the belt causes a sag on the underside of the belt when the countershaft is toward the operator. This permits the slack thus formed to easily travel to the next higher cone when it is shot in that direction by vibration or other causes, and the heavier the chip the greater the sag, owing to the belt stretching. Referring to the other illustration, with the countershaft away from the operator the slack is on the top side, and the weight of the belt tends to cover the cone instead of leaving a gap as before. This is the condition which will result in the better service, and which should be obtained if possible.

A light lathe will often work all right with the countershaft toward the operator, but it is unhandy and should be avoided. A large lathe like the one mentioned in the article is almost sure to cause trouble. A lathe set up with the belt slanting outward toward the operator is generally very inconvenient.

When a lathe is lugging a heavy cut the slack side of the belt is slapping back and forth, pivoting at the points of contact with the cones on the slack side. It is during this time that the large cone catches the belt, all the slack having concentrated under the cone on the lathe.


This side straight being in tension
This side straight being in tension
Towards Operator

A COUNTERSHAFT-DRIVE PROBLEM

With these points in mind, if the reader should watch a lathe laboring under a heavy cut I think he could see for himself what I have tried to portray.

The foregoing also explains why a lathe with the same ratio of pulleys on the "go ahead" and "back up" will pull more on the go ahead than when backing up, if belted with the countershaft away from the operator, as is the usual way.

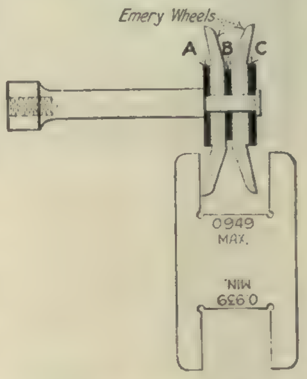
Mr. Martindale's lathe would not have given him any trouble had he run it backward, but of course this would not be very convenient.

Grinding Snap Gages

By Charles M. Valdes

Several days ago I had to make some gages, all over $\frac{3}{4}$ in. in size.

Our plant is in a great rush, and our toolroom work must be done on record time. Instead of doing the grinding of those gages in the regular way—grinding one side first and then changing the wheel around and doing the other side—I decided to do the following: I got two small saucer wheels, mounted them on the spindles of the grinder and trued them to the same diameter and on the faces. Three steel spacing washers occupied the positions *A*, *B*, *C* on the extension arbor. First one side of the gage was ground and then the other, without stopping or losing any time. I used the same operations on all the gages I had to grind. My wheel lasted much longer than if I had to remove it and do the opposite side on every gage, as shifting would of course have involved retruing each time.



GRINDING SNAP GAGES

Gear Dentistry

By Robert E. Newcomb

The subject of gear dentistry is well illustrated on page 984, Vol. 46, but the method shown of repairing or replacing a broken gear tooth does not work out well in actual practice. The babbitt tooth soon peens and becomes distorted and loose on the pins, and may even become entirely free of the pins before it is noticed and cause serious damage by falling into other gears or moving parts of a machine.

There are several other methods of repairing broken gear teeth that may be used with much better results:

First, a tooth may be welded by the oxyacetylene process and filed or recut. The welded process, however, is not always available or convenient, and frequently requires the removal of a gear from the shaft. In many cases it will so distort a gear that future satisfactory operation is impossible. However, it has been done with satisfactory results and may be accomplished nine times out of ten where the welder thoroughly understands welding and the mechanic the filing of gear teeth.

Second, a dovetail slot may be cut into the face of the gear at the point where the damaged tooth broke away. A suitable dovetail key may then be fitted to this slot and filed to the proper tooth form. It requires considerable time and a good mechanic to make a nice job by this method.

Third, probably the most satisfactory method is to drill a number of holes, carefully ream them and drive into these holes cold-drawn steel wire of the proper size. The wire to be driven into the holes should be a good driving fit. The pins should not be screwed in, as they are more likely to become loose and work out or break off. The method is illustrated in the top row of the figures shown on page 984, second and third figures from the left-hand side of the page, except that the pin should be driven instead of screwed into place. Of course, pins should be of sufficient diameter to provide ample width of tooth at the base. They must then be filed by a careful mechanic to the proper tooth form. When the work is properly executed the repair will last for a long time and is frequently more durable than the original gear tooth.

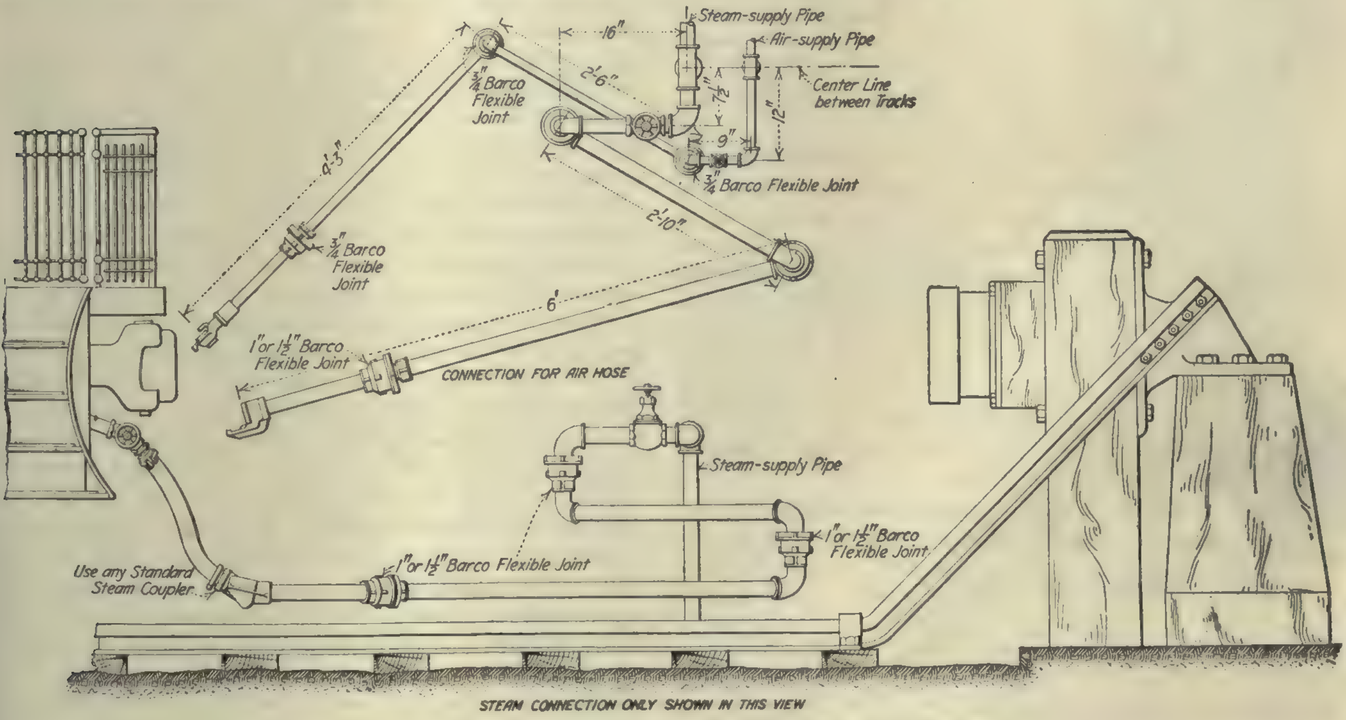
It should be remembered, however, that gear dentistry is to be used only when temporary repairs are needed, and as soon as possible a new gear should be installed.

Steam and Air Connections for a Railroad Yard

By Joseph K. Long

The illustration shows a new method of fitting up coach yards with adjustable steam and air connections. We have just fitted up one of our coach yards in this manner and are now equipping our Sunbury and Williamsport yards the same way, as we formerly had so much trouble due to steam hose bursting or blowing off when long pieces of hose were used.

In the upper part of the drawing the air and steam lines are shown in plan view. Where the lines come out of the ground there is a T, and this is piped to two tracks, one on each side. When two tracks are to be fitted up, the lines look best if supply pipes come up directly between the two tracks, and both will be equally well taken care of and the lines will be as efficient if both are fitted up with the same length of pipe to each track. Pipes of the length indicated in the diagram have a range of about 5 or 6 ft., and it is an easy matter to place the cars on the track or siding inside that range of space.


Steam-supply Pipe
Air-supply Pipe
16"
2'6"
Center Line between Tracks
12"
12"
9"
¾" Barco Flexible Joint
¾" Barco Flexible Joint
4'3"
2'10"
¾" Barco Flexible Joint
6'
1" or 1½" Barco Flexible Joint
CONNECTION FOR AIR HOSE
Steam-supply Pipe
1" or 1½" Barco Flexible Joint
1" or 1½" Barco Flexible Joint
Use any Standard Steam Coupler
STEAM CONNECTION ONLY SHOWN IN THIS VIEW

STEAM AND AIR CONNECTION FOR RAILROAD YARD

The arrangement permits of considerable extension, and when not in use it can be folded into a very small space. The joints should always be put at right angles to the pipe, except where a third is necessary. Where the joint is on the coupler end, it may be put in line with the pipe and 12 to 18 in. from the coupler if desired. We use Barco flexible joints in this work, and they can be moved in any direction with this combination. You will notice that the globe valves are near the source of supply from the ground line.

This arrangement will also be found useful and satisfactory for unloading tank cars and wagons, filling them or conveying steam to heat coils in the tank cars, where heavy oils must be heated before unloading. This plan here described should be doubly interesting during cold weather, as a device of this nature is necessary in order to properly take care of coaches, the old method of using hose having proved inefficient.

Broadmindedness in Design

By J. C. Austin

Recently, while looking over some blueprints of parts on which quotations were asked, my attention was particularly drawn to the following notation stamped upon them: "Please Note—We welcome suggestions as to changes or redesign which will improve, cheapen or standardize our product."

This solicitation of suggestions is so frank and seems so truly genuine, that it is, in my opinion, worthy of special mention. Human nature is such that the average designer is inclined to consider the products of his own brain about perfect and often resents suggestions of change although distinctly an improvement. But when one places on his drawings an earnest request for helpful ideas, it is an indication of extreme broadmindedness and willingness to put the personal element in the background so that the highest standard of efficiency might be attained. Particularly in this keen age of specialization should this spirit be cultivated. No man can cover all fields of knowledge, but if he will draw ungrudgingly from the experience gained by another who may have given some particular item more study, greater results are in store for him.

Reclaiming Rejected Shells

BY JAMES FORREST

Some very interesting features crop up from time to time in the manufacture of shells. What follows is an example of how shells that have been rejected on account of not meeting certain requirements can, by having a little thought and intelligent workmanship expended on them, be made to come within the limits of the required tests. The shells referred to here are 220-mm. and 270-mm. French shells, but the principles involved can be applied to any shell.

In the shop where these shells are made, there is a department devoted exclusively to the reclaiming of scrap finished shells. The inspector and his assistants, by means of a complete equipment of gages, determine in what particular point the shell has failed to pass inspection by the Government men. The inspector sizes the situation up for each shell and can tell at once, by his experience, whether the shell can be reclaimed or not.

The following are the principal points on account of which the shells have been finally rejected: Incorrect thread diameter, faults of threading, concentricity, size of choke, size of recess, top not level, incorrect profile, size of enlargement, diameter front of band, diameter back of band, dimensions of band groove, thin base, thick base, total length, finish of exterior surface, finish of interior surface, dimensions of band, rotating balance, gravity balance, and weight.

Regarding some of these faults, the conditions governing their remedy are quite apparent, as when, for instance, a shell has been rejected on account of a thick base. The base is measured, and a note is made of how much must be removed, as a minimum, to reduce it to the proper thickness. Next, the over-all length is measured; and if the amount to be taken off the base will not bring the over-all length of the shell below the minimum gage, it is all right so far. Finally, a calculation is made of how much the shell will be reduced in weight; and if it will still be over the minimum weight, the shell can be saved.

For most of the faults the remedy is a simple correction of the defect itself, without reference to any of the others, but the manner of correcting the balance is interesting. The weights of these shells in pounds are as follows:

	220-Mm. Shell		270-Mm. Shell	
	Without Band	With Band	Without Band	With Band
Maximum	161.145	163.35	237.39	239.86
Minimum	155.45	156.95	227.83	229.13

Take for an example a shell of 220-mm. caliber, 12 oz., or 0.75 lb., out of gravity balance, heavy on base end, total weight of shell without band 157 lb. As the minimum weight can be 155.45 lb., there is a margin of 1.55 lb. of metal to work on.

If the operator can take off 0.75 lb. from the cylindrical surface of the shell at the base end and still keep the shell large enough in diameter so that the minimum caliper gage will not go over, the shell can be saved.

If the base thickness and the over-all length permit, some of this weight can be removed from the base itself. In a case of this kind, the shell can be set up true in the lathe and a cut started along the circumference until 0.75 lb. of chips has been removed. It is better, where the weight of the shell is well over the minimum, to take off two or three ounces more metal than is actually required, to make sure the shell will come within the limits allowed.

Take another example: Suppose a shell is 15 oz. out of gravity balance, heavy on the nose end and at the same time 8 oz. out of rotating balance, the total weight of the shell being 156.5 lb. The metal to be removed to correct this shell can be taken from the outside, if the diameter allows, or otherwise from the inside. The method of working on the inside is adopted only as a last resort, both on account of the awkwardness involved and also on account of the fact that the farther away from the axis of the shell the metal is removed the greater effect it will have on bringing it into rotating balance. The deficiency in ounces of rotating balance is always given with reference to the exterior.

It can readily be seen that, as far as the rotating balance is concerned, 4 oz. of metal would have to be removed at a distance of 2 in. from the axis of the shell to get the same effect as 2 oz. removed 4 in. from it.

In the example cited, the procedure would be as follows: After gaging the diameter of the shell in front of the enlargement and finding it still well over the minimum size, the shell would be set up to revolve eccentrically in the lathe so that it touched the tool exactly at the point where the rotating balance was out, and just enough so that when the tool had cut completely round the semicircumference of the shell, which was set high, the diameter would be large enough to prevent the minimum caliper gage from going over it.

Suppose that, after the outside has been taken down to the limit, the weight of the chips shows that 6 oz. of metal has been removed. Then it is known that the shell is still 9 oz. out of gravity balance and 2 oz. out of rotating balance, and nothing is left but to work on the inside of the shell up near the nose end.

The metal here is usually thick from nosing, and the distance of the center of gravity of the metal removed from the inside of the ogive (from a point as far in as can conveniently be reached to the choke), from the vertical axis of the shell, is approximately one-half the distance from the outside of the shell to the axis.

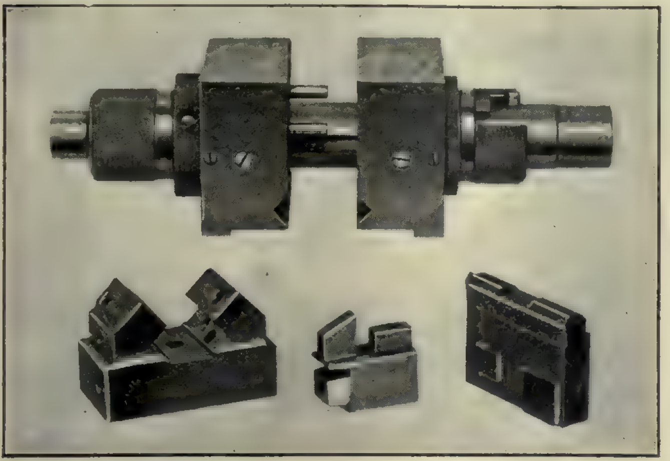
The shell must now be set up eccentrically so that the tool working on the inside of the ogive will have removed 4 oz. of metal just as it begins to touch on the opposite side of the shell to that thrown over toward the tool. This 4 oz. is equivalent to 2 oz. removed from the outside of the shell, as far as the rotating balance is concerned. Now the shell is in rotating balance, and it only remains to remove the last 5 oz. of metal, with an ounce or two over for assurance, to bring the shell into gravity balance.

By proceeding on the lines indicated above, about 96 per cent. of the shells worked on are saved from the scrap heap. An interesting feature of the job is that the operators who reclaim these shells are on piecework and are paid so much per ounce of chips removed.

Milling Vise for Use Between Centers

By J. B. Boylan

The illustration shows a milling vise to be used between centers and controlled by the index head. A set-up in the old type of vise takes considerable time, and each angular cut means a new set-up. With this vise, after the work is once set up, it is possible to take cuts at any angle, as well as bore, drill and ream at any angle, as the vise is under the control of the index head at all times.



MILLING VISE FOR USE BETWEEN CENTERS

The mechanic will readily see its usefulness, as a movement of two spaces on the 18-hole circle gives an angle of one degree.

Estimating Gear-Shaper Production

By A. E. Burrell

The accompanying table may be of use to those readers of the *American Machinist* who have occasion to estimate on spur gears cut on the Fellows gear shaper, or for setting premium or bonus times for that machine. It is a practical shopman's table, requiring no mental gymnastics or slide-rule juggling, but only a knowledge of what can be done in the line of speed and feed, also of the number of cuts required, to produce gears of the necessary quality on this machine.

The figures given are not based on the pitch diameter, but represent the time required, in minutes, to cut one tooth (at any of the three feeds, fast, medium or slow) at one stroke per minute, for each pitch.

Given this base figure, it is obvious that multiplying it by the number of teeth in the gear to be cut, and dividing the product by the number of strokes per minute at which the machine is to be run, will give the actual cutting time, provided the gear is to be completed with one cut.

To explain more fully the example given in the table, the gear in question, 30 teeth, 6/8 pitch, would be made from a forging, probably of chrome-nickel steel, requiring three cuts to give a first-quality gear. The roughing cut is taken on a tandem (double cutter) machine, running at 175 strokes per minute, using medium feed. The table gives 35 min. as the time required to cut one tooth, at one stroke per minute. Multiplying this by 30 (the number of teeth) and dividing by the number of strokes per minute, 175, gives 6 min. actual cutting time. To this must be added 1 min., the approximate time required to feed the cutter in to the full roughing depth, while 1½ min. should be ample for changing each set of four gears, giving a total of 8½ min., or 2.13 min. per gear.

The two finishing cuts would be taken on a standard machine, the first on fast feed, the second on slow. Adding the numbers given for each feed gives approximately 119; multiplying by the number of teeth, 30, and dividing by the strokes per minute (210 in this case, as both cuts are light) gives an actual cutting time of 17 min. One-half minute is sufficient for both the feeding into depth and changing feed at the end of the first cut, while 1 min. will cover the changing of the finished gears for a roughed-out pair, giving an elapsed time of 18½ min. for two gears, or 9¼ min. per gear, making the total cutting time per gear slightly less than 11½ minutes.

When using a cutter other than standard, as is sometimes done on special work, the correct base figure can be found by

$$\frac{\textit{Base figure given} \times \textit{pitch diameter of cutter used}}{\textit{Pitch diameter of standard cutter}}$$

or

$$\frac{\textit{Base figure given} \times \textit{number of teeth in cutter used}}{\textit{Number of teeth in standard cutter}}$$

CHART FOR ESTIMATING
ACTUAL CUTTING TIME FOR GEARS ON GEAR SHAPER

	Standard Machine Feed S	Standard Machine Feed M	Standard Machine Feed F	Pitch	Tandem Machine Feed F	Tandem Machine Feed M	Tandem Machine Feed S	
4-in. cutter	87.5	62.5	46.88	4	40.0	52.5	75.0	4-in. cutter
	70.0	50.0	37.5	5	32.0	42.0	60.0	
	77.7	55.5	41.6	6	26.6	35.0	50.0	
	66.6	47.62	35.71	7	23.0	30.0	43.0	
	58.3	41.6	31.25	8	20.0	26.3	37.5	
	51.85	37.04	27.7	9	17.7	23.3	33.3	
	46.6	33.3	25.0	10	16.0	21.0	30.0	
	38.8	27.7	20.83	12	13.3	17.5	25.0	
	33.3	23.81	17.86	14				
3-in. cutter	29.16	20.83	15.63	16				
	25.93	18.52	13.89	18				
	23.3	16.6	12.5	20				
	21.2	15.15	11.36	22				
	19.4	13.8	10.42	24				
	17.94	12.82	9.62	26				
	16.6	11.91	8.93	28				
	15.5	11.1	8.3	30				
	14.58	10.42	7.81	32				

For ordinary work use nearest whole number.

For other cutters, use: Number given $\times \frac{\text{size cutter used}}{\text{size cutter charted}}$

Radial feed is 0.0018 per stroke.

Example—Sliding gear, 30 teeth, 6/8 pitch. Rough on tandem machine.

Finish, 210 strokes, 2 cuts, 1 F., 1 S.
41.6 + 77.7 = 119

	Min.
$\frac{119 \times 30}{210}$ =	17.0
Feeding in	0.5
Changing gears	1.0
For two gears	18.5
Per gear	9.25

Rough, 175 strokes, medium feed.

	Min.	
$\frac{35 \times 30}{175}$ =	6.0	actual cutting
	1.0	feeding in
	1.5	changing gears
	8.5	for four gears
	2.13	per gear

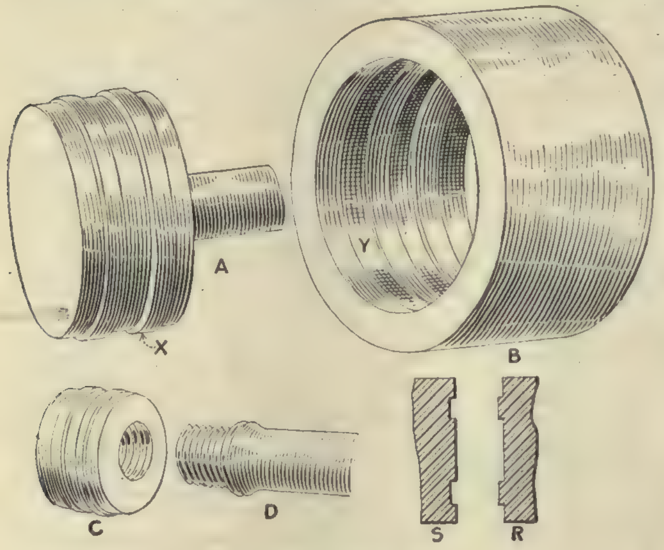
Repair Work for Steam-Hammer Pistons

By J. V. Hunter

It seems to be a view quite generally held among a great many hammersmiths using steam hammers that, when any accident occurs to the piston of the hammer, causing it to break, nothing can be done except to replace the broken part with an entirely new piston, and that pistons to be serviceable must be forged out of one piece of steel. So this practice is often followed, no matter how large the piston head is; in many cases an enormously large billet is required to be of sufficient diameter for the head. For the past two or three years we have been disproving this theory by the continued use of several repaired pistons and heads, which are giving remarkably satisfactory service.

Several years ago the piston of our 1500-lb. steam hammer broke off several inches below the head. For such a break the suggestion of a weld would really be absurd, for the continued percussion stresses would quickly open the best of welds, whether forged, thermit welded or acetylene-torch welded. The piston head is about 12 in. in diameter, nearly double the size of any billet that we then had available, but we did have in the scrap pile a number of old high-carbon steel car axles that were sufficiently large to machine up to the diameter of the piston.

The manner in which the repair was made is illustrated where the parts *C* and *D* are shown. The broken stub of the piston was sawed from the head, and the latter was bored out and tapped to a diameter equivalent to that of the piston rod, a large fillet space being cut off the bottom edge to accommodate a corresponding fillet-like collar provided on the piston rod. The sketch of the piston rod also shows the precaution taken to provide a fillet, since it seemed possible that if there were any tendency toward breakage of this new rod, it would occur at this point, which takes the full side twist of the head.



PISTON REPAIRS

The rod was tightly screwed into the head; the threaded section was of sufficient length so that it projected slightly above the upper side of the head, and this projection was battered and peened over to prevent all possibility of the rod working loose. The repair was successful, and the hammer has been in constant daily use for over two years.

On two of our other steam hammers we have had occasion to bore out the cylinders, on one for excessive wear, on the other for the removal of deep grooves cut by a broken piston ring. Both times the amount of material removed from the inside walls was so great that there was no possibility of using the old piston heads, as they formerly were, by simply providing new rings.

Each of these pistons was turned down to 2 in. less diameter, leaving two ribs or bands, to act as keys, extending completely around their circumference, as shown at *X* in *A*. A shrink band of sufficient width and thickness to allow for the increased diameter of the cylinder was welded up as shown at *B*. The interior of this band was bored out, and the two grooves at *Y* were provided, $\frac{1}{16}$ x $\frac{3}{4}$ in., to match the bands that were left on the head. The bore of the band is left $\frac{1}{32}$ in. less in diameter than the head, to give plenty of pressure upon shrinking.

When thus made, a band will expand enough when heated to a good red so that it will pass over the ribs of the thickness mentioned left on the piston head. The ribs and recesses are given a little taper on their edges, as indicated in the sectional views at *R* and *S*, so that there will be no chance for the band to hang on any of the edges of the ribs when it should be shrinking tightly into place. These sizes for ribs and grooves apply for heads that are left at least 10 in. or more in diameter; smaller pistons must have proportionately smaller ribs, grooves and shrinkage allowance.

After the band is shrunk on the head, the outside is turned off to match the inside diameter of the rebored cylinder, and new ring grooves are turned in its outside surface.

In making up new rings for such a piston, one point worth remembering, which probably must be explained to the machine-shop foreman, is that rings for a steam-hammer piston, unlike those for a plain steam engine, are not made of cast iron, but must be turned from a forged-steel band that the forge shop should have prepared while the other work is being done. Cast-iron rings are really most unsuitable, because the jar of the hammer in service will break up rings of this material in a few days; and these pieces will start in at once to score the inside walls of the cylinder.

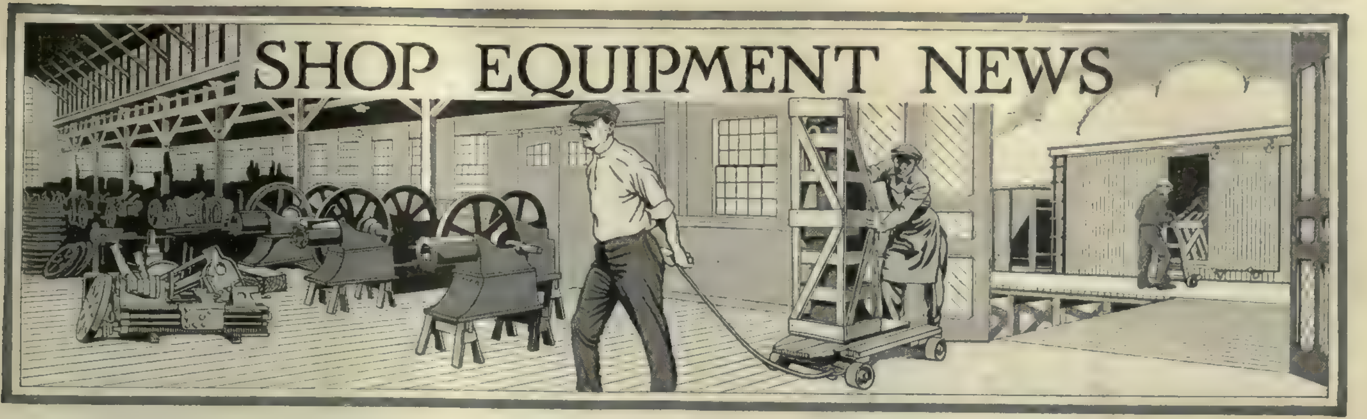
The largest hammer that we have so far had occasion to repair in this manner is rated at 2500 lb., but both of those that we have so repaired have been in service for a long time with no signs to date that the rings are either loosening or slipping.

Finding Developed Length of Steel Tubing

In making drag-links and other parts of automobiles from seamless steel tubing, it is necessary to figure the exact length the tubing is to cut before bending. This can be figured theoretically on the same basis as for a solid rod of the same outside diameter as the tube; but in practice this method does not work out, for the low price at which these parts must be manufactured precludes loading the tube with lead, sand or other material to prevent collapse and distortion. In most cases the tubing shows a tendency to stretch and collapse, but there is evidently, sometimes, a shortening due to compression of the tube on the inside of the bend.

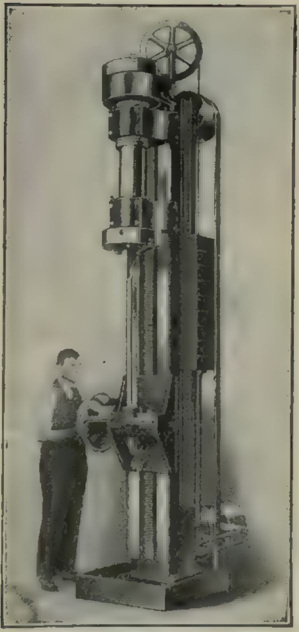
As the writer views this matter, there is opportunity for someone to develop a formula or set of tables that will be of considerable value to manufacturers of this line of supplies. It will be well to note some of the factors that enter into results—namely, diameter of tubing; thickness of tubing wall; radius of bend; arc of bend; and whether bend is made hot or cold. Temper of the tubing may be eliminated, for the temper of all makes and grades of tubing is practically the same in most cases.

Do not all speak at once, please.



SHOP EQUIPMENT NEWS

Stecher Spindle Drilling Machine

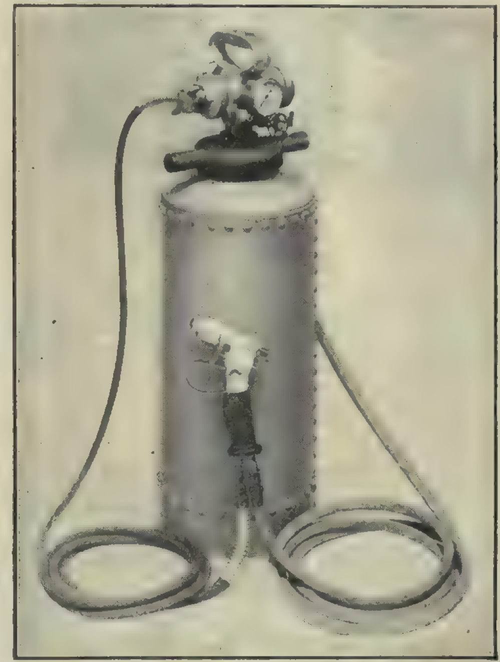


DRILLING MACHINE

The machine shown in the illustration is one that has recently been placed on the market by the Charles Stecher Co., 1574-80 Crossing St., Chicago, Ill. It has been brought out particularly for the use of the Government in boring out recoil cylinders, artillery axles and work of like nature, but is applicable to other types of work. The machine is similar to that described on page 479, Vol. 46, except that it is considerably larger, accommodating any stock up to 5 in. in diameter, the maximum length of hole bored being 64 in. As may be seen, the work is carried in the upper or stationary head, two chucks being used to hold the work in position. The spindle has two bearings, the thrust being taken by auxiliary ball thrust bearings. The lower, or traveling, head carries the stationary boring tool and is counterweighted to permit ease of operation. The base is made in the form of a deep pan, and a pump is provided which forces the lubricant to the work through the hollow tool.

Spray Pneumatic Painting Equipment

The Spray Engineering Co., 93 Federal St., Boston, Mass., is now marketing the form P-1 painting apparatus shown in the illustration. The apparatus may be used for applying all kinds of liquid coatings and is portable, being thus adapted for either shop or field use. It operates on compressed air at from 35 to 75 lb. pressure per square inch, depending upon the material being sprayed. It is claimed that all materials from the highest grades of lacquer and varnish to heavy asphaltum and structural paint may be applied with equal facility. The parts are so arranged that the gun and hose may be blown free of paint without the necessity of taking them apart as is necessary with some types of equipment.



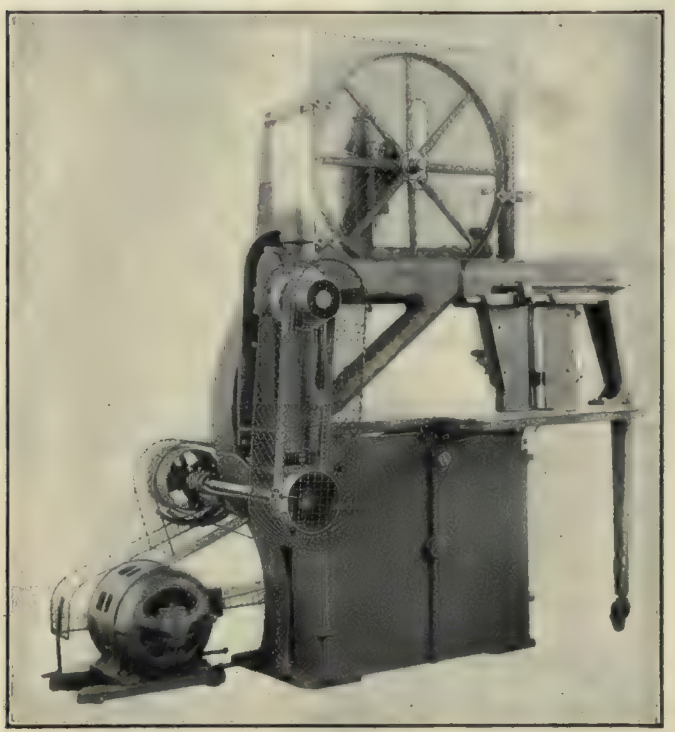
"SPRACO" PNEUMATIC PAINTING DEVELOPMENT

In the illustration the apparatus is shown equipped with a 5-gal. paint container, but a 3-gal. size is furnished if desired. With a slight change of parts the gun may be attached to a 1-qt. container for use on small work or where a variety of colors or materials is used. An extension pole may also be furnished where the work is not easily accessible. Copper-lined hose is used for the paint, while the air hose is of rubber and canvas. The pressure-control head is mounted on the top of the paint container and is fitted with all parts required for the control of the air and paint supplied to the gun. The paint strainer is also incorporated.

Oliver Band Re-Saw

The illustration shows the No. 15-R 38-in. combination re-saw and band-saw upon which a number of improvements have recently been made by the Oliver Machinery Co., Grand Rapids, Mich. The change from re-sawing to ordinary band-sawing is instantly effected by swinging the arm carrying the two corrugated power-driven rolls out of the way and changing saws. The table tilts 45 deg. in one direction and 5 deg. in the other direction and is double ribbed and supported upon rockers for angle adjustments. Tilting is done by means of a worm, gear and handwheel. A dial indicates the amount of tilt in degrees.

An auxiliary table is bolted to the frame, which is vertically adjustable and increases the surface of the work table nearly half. The shafts are ground and carry the wheels on tapers. The upper shaft is adjustable vertically and may be tilted by means of a handwheel for tracking the saw. A metal casing incloses the lower wheel, and a device is provided which throws the dust to the front of the machine, where an exhaust fan may be attached. A coil spring counterbalances the guide post, which carries an adjustable frictionless roller guide, and a similar guide is located just beneath the table. On the column is a grooved saw guard that protects both sides of the saw. A front guard is carried on the guide post and covers the saw above the guide. The upper wheel is guarded by a door made of wire mesh.



BAND RE-SAW

Floor space, 60 x 47 in.; table, 40 x 36 in.; height of table, 40 in.; tilt of table, 45 deg. one way, 5 the other; auxiliary table, 21 x 22 in.; diameter of wheels, 38 in.; stock handled, 16 in. wide by 8 in. thick; length of saws accommodated, 18 to 20 ft.; horsepower required, 5 to 10; weight crated, 4000 lb.; drive, either belt or motor as desired

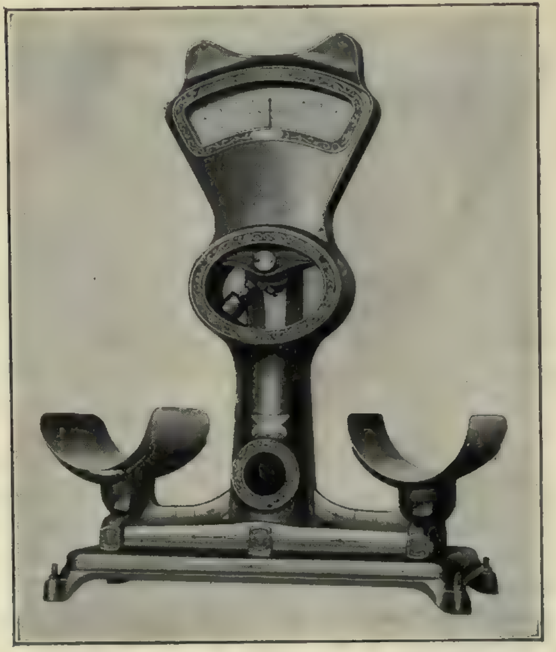


FIG. 2. MUNITION AND SHELL SCALE

Computing and Shell Scales

The illustrations show two types of scales that are now being made by the Computing Scale Co., Dayton, Ohio, and marketed by the Moneyweight Scale Co., 326 West Madison St., Chicago, Ill.

Fig. 1 shows the computing scale, which is of the beam type with a capacity up to 600 lb. The tare beam has a capacity of 100 lb. and is sensitive to ½ oz. The counting beam is graduated for use when one, five or ten units are placed in the pan. A third beam is also provided which reads directly in pounds.

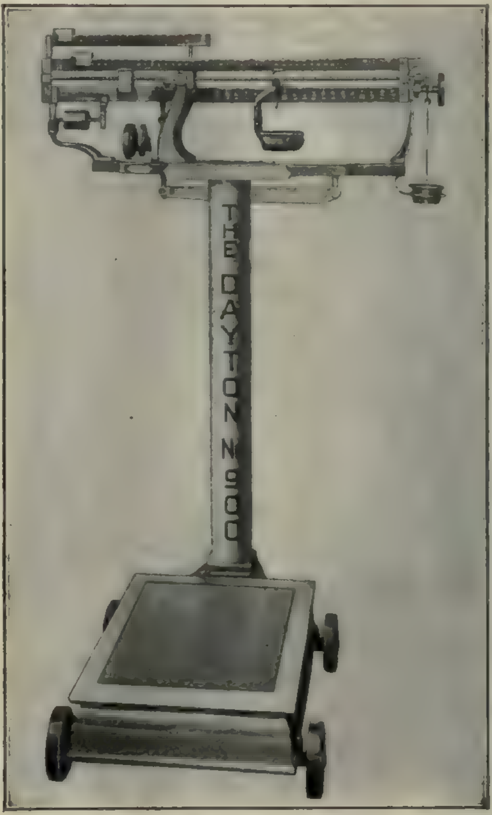
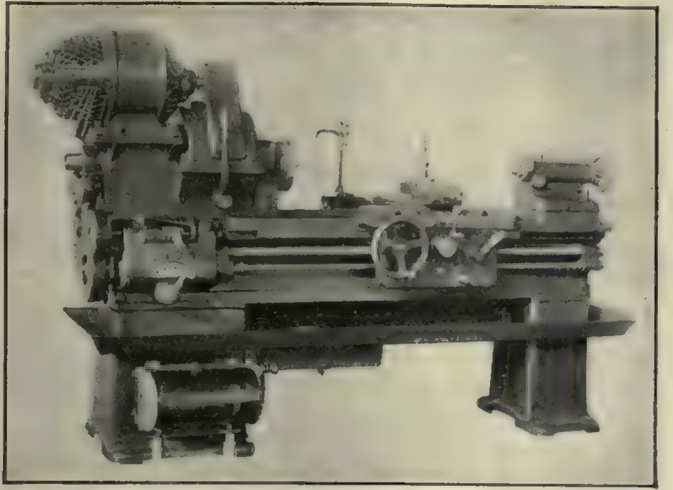


FIG. 1. COMPUTING SCALE

Fig. 2 shows the munition and shell scale. With this device a master or standard weight is placed in one scale pan; and when the shell is placed in the other pan, the amount it weighs either over or under the master weight may be read directly from the scale, which is graduated to read in steps of $\frac{1}{16}$ oz. for weights up to 4 ounces.

Oliver Heavy-Duty Engine Lathe

The Oliver Machinery Co., Grand Rapids, Mich., has made a number of changes on its 16-in. heavy-duty engine lathe, the latest form of which is shown in the illustration. The headstock on the new machine is of the bowl type, which affords better protection for the belt. New gear covers have been provided, and the tailstock has been made longer and heavier. A lubricant reservoir has been placed on the under side of the oil pan, and oil wipers have been incorporated in the carriage.

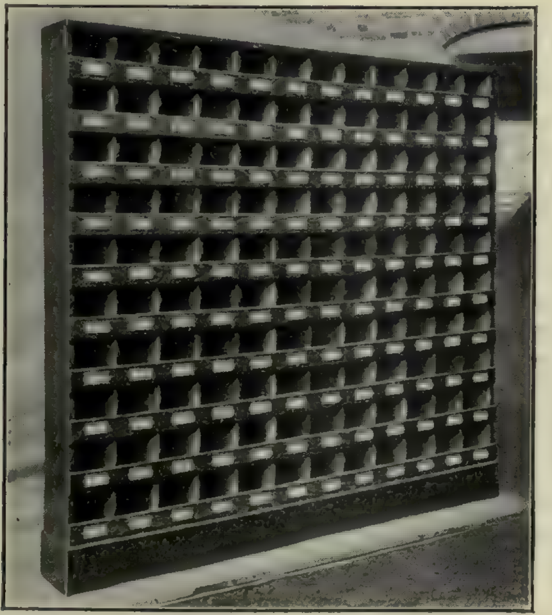


HEAVY-DUTY 16-IN. ENGINE LATHE

Swing over shears, $17\frac{1}{2}$ in.; swing over carriarge, $10\frac{1}{4}$ in.; distance between centers, $38\frac{1}{2}$ in.; spindle speeds, eighteen, 14 to 335 r.p.m.; feeds, 32; back-gear ratios, 2.9 and 9.02 to 1; front spindle bearing, $3\frac{5}{8}$ x 5 in.; hole through spindle, $1\frac{5}{16}$ in.; rear spindle bearing, $2\frac{3}{8}$ x $3\frac{3}{4}$ in.; cuts threads, 3 to 46; weight crated, 3600 pounds

Hobart Brothers Stock Bin

The stock bin shown is one that has recently been placed on the market for storing nuts, bolts, screws or other small parts around a machine shop or toolroom. It contains 120 compartments, each measuring 6 x 8 x 10 in. The front partition and the ends of the bin are of oak, while the back is of sheet steel. Each compartment is furnished with a metal card holder for indexing purposes. Hobart Brothers Co., Troy, Ohio, is the manufacturer.

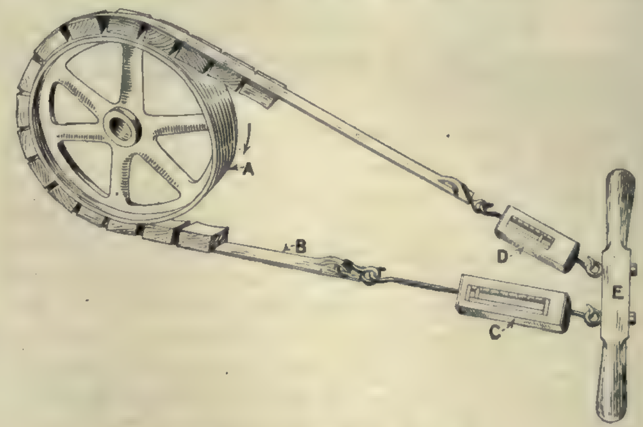


ACCESSORY AND STOCK BIN

Portable Prony Brake

By E. E. Larson

The illustration shows a portable prony brake consisting of a belt about 4 ft. long and 2 in. wide. To one end is attached a spring scale *C*, having a capacity of 100 lb. The scale *D*, with a capacity of 25 lb., is fastened to the other end. Both scales are joined to a common handle *E*. The belt *B* must be very flexible and must be lined with hard-maple blocks where it comes in contact with the pulley. The blocks may be ½ x 1 x 2 in. and should be attached with rivets having the heads countersunk in the wood.



PORTABLE PRONY BRAKE

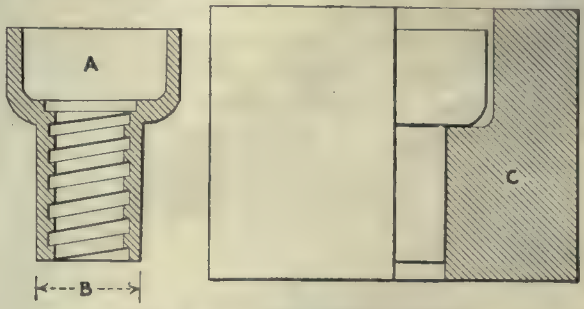
In use, the belt is placed on the pulley *A* as shown; the handle *E* is pulled until sufficient braking is secured. The scales are then read, and the reading on the small scale is subtracted from the reading on the large one. The remainder is multiplied by the peripheral speed of the pulley per minute, which gives the foot-pounds.

Shrinking a Forging Part

By L. V. Lauther

The illustration shows a part of a chocolate machine that was built in Switzerland to metric measurements.

Owing to wear in the threaded part, the piece would not function properly, and as the thread was metric, we had no means of making a new one. The recess *A* carried a ball race, and it was therefore desirable to leave this as it was. A block *C* of machine steel was bored a very tight shrinking fit for the diameter *B*, heated red hot, and forced on. In cooling, it contracted *B* and restored its usefulness without affecting the race seat *A*. The block of steel was afterward split and taken off.



THE WORK AND METHOD USED

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Hotel Powhatan, Washington, D. C., Sept. 8, 1917—It is with deep regret and a feeling of real personal loss that I record the death of Maj. Henry Souther, whom I have mentioned at various times in these letters. Our acquaintance began about 15 years ago in the early days of the automobile industry, and it is perfectly safe to say that during the intervening years he has done more for the standardization of automobile parts and practices than any other man. Born in Boston in 1865, he graduated from the Massachusetts Institute of Technology and then took post-graduate work at the leading German metallurgical schools.

His practical experience began with the Pennsylvania Steel Co., Steelton, Penn., and he was later closely identified with large bicycle production and in metallurgical and general consulting capacities. All this experience made him a particularly valuable man in the automobile field, and much of the pioneer testing was done by him in his laboratory. In later years he was associated with the Standard Roller Bearing Co., in Philadelphia, and the Ferro Machine and Foundry Co., of Cleveland; but the outbreak of the war found him deeply interested in the work of this country looking toward real preparedness, although his active connection with the Government did not begin until early in 1916. His work during the past year in association with the Aviation Section of the Signal Corps, first as consulting engineer and later as major in the United States Reserve, was fundamental in character. From the very outset his foresight and imagination led to a conception of the vastness of the problem and to the evolution of an organization suitable for this work.

The activities at Langley Field, Hampton, Va., where design, experimentation and research in connection with aircraft development will be carried on, are to a great degree the result of Major Souther's grasp of the problems to be solved. The multitude of specifications and other details that formed the basis for production work now under way were largely the result of his activities.

It is to be regretted that Major Souther will not be identified in the public eye with the successful conclusion of the aircraft-production program. It remains, however, for his immediate associates, and those of us who are familiar with the work he did, to remember and to record that the breadth and solidity of the foundation for the completion of this great problem were in a large measure due to the keen mind, tireless application and that quality which attracts loyal support, these being but a few of the admirable characteristics of the late Maj. Henry Souther.

One of the most encouraging features of the whole war program is the new aviation engine and the way in which it has been handled almost from start to finish. Two of the best-known internal-combustion engine designers in the country were called in and put to work, not to devise something especially new and startling, but to combine as many good points as possible from existing engines on both sides of the water and so to design the new engine that it could be manufactured in large quantities by modern shop methods. How well they succeeded can only be appreciated by seeing the new engine and going into the details of its construction from both an engineering and a manufacturing point of view.

There is a remark attributed to Howard Coffin which seems to fit the case as showing the difference between our methods and those of some of our allies. One of the foreign aviators remarked that it was doubtful if we could build enough high-grade engines because we had so few mechanics who could handle a file, to which Mr. Coffin replied that this was the very reason why we could build them in large quantities.

Since the engine has been designed with an especial view to easy manufacture and with a full knowledge of the manufacturing methods of the most modern automobile plants in the world, the question of production is much simplified. Almost no special machinery is required in addition to that already installed; and excepting for particular attention to accuracy, even more than in the high-grade automobile work because of the high power per cylinder and the extremely light weight, the engines can be built in much the same way as the regular product.

As might be expected, this work will be done by a number of the well-known automobile plants in various parts of the country, and there should be no difficulty in securing a large production as soon as standard gages can be supplied so as to insure duplication of parts or at least such parts as require replacement or repairs. This work is well under way, and the output promises to be surprising in the course of a few months.

The Matter of Records

Every shop manager who has been impressed with the advisability, if not necessity, of securing records of one kind or another has sooner or later been confronted with the fact that records and statistics are of little value unless they are arranged in some usable form. It is comparatively easy to get together a lot of records as to performances of certain machines or certain operators, but just how to make these records of value so that they can be used in future and without spending more time over them than they are worth is quite another problem. This is one of the great difficulties with the various inventories that are being taken or have been taken in some states; the information is not of such a character or in such form that it can be used. Nothing is more discouraging than to have data of this kind thrust upon you in the belief that they are of real value, only to find that they are practically, if not wholly, useless.

In other cases perfectly good data are allowed to lie untouched, because people are not accustomed to working with condensed or tabulated facts. Whichever reason may be assigned, the fact remains that comparatively little use is evidently being made of the mass of information that has been collected, along some lines at least, when it comes to placing contracts.

One specific instance is the placing of a good-sized contract for gages with a concern that, while highly successful in some lines, is evidently not experienced in gagemaking, if we can judge from the fact that it has been, and still is, trying to sublet the contract in various parts of the country. Now one of the subcontractors, presumably more than once removed, is again trying to sublet the contract, because it cannot fill the requirements.

This instance is simply one of the errors of judgment that come when one is not familiar with the output of the various shops of the country and, in placing contracts, allows a good reputation in one line to cover entirely different kinds of work. A good inventory, properly classified and intelligently used, might easily prevent such mistakes, and adequate inspection as to the progress of work would readily detect whether the work was being done, how fast it was being done and when and where it was being peddled to other shops. The main difficulty with this sort of blundering is that it causes needless delay as well as adding greatly to the expense, much of this work being done on a "cost-plus" basis.

CENTRALIZING THE FORGING SUPPLY

As has been pointed out on several occasions in these columns, forgings are at the foundation of a large amount of manufacturing, and on them depends to a large extent the amount of product that can be expected. This truth is felt in some lines at the present time, and considerable scouting is being done to see where forgings of both steel and the nonferrous metals can be secured. And as forgings are to a large extent dependent on the dies in which they are made, an adequate supply of forging dies is absolutely necessary if the forgings are to be made in large and regular quantities.

Diemakers are probably among the scarcest individuals in the whole field of labor; and there are doubtless many small hammer shops that could assist in the production of forgings, if they could be supplied with dies by some central department. Such a die department could furnish dies for a great variety of forgings, and by a little systematic management dies could be shipped regularly to certain shops, these shipments being based on the known life of the dies and the output of the forging plant.

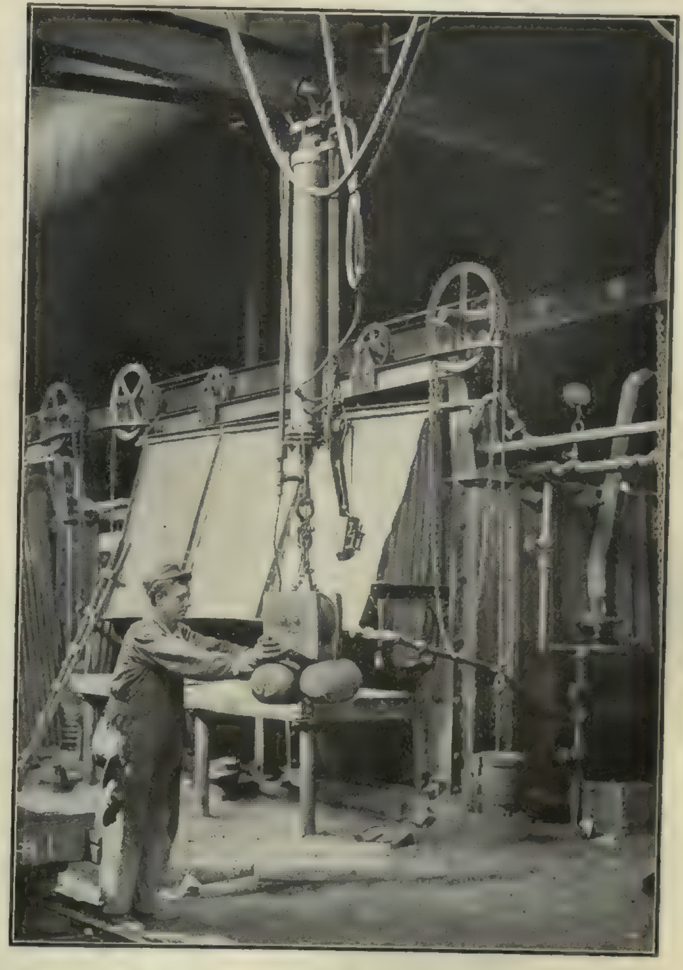
As the new standard aviation motor will require many forgings and as the same central diemaking department could handle these as well as other forgings, it would seem as if some arrangement of this kind might well be undertaken at an early date. But whether this plan be adopted or not, it will be well for all who have either diemaking or drop-forging capacity available to communicate with the Aircraft Production Board and also with such firms as are known to be making engines and other mechanisms.

The same condition is sure to apply to gages for the new engine in the very near future, as any sort of standard engine requires a large number of gages, and comparatively few builders will have sufficient gagemaking capacity in their own shops. Here again, concerns with capacity to turn out this class of work should get into communication with those who are to build the new engines, either directly or through the Aircraft Production Board.

Handling Large Shell Blanks

BY M. E. HOAG

The illustration shows the method of handling 8-in. shell blanks from the trucks to the furnaces in the plant of Curtis & Co. Manufacturing Co., St. Louis, Mo. The magnet will hold two of these blanks as the air hoist lifts them to the level of the furnace platform. The type of water apron used in front of all the heating furnaces is also plainly shown.



HANDLING LARGE SHELL BLANKS

Personals

Dr. Robert Grimshaw sailed on the "Esperanza," Sept. 1, for Mexico, for a short business trip.

W. E. Firth, safety engineer of the Midvale Steel Co., Nicetown, Philadelphia, Penn., has resigned his position.

Business Items

The Gisholt Machine Co. has moved its New York office from 50 Church St. to Rooms 723-725, 30 Church Street.

The Hendricks Manufacturing Co., Seattle, Wash., has moved to its new plant at First Avenue South and Horton St.

The Atcheson & Barok Die Tool Co., Peters Power Building, Columbus, Ohio, announces the opening of a shop equipped for the purpose of manufacturing small accurate tools and dies of all descriptions.

The American and Foreign Sales Corporation, 206 Munsey Building, Washington, D. C., has elected the following officers: John L. Newbold, president; Ross P. Andrews, vice president; E. E. Thompson, secretary and treasurer; Louis C. Witkowski, sales manager. The purpose of the corporation is to render service to large manufacturers who want personal representation before the Government and to the various branches of the United States Government.

Trade Catalogs

Maag Gears. Maag Gear Co., Yonkers, N. Y. Loose-leaf catalog; 8½ x 11 in.; illustrated.

Hoevel Sandblast Machines. Hoevel Manufacturing Co., 50 Church St., New York. Catalog F. Pp. 16; 8 x 10½ in.; illustrated.

Improved Sine Bar, Indicating Square. Slocum, Avram & Slocum Laboratories, Ind., 531 W. 21st St., New York. Folders. Illustrated.

Link-Belt Roller Chains for Tractors and Trucks. Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Book No. 326. Pp. 14; 6 x 9 in.; illustrated.

Ball-Bearing and Plain-Bearing Grinding and Polishing Machinery. The Webster & Perks Tool Co., Springfield, Ohio. Loose-leaf catalog; 9 x 11½ in.; illustrated.

High Speed Steel Collet Shanks, End and Side Milling Cutters, Woodruff Keyseat Cutters, etc. The Gale-Sawyer Co., Boston, Mass. Catalog. Pp. 14; 4½ x 7 in.; illustrated.

Red-E Tools. The Ready Tool Co., Bridgeport, Conn. Catalog No. 15. Pp. 20; 6 x 9 in.; illustrated. This describes lathe and planer tools, Stellite tools, lathe dogs, boring bars, etc.

Some Facts About Roller Chain Drives. Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Book No. 361. This contains an article by A. Lee Henson, of the Smith Motor Truck Corp.

Frasse-Electric and Open Hearth Steels. Peter A. Frasse & Co., 417-21 Canal St., New York. Catalog. Pp. 98; 4½ x 7 in.; illustrated. This is a very nicely bound catalog containing complete description of the various grades of steel made by this company, also numerous tables.

New Publication

Theory of Machines. By Robert W. Angus. Three hundred and twenty-two 6 x 9-in. pages; 193 illustrations; cloth bound. Published by the McGraw-Hill Book Co., Inc., 239 W. 39th St., New York City. Price $3.

Reviewed by Dexter S. Kimball

This is the second edition of a book on this subject by this author, but it has been entirely rewritten, enlarged and revised. The old cuts have been redrawn, and much new material has been added. The book is based on a number of years of experience in teaching engineering students at the University of Toronto as well as on considerable practical experience.

The author divides the study of machines into four parts: Kinematics of machinery or mechanisms; the problems of static equilibrium, mechanics of machinery and machine design. The first three divisions only are discussed in this book, and the first eight chapters of Part 1 are devoted to the discussion of the kinematics of machinery. The items discussed are those usually found in treatises of this kind, as the names of the several chapters indicate. These are as follows: The Nature of the Machine; Motion in Machines; Velocity of Diagrams; The Motion Diagram; Toothed Gearing; Bevel and Spiral Gearing; Trains of Gearing; Cams.

The nature of the discussions and the general methods of attack are similar to those found in other treatises on this subject with the exception of Chapter 4. In preceding chapters the author develops the theory of instantaneous centers, demonstrates Kennedy's theorem and illustrates their application to the finding of velocity diagrams. In Chapter 4, however, he develops another method for attacking these problems by means of what he calls the "phorograph." This is a graphical method which he says was discovered by Prof. T. R. Rosebrugh, of the University of Toronto, 25 years ago, but which has not appeared in print before. The method is applied to the solution of several well-known mechanisms. The theory will probably be somewhat difficult for students to follow, but it appears to be simple in application. At any rate it is interesting.

The remainder of Part 1, Chapters 9, 10 and 11, entitled respectively, Forces Acting on Machines, Crank Effort and Turning Moment Diagrams and The Efficiency of Machines, contains discussions of problems in the second section of the author's classification; namely, static equilibrium. In Chapter 4 the force diagrams of several well-known machines are solved, using both instantaneous centers and the phorograph. In Chapter 10 the crank-effort diagrams of several kinds of prime movers are worked out.

Part 2 is called Mechanics of Machinery. It consists of five chapters, named respectively, Governors, Speed Fluctuations in Machinery, The Proper Weight of Flywheels, Acceleration in Machinery and Their Effects, and Balancing of Machinery. There are also two appendixes—Appendix A, Formula for Piston Acceleration, and Appendix B, The Moment of Inertia of a Body—the latter being an account of an experimental method of determining the moment of inertia of any body. The scope of this section of the book is obviously limited as compared with other treatises on this line of work, the object of the writer evidently being to present to the student the most important problems of this kind in condensed form. The work appears, however, to have been carefully and painstakingly performed.

This is true in fact of the entire volume, and it contains much solid matter and little that is unnecessary. If there is any criticism of the book called for it may perhaps be that there is not enough of it for effective use in many engineering courses where it is sought to give a broader grounding in some of these subjects than is attempted in this book. There would appear to be little question of the quality of the discussions presented. In his introduction the author states that he has used few formulas involving anything more than elementary trigonometry and algebra and that the two or three cases involving the calculus may be omitted without detracting from the usefulness of the book.

This may be true so far as the use of the volume by practicing engineers of limited education is concerned, but it does not seem to be worth while trying to train engineers in technical schools so that they can handle intelligently such discussions as are included in Part 2 without giving them not only a firm grounding in calculus, but extensive practice also in its application. One of the great weaknesses of the graduates of our technical schools is their inability to use higher mathematics freely and accurately, and in the reviewer's opinion any treatise on mechanics loses a large part of its value when it fails to furnish a good training in the use of higher mathematics, even though graphical solutions are often easier, simpler and clearer. Graphic methods have their limitations also, and there comes a time when they are not sufficient and resort must be had to pure mathematics. The ability to handle both methods of attack is essential, and the latter is by far the more difficult of the two to acquire.

The book, nevertheless, is a fine piece of work and will no doubt find a use in many schools. Every teacher of these subjects will find in it much to interest and help him, and the practicing engineer will find the last chapter of especial interest.

Forthcoming Meetings

The twelfth annual exhibit of foundry and machine-shop equipment and supplies will be held under the auspices of the American Foundrymen's Association in the Mechanics Building, Boston, Mass., from Sept. 25 to 28, 1917. The officers of the exhibit committee are: President, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; vice president, Benjamin D. Fuller, Westinghouse Electric and Manufacturing Co., Cleveland, Ohio; secretary and treasurer, A. O. Backert, 12th and Chestnut Sts., Cleveland, Ohio; manager of the department of exhibits, C. E. Hoyt, 123 West Madison St., Chicago, Illinois.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch ·National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

The annual congress of purchasing agents, under the auspices of the national association, will be held at Pittsburgh, Oct. 9 .to 11. The program includes business sessions for the mornings and visitation and inspection of industrial works during the afternoons. Special features are: Tour of Pittsburgh's principal business districts by automobile during the late afternoon of the first day, and cabaret dinner in the evening, to be held at one of the country clubs. The banquet will be held at the Convention Hotel the evening of the second day, Oct. 10, with speakers of national prominence. All purchasing agents and others interested are welcome and expected to attend and participate in the activities of the convention. Special arrangements are planned for the entertainment of the ladies.

American and Canadian engineers and architects of Norwegian birth or descent will hold an informal congress at the Chicago Norske Klub, Chicago, Ill., Sept. 27 to 29. Correspondence should be addressed to Joachim G. Giaver, Railway Exchange Building, Chicago.

The American Gear Manufacturers' Association will hold a meeting at the Edgewater Beach Hotel, Chicago, Ill., Sept. 14 and 15, 1917. Papers will be presented on the following subjects: "Advertising Don'ts," "Heat-Treating and Hardening Gears," "Inspection of Gearing," "Spur Gearing by the Rotary or Disk Process," "Spur Gears by the Shaper Method."

The American Museum of Safety and the National Safety Council will hold the fourth National Exposition of Safety and Sanitation, at the Grand Central Palace, New York City, Sept. 10 to 15.

Condensed Clipping-Index of Equipment

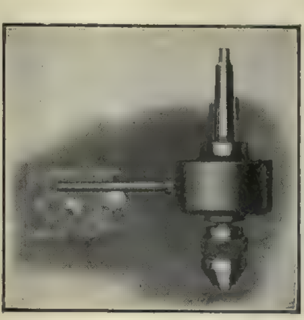
Clip, paste on 3 x 5-in. cards and file as desired

Tapping Attachment

Bicknell-Thomas Co., Greenfield, Mass.

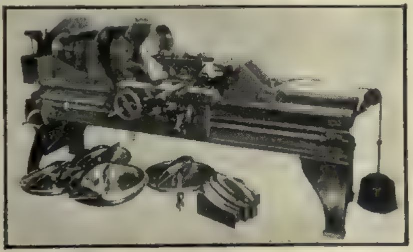
"American Machinist," Aug. 30, 1917

A reversing tapping attachment for the drilling machine, which is made with either positive or friction drive. The friction-drive device is built in one size for work with taps from $\frac{3}{32}$ to $\frac{1}{4}$ in. in diameter and is made with either a No. 1 or a No. 2 Morse taper shank. The positive-driven attachment is built in two sizes with capacities of from $\frac{3}{16}$ to $\frac{3}{8}$ in. and from $\frac{5}{16}$ to $\frac{3}{4}$ in. The former is supplied with either a No. 1 or a No. 2 Morse taper shank, while the latter may be had with a No. 3 or a No. 4 taper shank. Positive-driven attachment may be supplied with friction chuck if desired



Lathe, Concave Turning

Luster-Jordan Co., Franklin Ave. and Washington St., Norristown, Penn.

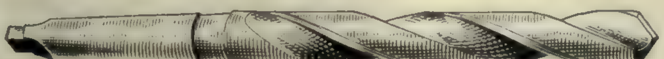


"American Machinist," Aug. 30, 1917

Designed especially for turning the inside surface of air-flask heads for torpedoes, but may also be used for other concave turning work. Has a special form of tool-feeding attachment allowing from two to five distinct curves to be cut on the same piece of work

Drills, Forged Twist

Russ Forged Drill Co., Cleveland, Ohio

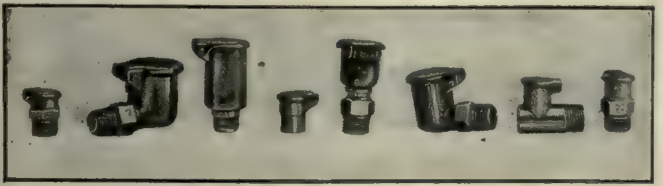


"American Machinist," Aug. 30, 1917

This company is now manufacturing a line of forged twist drills which are made up in a large variety of styles and sizes. They are sold under the trade name of "Drill-Far"

Oil Cups

Gits Brothers Manufacturing Co., 553-555 West Monroe St., Chicago, Ill.



"American Machinist," Aug. 30, 1917

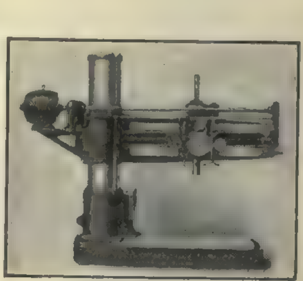
These cups are made in a variety of sizes with shanks for standard pipe thread, straight thread or for a taper drive fit. All parts except the covers are brazed together, it being claimed that this construction enables a cup as strong as the cast variety to be made at a considerably lower cost

Drilling Machine, Radial, Motor Driven

Triumph Machine Tool Co., 1276 East 55th St., Cleveland, Ohio

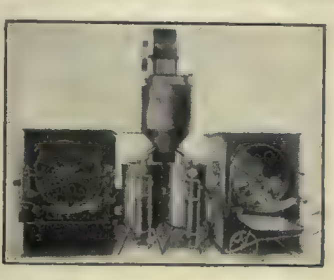
"American Machinist," Aug. 30, 1917

Height of base, 9 in.; size of base-working surface, 4 ft. by 6 ft. 8 in.; vertical adjustment of arm, 4 ft.; travel of head, 4 ft. 2 in.; minimum distance spindle to base, 8$\frac{1}{2}$ in.; maximum distance spindle to base, 6 ft. 2 in.; minimum distance column to spindle, 24 in.; diameter of column, 18 in.; height, 10 ft. 4 in.; motor horsepower, 5; spindle speeds, twenty-one, 15 to 260 r.p.m.; vertical spindle traverse, 19$\frac{1}{2}$ in.; weight, 16,500 lb.; feeds, four, 6, 9, 15 and 24 thousandths per revolution



Sand Blast Machine

Mott Sand Blast Manufacturing Co., Inc., Brooklyn, N. Y.

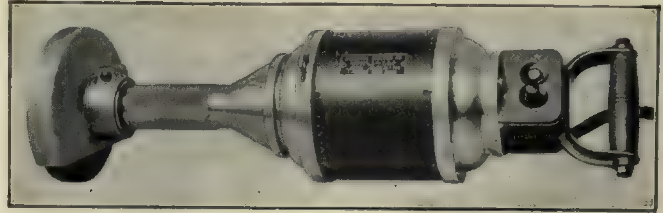


"American Machinist," Aug. 30, 1917

A double-barrel machine with separate sand blast for each barrel. Abrasive material is elevated mechanically by a belt and bucket elevator and passes through a mechanically operated screen. Made in various sizes to meet the requirments of large or small shops

Grinder, Electric

Universal Electric Co., 9 Oliver St., Newark, N. J.

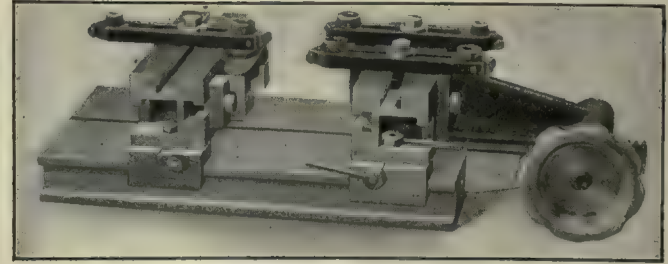


"American Machinist," Aug. 30, 1917

A $\frac{1}{2}$-hp. machine that runs at a speed of 3575 r.p.m. and accommodates grinding wheels up to 6 x $\frac{1}{2}$ in. The motor bearings are of the S K F ball type, while the wheel bearing is of bronze. Acieral metal is used wherever possible, the weight being thus kept down to 31 pounds

Jig, Universal Drill

Berggren & Pearson Machine Co., Inc., 221 Canal St., New York



"American Machinist," Aug. 30, 1917

Designed with the idea of providing a jig that may be quickly adjusted to various sizes and types of work. Consists of a base and two uprights to which are secured bars holding hardened bushings of any desired size up to 1$\frac{1}{2}$ in. in diameter. Made in five sizes, the largest holding work 16 in. wide and 8 in. thick

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations were current as follows at the points and dates indicated:

	Sept. 7, 1917	One Month Ago	One Year Ago
No, 2 Southern Foundry, Birmingham	$47.00	$47.00	$14.50
No. 2X Northern Foundry, Buffalo	53.00	53.00	19.75
No. 2 Northern Foundry, Chicago	55.00	55.00	19.00
*Bessemer, Pittsburgh	52.95	55.95	21.95
*Basic, Pittsburgh	48.95	53.95	18.95
No. 2X, Philadelphia	53.00	53.00	19.50
*No. 2, Valley	53.00	53.00	18.50
No. 2, Southern Cincinnati	49.90	49.90	17.40
Basic, Eastern Pennsylvania	50.00	50.00	19.75

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.

STEEL SHAPES—The following base prices in cents per pound are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Sept. 7, 1917	One Month Ago	One Year Ago	Sept. 7, 1917	One Year Ago	Sept. 7, 1917	One Year Ago
Structural shapes	5.25	5.25	3.25	5.00	3.25	5.00	3.10
Soft steel bars	5.00	5.00	3.30	4.50	3.30	4.50	3.10
Soft steel bar shapes	5.00	5.00	3.25	4.50	3.25	4.50	3.10
Plates, ¼ to 1 in. thick	10.00	10.00	4.50	7.00	4.00	9.00@10	3.50

BAR IRON—Prices in cents per pound at the places named are as follows:

	Sept. 7, 1917	One Year Ago
Pittsburgh, mill	4.75	2.60
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Sept. 7, 1917	One Month Ago	One Year Ago	Sept. 7, 1917	One Year Ago	Sept. 7, 1917	One Year Ago
*No. 28 black	8.00- 9.00	10.50	10.50	3.65	9.00	3.40	10.00	3.35
*No. 26 black	7.90- 8.90	10.40	10.40	3.55	8.90	3.30	9.90	3.25
*No. 22 and 24 black	7.85- 8.85	10.35	10.35	3.50	8.85	3.25	9.85	3.20
No. 18 and 20 black	7.80- 8.80	10.30	10.30	4.45	9.20	3.20	9.80	3.15
No. 16 blue annealed	8.20- 9.20	10.20	10.20	4.45	9.20	3.70	10.20	3.60
No. 14 blue annealed	8.10- 9.10	10.10	10.10	4.35	9.10	3.60	10.10	3.50
No. 12 blue annealed	8.05- 9.05	10.05	10.05	4.30	9.05	3.55	10.05	3.45
No. 10 blue annealed	8.00- 9.00	10.00	10.00	4.25	9.00	3.50	10.00	3.40
*No. 28 galvanized	10.00-10.50	12.00	12.50	5.00	10.75	4.70	11.50	4.75
*No. 26 galvanized	9.70-10.20	11.70	12.20	4.70	19.45	4.40	11.20	4.45
No. 24 galvanized	9.55-10.05	11.55	12.05	4.55	10.30	4.25	11.05	4.30

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring fair-sized lots, the following quotations hold:

	Sept. 7, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	45%
Cleveland	40%	45%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—This material per 100 lb. sells as follows:

	Sept. 7, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	15.00	6.30
Chicago	13.00	5.50

In coils an advance of 50c. usually is charged.
Note—Stock scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in fair-sized lots:

Welding Wire*		Cast-Iron Welding Rods	
3/8, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00	3/16 by 12 in. long	16.00
No. 8, 5/32 and No. 10		¼ by 19 in. long	14.00
⅛		⅜ by 19 in long	12.00
No. 12		½ by 21 in. long	12.00
3/32, No. 14 and 1/16			
No. 18			
No. 20			

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

* Very scarce

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Sept. 7, 1917	Cleveland Sept. 7, 1917	Chicago Sept. 7, 1917
Tire	5.00	5.00	4.50
Toe calk	5.70	5.50	4.75
Openhearth spring steel	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
BUTT WELD					
⅛, ¼ and ⅜	42%	15½%	¾ to 1½	33%	17%
½	46%	31½%			
LAP WELD					
2	42%	29½%	2	26%	12%
2½ to 6	45%	32½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	38%	20½%	¾ to 1½	33%	18%
½	43%	30½%			
¾ to 1½	47%	34½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4	43%	31½%	2¼ to 4	29%	17%
4½ to 6	42%	30½%	4½ to 6	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	38%	25%	38.8%	24.8%
3½ to 6 in. steel lap welded	26%	7%	23%	39%	42.8%	27.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound:

	Sept. 7, 1917	One Month Ago	One Year Ago
Copper, electrolytic (carload lots)	26.00	28.50	29.00
Tin	61.00	63.75	39.00
Lead	10.00	11.00	6.75
Spelter	8.25	8.75	8.50
ST. LOUIS			
Lead	9.75	10.75	5.87½
Spelter	8.00	8.25	9.50

At the places named, the following prices in cents per pound prevail:

	New York			Cleveland		Chicago	
	Sept. 7, 1917	One Month Ago	One Year Ago	Sept. 7, 1917	One Year Ago	Sept. 7, 1917	One Year Ago
Copper sheets, base	36.00–40.00	39.00	37.50	38.00	38.50	38.00	38.00
Copper wire (carload lots)	38.50	38.50	32.00	38.00	33.00	38.50	33.50
Brass pipe, base	43.00–45.00	43.00	46.50	46.00	45.00	44.00	45.00
Brass sheets	40.00	40.00	44.50	36.00	42.00	39.50	39.00
Solder ½ and ½ (case lots)	39.25	39.25	24.62½	39.50	24.75	39.25	24.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Sept. 7, 1917	One Year Ago
Mill	$42.00	$42.00
New York	38.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

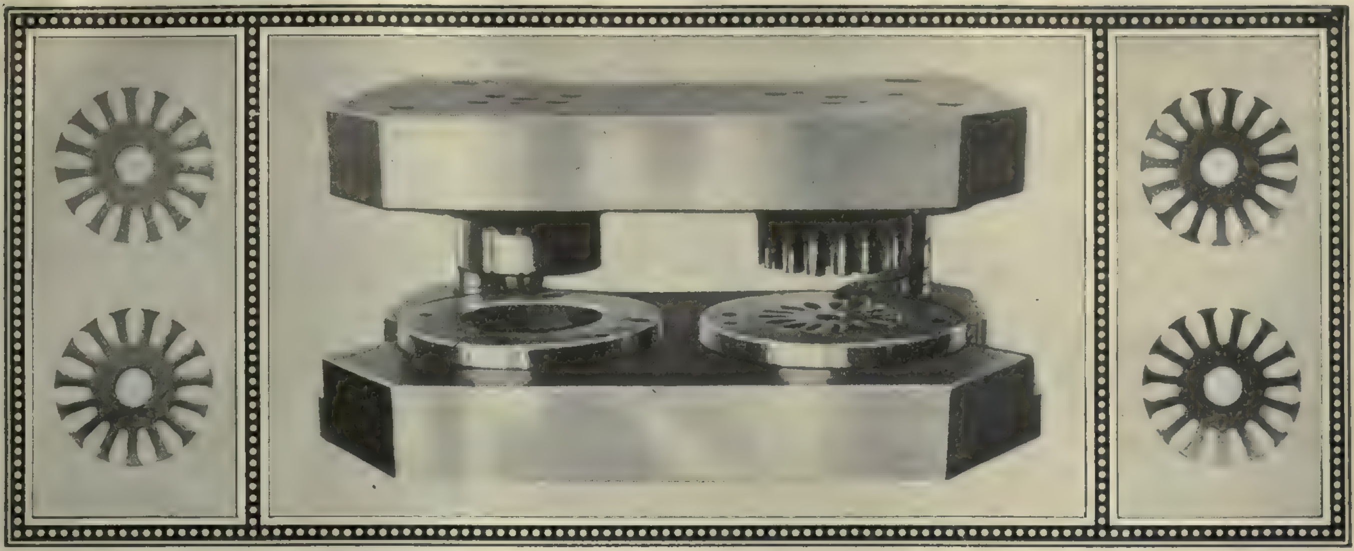
ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Sept. 7, 1917	One Year Ago	Sept. 7, 1917	One Year Ago
New York	21.00	17.00	21.50	18.00
Cleveland	23.00	16.75	23.25	17.50
Chicago	22.50	17.00	23.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound for spot delivery, duty paid:

	Sept. 7, 1917	One Year Ago
New York	14.50	13.50
Cleveland	17.50	13.00
Chicago	16.50	13.50



Relation of Press Stroke to the Life of a Die

By E. F. Creager

ASSISTANT FACTORY MANAGER, REMY ELECTRIC CO.

SYNOPSIS — *Decreasing press stroke increases the life of a punch and die. This statement is backed by data of undoubted value obtained through years of experiment and experience.*

DOES a short-stroke press—that is, less than standard—increase the life of a punch and die? I have asked a number of press and toolroom foremen the question, "Does it make any difference in the life of a punch and die if it is worked in a press of 3-in. stroke or in one of 1-in. stroke, all other things being equal?" Almost invariably the reply was, "None at all if the presses are run at the same speed." Why the addition regarding the speed, I have not yet been able to fathom.

Believing differently, I made a few experiments and found that it did make some difference; and having some very definite data on the method then in use in the works I was connected with, I ordered a press, not geared, with a 1½-in. stroke, and put it to work at 80 strokes per minute. I was agreeably surprised at the results.

The presses already in use were a geared press of 3-in. stroke that ran at 65 strokes per minute and easily blanked the work, and a nongeared press the same size of 2½-in. stroke that ran at 90 strokes per minute and barely did the work, which was to punch armature laminations from standard armature-lamination stock $\frac{1}{32}$ in. thick and 3.238 in. in diameter, with 15 wire slots and a 0.750-in. round shaft hole, as shown in Fig. 1. The shaft hole must be held to close limits to drive tight on the shaft for spiraled slot armatures, since the torque on the armature is severe.

The method shown of holding the laminations by knurling for straight-slot armatures is an economical and very effective method of doing this. It is also employed for holding the commutators, the friction alone being sufficient to prevent shifting. The slots in the disks must be in good alignment and free from fins, so that the insulation of the wire shall not be injured.

The material from which the blanks are made is a tough annealed stock and there is plenty of scale, all of which tends to shorten the life between "grinds."

The type of punch and die used is a progressive subpress with two guides 1⅜ in. in diameter, accurately ground to fit the reamed hole in the punch-and-die mounting, as shown in Fig. 3.

While the making of punches from one piece of metal is not new, still we do not find many toolmakers with the ability to make one of the type shown in Fig. 4, and fewer yet who can properly harden one made of high-speed steel. The time it takes to make a punch is from 67 to 76 hours, though less time is taken to make the die. The completed die mounted for the press takes 270 hours, the material used being high-speed steel; there is no shrinkage in hardening and no lapping or stoning is required to fit after hardening.

DATA THAT PROVE VALUE OF SHORT PRESS STROKE

I have no accurate data on the average life of the "built-up" type of punch and die, but it was under 8000 blanks between grinds. Hence I will consider only the "solid" type in its evolution toward efficiency. As originally worked, the production between grinds was from 8000 to 10,000 blanks, rarely the latter figure. By changing the steel from which the punches and dies were made, this was increased to an average of 15,000 blanks. In the 2½- and 3-in.-stroke press the variation in strokes per minute between the geared and nongeared press showed no appreciable difference in the life of the die.

At this time we were accepting an amount of fin that would not be tolerated at present and one that required considerable filing after assembling to remove. The same punch-and-die set was then transferred to the press with 1½-in. stroke, and immediately it gave 40,000 blanks before the fin was as bad as it was in the longer-stroke press at 12,000 to 15,000 pieces. We cut the output to 30,000 or 35,000 pieces and get a blank that has no objectionable fin. We do not have to file after assembly, neither do we have to grind as much from the punch and die to resharpen.

The benefits we received aside from the longer life of the punch and die are: The saving of set-up time, which is only one-third as often; two diemakers produce all the punches and dies needed where it previously kept six men on the jump; die breakage is rare; punches and dies wear more evenly, and we are able to use all nongeared presses with the normal difference in speed over the geared press.

The punch as shown is 2 in. long when new and is used to 1⅜ in. The die is 1¼ in. thick and is used to ⅝ in., which, with a production of 30,000 pieces between grinds of 0.004 in. each, gives 4,680,000 blanks (stock production sheets show that our average is over 5,000,000). The latter figure gives an actual net die cost of 4c. per 1000 blanks.

Formerly we removed from 0.010 to 0.015 in. from each punch and die. An average of 0.012 in. ground off each time would give a total die production of 1,560,000 pieces during the life of the punch and die, or only one-third of the present production. All the presses we added recently have been of short stroke, and we endeavor to use the stroke as short as we possibly can and allow the stock to be fed in the interval when the press is operating at its normal strokes per minute; that is, as fast as the operator can feed the press without removing his foot from the pedal after the first blank is struck.

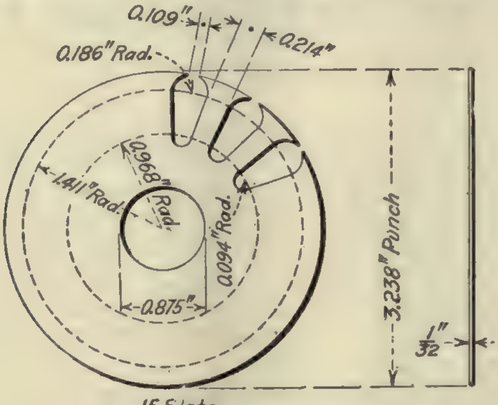


FIG. 1. DETAIL OF ARMATURE LAMINATION

I know that some will say that much of the gain mentioned was made because the short-stroke press was new and the gate or ram was a snug fit in the guides. Owing to the punch and die being mounted subpress, this does not affect it so much as the ordinary punch and die is affected; but it does affect it more than is usually thought. We keep all our presses adjusted so that the ram is just held up by the friction of the guides when it is loose from the crank. This, we believe, is the usual rule for adjustment advised by the makers, and it relieves the duty on the brake-band clutch release. The usual shop remedy when the ram becomes free and the press overruns and begins to pound the release and clutch parts is to tighten up on the brake, when this, as a rule, needs but little adjustment. The remedy should be applied, when needed in the guides for the gate or ram. This, however, should not be done when a punch and die is set up in the press without resetting. This caution may seem unneeded, but I have known it to be done; and the results were not pleasing.

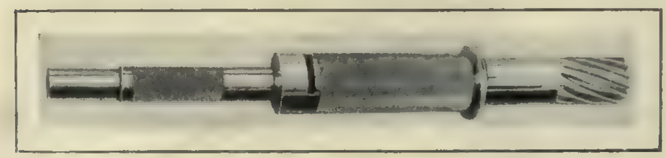


FIG. 2. KNURLED ARMATURE SHAFT

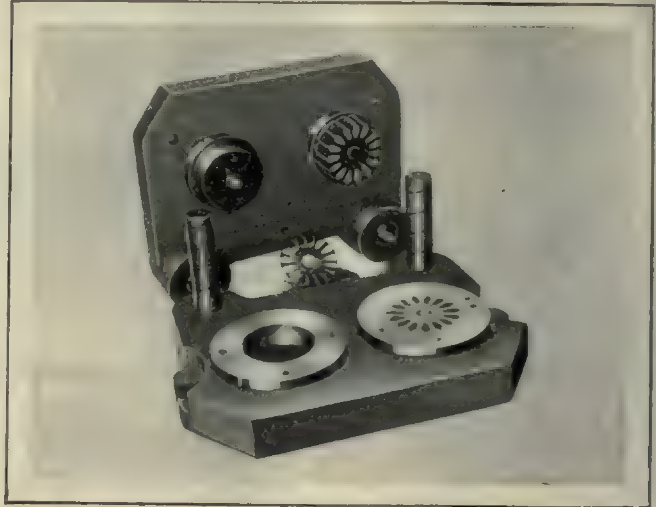


FIG. 3. TYPE OF PUNCH AND DIE USED

CRITICAL NOTES ON PRESS CONSTRUCTION

It is to be regretted that more care is not exercised by many press builders in the construction details of their presses. Almost any old thing seems to be the limit for the parallelism of bolster and bar plate or bed of press. Also, attention to some of the smaller points of construction, with proper care in design and workmanship, would make a better press for the purchaser and a safer one for the operator.

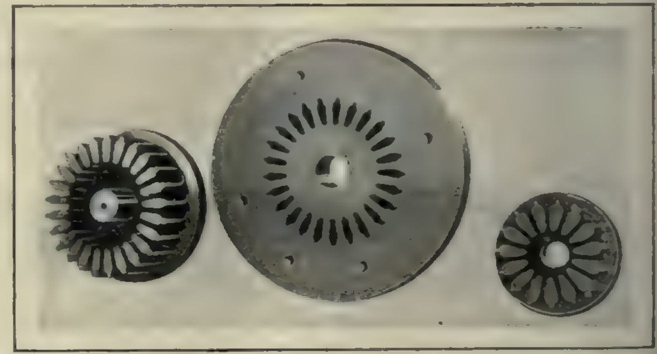


FIG. 4. UNMOUNTED PUNCH AND DIE

To secure the key in the brake wheel would not cost much, but I have seen at least two accidents caused by the key dropping out and allowing the release to strike the stop pin hard enough to break it off and allow the press to repeat. I have also seen several brake wheels split by trying to tighten up the key by putting shims under it. Another favorite method of holding the key in position is to cut a heavy chip from the edge of the keyway and force it against the head of the key. An easy remedy for all this is to drill and tap the brake wheel over the key and countersink the key slightly, then use two headless setscrews, one acting as a lock. The trip operating mechanism on many presses appears to be an afterthought—on some a very long way after.

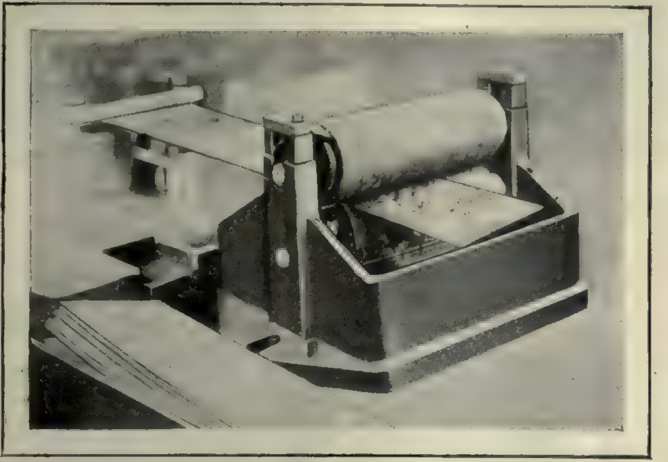


FIG. 5. STEEL STRIP-OILING DEVICE

The many unnecessary bends on the pedal rod in some and the general flimsiness of others are certainly the wrong way to economize. I have taken the name of one manufacturer from my purchase list for this cause. I believe that all presses should be supplied with a nonrepeat trip that could be used or not as desired. And all presses should be guarded at the crankshaft where it approaches the ram—that is, so the operator cannot get his hand between the camshaft and the press slide. Also, all flywheels should be guarded, as is now required by many state, factory and industrial laws.

BOSSES FOR FASTENINGS

It would at least facilitate matters if a few bosses or arms were provided to which some type of safeguard could be fastened. I believe that manufacturers should be compelled to supply designs of sane and practical safety guards for their machines and provide methods for attachment of them. I believe there would be more in use. Some of the monstrosities offered—aye, and approved—are a trial to the eye, a waste of space and a menace to the workman, as well as a great waster of time in removing and replacing belts or changing gears.

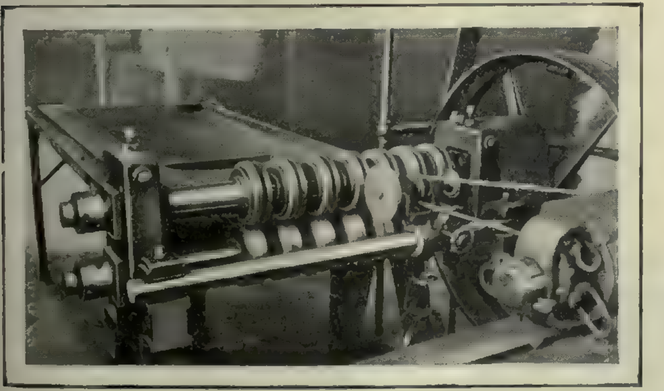


FIG. 6. MOTOR-DRIVEN SHEAR-ROLL GRINDER

Fig. 5 shows a simple, little-known device for oiling the strip before punching. Formerly three men with brushes did this work; now the operative does it with no decrease of speed, no increase of cost and a saving of approximately 60 per cent. in oil.

In this connection—economy of operation—a point that is frequently overlooked by users of slitting shears for cutting up the sheets, particularly gang slitters, is the grinding of the cutters in position. It is almost impossible to grind and replace a set of cutters so that they will run true and not nick themselves by rubbing together or by producing strips with an excess of fin and twist. A trial of grinding in position will convince a shopman that the extra motor shown in Fig. 6 will not cost much and be more convenient than the usual cumbersome overhead supplied by the makers.

SETTING CUTTERS FOR DEPTH

Care in setting the cutters for depth so that they will shear instead of tear will greatly reduce the twist in the sheet and facilitate handling in the press. Cutters ground in position will last five times as long between grinds, and total life will be at least as much longer. I have seen three or four new cutters of the gang of nine chip before a half dozen sheets had been cut, owing to their binding from not being true on the shaft; and the amount of "play" that will permit this is surprisingly small.

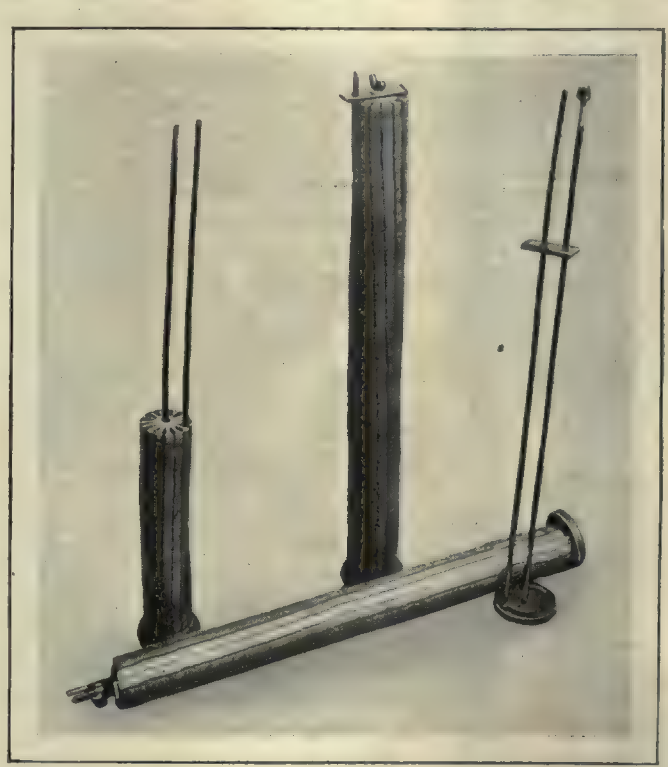


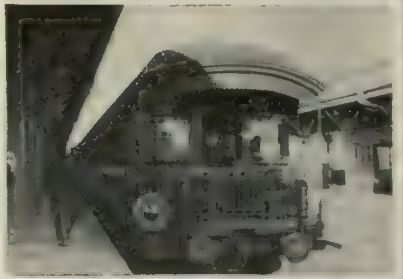
FIG. 7. RODS FOR STACKING AND STORING PUNCHINGS

STORING PUNCHINGS

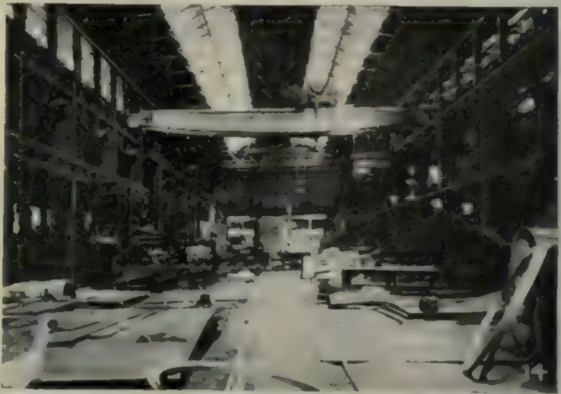
A method of handling armature disks and similar material to prevent bending and to facilitate "stacking" and storing is shown in Fig. 7. The guide rods are placed under the press and the blanks fall in position readily. This device does away with six girls, who were employed formerly in sorting and stacking the disks ready for the drivers. When a guide rod is full, a plate is placed over the top, and a thumb-nut is screwed onto the rod.

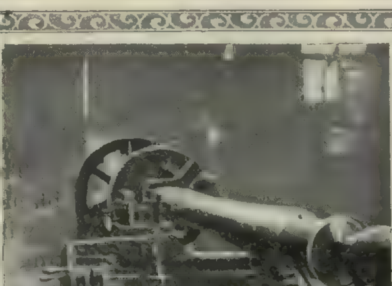
LOCOMOTIVE BUILDING IN JAPAN

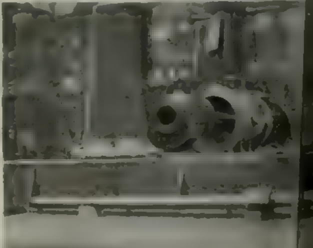
BY "HI" SIBLEY



FORTY-SIX years ago, there was not a mile of railroad track in Japan. The great bulk of intercity freight and passenger transportation was by water, and as all the principal cities were seaports, this was easily accomplished. Even Tokyo had a harbor, though a shallow one, and the light-draft junks could not only navigate up to the quays, but many of them could negotiate the numerous canals that form a network throughout the city. Likewise Yokohama, Kobe, Osaka, Nagasaki and Shimonoseki were thus accessible. The interior, in consequence, was not only in a comparatively benighted state, but very much isolated; and all communication between different sections inland was accomplished by ox and horse teams, and the two-wheeled coolie carts, which were both slow and medieval. At that time, away from the coast, the country was almost entirely agricultural; even today, although only one-fifth of this mountainous empire is arable, 60 per cent. of the population is engaged in farming. The railroads, however, are rapidly diminishing that ratio. In 1872, a British company built the first line of railway from Yokohama to Tokyo, a distance of 18 miles, which was narrow gage (3 ft. 6 in.) and established a standard for all subsequent lines. Not only that, but the railway equipment and the operating system are patterned pretty much after the English, and they have proved very effective. There are few accidents, and the trains run on schedule, although their average rate is much lower than in America. There are now 7000 miles of railway to take care of the transportation needs of a coun-







try with an area slightly larger than that of California, and with a population estimated from the last census to be in the vicinity of sixty to seventy million people.

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With Japan rapidly changing from an agricultural to an industrial nation, with nineteen thousand factories employing over a million hands, the Imperial Government Railways (there are no private lines) have received a great impetus for extension, and this year their receipts were ten million dollars greater than last, or approximately sixty-seven millions. This was equally derived from freight and passenger traffic. As a result of all this, there is much activity in the locomotive shops, notably in the Kawasaki plant at Hyogo, near Kobe, and the Kisha Seizo Kaisha, at Osaka. The Kawasaki locomotive works are owned by the Kawasaki Dockyard Company, Ltd., and build all manner of railway equipment for both the Imperial Government Railways and some of the Chinese lines. The Kisha Seizo Kaisha builds locomotives in its Osaka plant and railway carriages at Tokyo. It is difficult for the foreign visitor to reconcile his idea of Japanese methods of manufacture with the great, modern establishment of the Kisha Seizo Kaisha at Osaka, for here he finds an organization in all respects similar to an American plant of that class. Here are neat brick office buildings, with an alert, industrious force of clerks, stenographers tapping away on American typewriters, draftsmen, accountants, designers, office boys and doormen. The staff for the most part, excepting the women, are dressed in European style, many of them speak English, and the visitor from abroad is received with the

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same courtesy that a foreigner would be accorded in an American establishment.

Out in the plant one sees the same restless industry among the mechanics and foremen. There are large, light shops—light enough to take snapshots inside, in fact—departments arranged with a view to efficient production, and a predominance of modern machinery made abroad. It is true that American machines are not so numerous as the English makes, and one comes upon such nameplates as William Muir & Co., Ltd., Glasgow; Alfred Herbert, Ltd., Coventry; Jones-Burton, Liverpool; Sharp-Stewart, Glasgow; Webster & Bennett, Coventry; Asquith, and a number of German machines from Reinecker, and Gollet & Englehard. There are, however, a fair number of American machines in evidence, such as Niles-Bement-Pond, Newton, Brown & Sharpe, Rockford Machine Tool, and Barnes. A number of machine tools are built by the Kisha Seizo Kaisha under its own name, and it was making in addition, at the time of the writer's visit, boring mills and gap lathes for an English importer, and from English designs. The writer was much interested in a well-known type of German gear hobber bearing a Japanese maker's nameplate. It had been copied from the German original.

THE FOUNDRY

In addition to the vast erection shops, assembling departments and machine shops, is a large foundry equipped to produce all the concern's brass and gray-iron and steel castings. The forge shop with its half-naked workmen was impressive, and in the woodworking departments some intricate and well-finished patterns were being turned out. The Japanese excel in woodworking of any kind, and although they are somewhat vague at times regarding the scientific principles of a properly designed pattern, they will work accurately from an original model or blueprint.

The yards are extensive, transportation of materials being effected by an industrial railway, but there was no stock of finished locomotives on hand owing to the great demand for such equipment. Three locomotives were under construction in the erection shop, and several sets of cylinders were being bored, connecting-rods milled and other parts being rushed to completion. Fourteen hundred hands are employed by the Kisha Seizo Kaisha, which is a considerable number for any Japanese manufacturing plant, and the annual capacity of this works is 100 locomotives, in addition to the machine tools and bridgework it is building. The efficiency of the organization is largely due to Dr. Hasegawa, M. E., who received his experience in an American locomotive works and in English shops, and who is alert to everything new in his particular line.

The accompanying illustrations convey the impression that Japanese machine shops are not unlike our own. The subjects illustrated are as follows: (1) Dr. Hasegawa, the managing director; (2) a Japanese-built observation car; (3) part of the Osaka plant; (4) hydraulic accumulator; (5) view in the yard; (6) coolies unloading boiler plate; (7) turning an axle in an engine lathe; (8) a laying-out table; (9) cylinder boring; (10) Japanese measuring sticks; (11) boring mills as a side line; (12) gap lathe built at the shops; (13) interior of machine shop; (14) erecting shop; (15) starting to erect a locomotive; (16) shop-made shaft hangers.

What Is the Patriotic Thing To Do?

BY ENTROPY

A machine-tool shop today is confronted by a three-sided dilemma. We know that war means munitions, also machinery with which to make munitions, also trained mechanics or operatives who will run the machines to make the munitions.

Every machine-tool shop is a potential munitions factory. It is also capable of training many operatives in machine-tool operation.

There will be great temptation to break away from the thing that we are doing and do something else, if for nothing more than the sense of aiding in preparedness. We have been unprepared for so long, and in every direction, that we are now running mad over the term and cannot think of the thing that we have always done as being any part of preparedness.

To be entirely logical in our decision, if a decision is left to us, we should consider what procedure will bring about the greatest supply of munitions in the whole country, and not merely in our own shops. If we can hasten the manufacture of shells and guns by training a multitude of men, and undoubtedly women, then that is what we should do. If we can effectively and without great change in our equipment make shells and other necessaries, then that is the thing to do. But if our shops are organized for the efficient production of machine tools, the chances are against our being able to make either mechanics or munitions with the speed and thoroughness with which we can make machinery.

Emergency Repair of Broken Shaft

BY C. H. WILLEY

The shaft of one of our small circulating pumps broke, as shown in Fig. 1, and an emergency repair was made, as shown in Fig. 2.

Two wide flats *A* were chipped and filed; then a 4-in. pipe coupling *B* was placed on the shaft. Two ½-in. holes *C* were drilled through the coupling and shaft, and two pins were driven in. The screws *D* were used to hold the coupling in place. Babbitt metal *E* was then poured to fill the coupling, and the job was complete. This temporary repair served very well until a new shaft could be made.

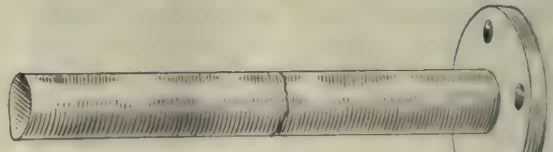


FIG.1

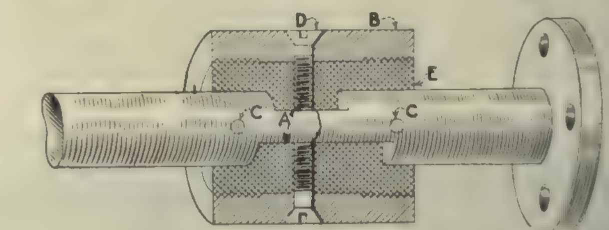
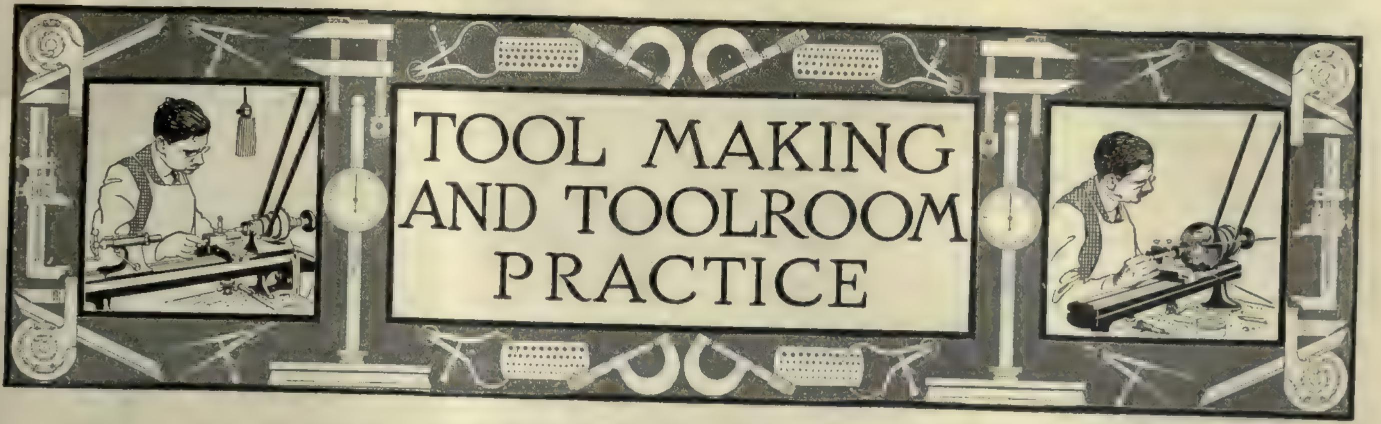


FIG.2

FIGS. 1 AND 2. BROKEN SHAFT AND EMERGENCY REPAIR



TOOL MAKING AND TOOLROOM PRACTICE

Elements of Gagemaking—I*

By C. A. MACREADY

SYNOPSIS—*Gagemaking is one of the uncommon trades, and yet thousands of gagemakers will be required in the near future. Where are they to come from? There are thousands of machinists competent to use several different kinds of machine tools and bright enough, if shown, to avoid the obstructions that the gagemaker avoids and to attain the almost unconscious habit of eliminating error and therefore producing accurate work. With these articles the "American Machinist" hopes to reach this class of machinists, start them thinking along lines that will give them confidence to try for the higher, but not necessarily more accurate, class of work—gagemaking. These men will then produce the bulk of the gages required.*

TO BECOME a skilled gagemaker it is as important to know what to avoid as to know what to do. The principles and methods for recognizing and avoiding errors have become so habitual to gagemakers that these articles may appear to be elementary. If, however, those of my readers who are gagemakers will look back over the years of their experience, they will remember how difficult it often was in the early days at the bench, when their work did not come accurate, to find the reason. If they will remember how they compared their tools and ways of doing work with those of other gagemakers and how errors and methods of avoiding them were pointed out by the older men, they will find that they have almost unconsciously acquired the habit of recognizing by touch or look those things that are liable to cause errors.

The machine tools referred to in this series of articles will be those found in the ordinary toolroom equipment, together with a few home-made ones. Most of the small tools are listed by one or more manufacturers of small tools, and the special tools are those which should be found in every toolroom crib.

In Fig. 1 is shown the common scriber. The illustration of the error (exaggerated) due to improper grinding and use makes this source of error so plain that even when using the best scribers that can be had, one will always look for it to see that it is as small as possible. The principle of the design of the tools shown in Figs. 2 and 3 is the same; that is, a scriber edge must be as thin as possible when scribing from templets and must be used as near as possible to the surface that controls its position. Also, it must be capable of rescribing the same line when the first one is too faint; that is to say, it must travel in the same path and exactly duplicate the line it has already made. Some gagemakers use a flat piece of steel, pointed as shown in Fig. 2. This works all right, but is liable to slip when under the pressure necessary to scratch a line. The user must therefore be on the lookout for this slippage.

For the usual run of gun gagework there should be a set of micrometers from 1 to 6 in., a Starrett planer tool gage, Fig. 4, and two parallels, which should be of the following proportions: One cast-iron parallel, 1 x 3 x 6 in.; one cast-iron parallel, 2 x 4 x 6 in. The 3 x 6 in. and 4 x 6 in. are scale measurements. With the planer gage, Fig. 4, as the adjustable member, these parallels will give measurements up to 6 inches.

Measurements between 0.50 in. and zero are taken care of with a parallel that is 0.50 x 0.30 x 6 in. long, placed between the base line and the surface plate. Surface plates and angle plates are found in most shops and will not be described here, but the surface plates must be planes and the faces of the angle plates must be at right angles.

Accurate Placing of Lines

Scribed lines can be located so accurately that intersecting lines can be prick-punched within 0.001 in. of correct location. This is quite close enough for gages that must be finished after hardening.

There may be conditions that require the scriber to be attached to the top step of the planer gage. This I do not advocate, as it is conducive to the entrance of errors. For instance, the screw pressure in Fig. 5 is liable to distort the scriber.

As gages must have distinguishing marks, these can be stamped where they will not interfere with the layout. To ascertain the location for the marks, the gaging points can be laid out to approximate position with the aid of a scale and marked with a lead pencil. Stamping usually distorts a gage; therefore, before proceeding with the work, this must be corrected.

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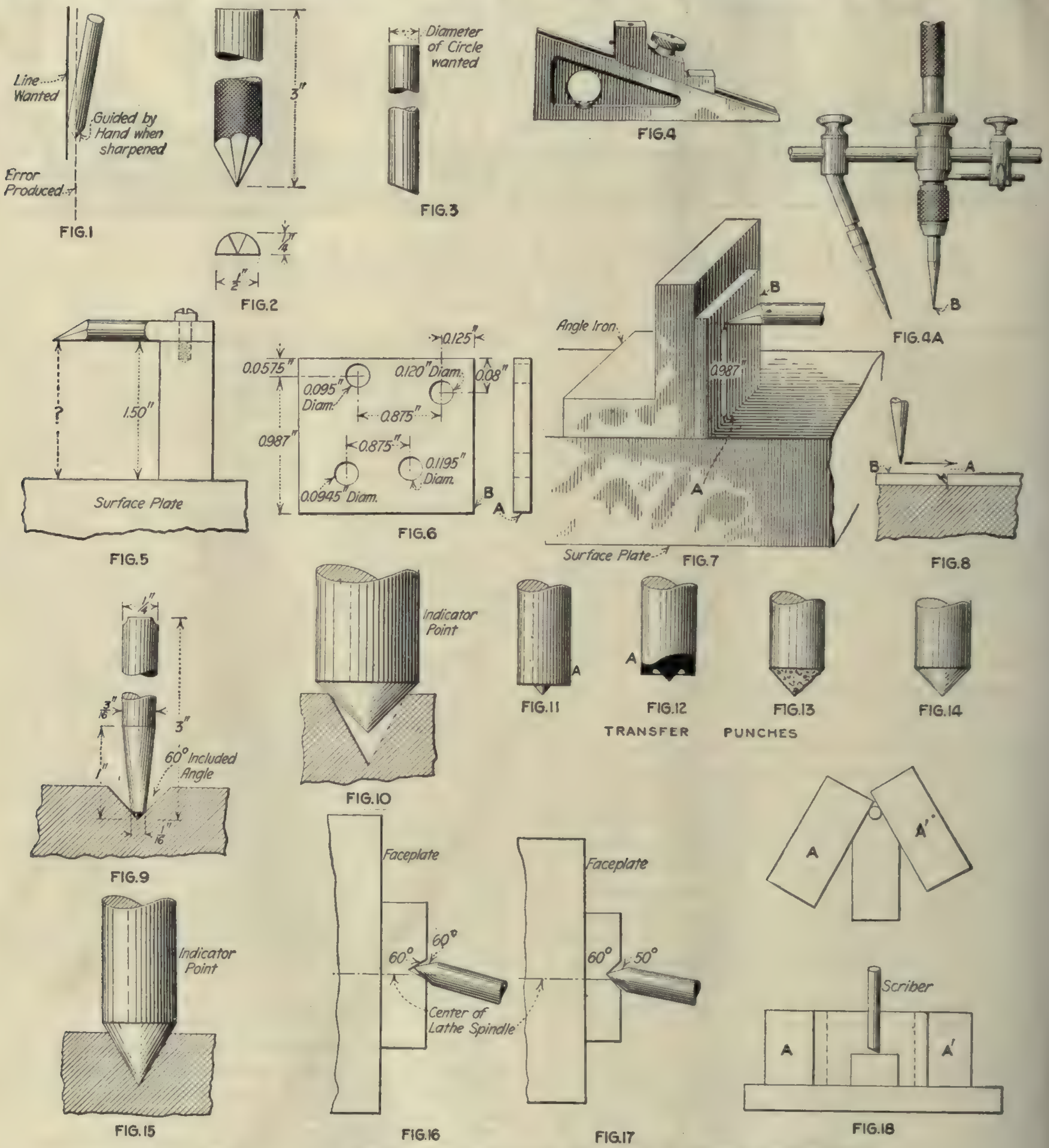
*Prepared for the author's forthcoming book on gagemaking; copyright, 1917, McGraw-Hill Publishing Co., Inc.

In the case shown in Fig. 6, the two edges *A* and *B* of the gage blank should be machined at right angles to each other, and the surface used to receive the lines should be smooth and either coppered with sulphate of copper or blued by heat. This makes the lines easily discernible with proper lighting.



FIGS. 1 TO 18. GAGEMAKERS' TOOLS AND METHOD OF THEIR APPLICATION

To eliminate accumulation of errors, base lines are used; and all measurements are made from these lines (not from the base line to the next line and from it to the next, and so on). The base lines are not lines proper, but surfaces like *A* and *B*, Fig. 6, which rest upon the surface plate and from which all measurements are made.

In Fig. 7 is illustrated the application of this method. After all measurements are made and scribed from the surface *A*, the surface *B* is placed upon the surface plate so that all measurements from the base line *B* can be made. It is a good habit to make a record of all lines scribed from each base. These lines that are scribed first form the path along which the point of the prick-punch is drawn until it drops into the slightly deeper indentation made by the scriber at the intersection of the lines (after the second set of lines is scribed).

This is illustrated in the exaggerated cross-section in Fig. 8, where *A* represents the last line scribed. As it passes across the line *B* the scriber raises a slight burr; and as it drops into the line *B*, it sinks below it. This slight depression at the bottom of the line *B* will, with little practice, be readily recognized. The snap of the prick-punch coming in contact with the slight burr next to the depression will be very evident. The prick-punch should always travel in the direction of the arrow; that is to say, from the angular side and *toward* the vertical side of the scribed line, as this will place the indentation as near the theoretically correct point as possible.

PRICK-PUNCH POINT A SOURCE OF ERROR

The indentation made by the prick-punch point must be as nearly as practical a theoretical point; that is, accuracy of *position* is of prime inmportance, while the size of the indentation should be kept as small as practicable. The nearer that we can obtain to this condition the more accurate the work will be. For most work, an indentation 0.01 in. deep is sufficient to carry the indicator point. The causes resulting in a change of location of the prick-punch mark and introduction of error will be such that, after they are explained, they will be looked for; and their avoidance will become one of the habits referred to.

The condition of the prick-punch point—its angle, variation from a true cone, sharpness and smoothness—has a controlling effect on the retention of its point at the exact intersection of the lines. This will be plain, if the conditions shown in Figs. 9, 10, 11, 12, 13, 14 and 15 are studied.

Some of these conditions will tend to make the prick-punch point travel out of true. Others will cause the indicator point to swage or wear the indentation out of the position in which it was placed. In Fig. 17 is illustrated a combination of indentation and indicator point. It will be noticed that the indicator point and indentation can be quite a distance from the axis of the lathe without the sides of the indentation coming into play as a fulcrum to swage the indentation out of shape. Swaging is liable to change the position as well as the shape of the prick-punch mark.

This combination (of punch mark, 60 deg. included angle, and the indicator point, 50 deg. included angle) permits a great amount of latitude in placing the work off center without damaging the original *point*. The prick-punch can be placed approximately central by using the edge of the faceplate or a line scratched upon the face of the faceplate as a guide for one leg of the universal dividers, Fig. 4-A. The end of the leg *B* is made hemispherical and must not be so small as to reach the bottom of the prick-punch mark.

In Fig. 10 the indicator point is shown as not entered to the bottom of the punch mark. It is evident that such a point is likely to wear a false seat in the punch mark, especially if the punch mark is not a true cone, is out of round, rough on one side or has a series of concentric rings on it transferred from the punch and originally caused by the grit of the wheel traveling in the same path when the point of the punch was ground. These concentric rings or ridges are more liable to be formed on what are called "transfer prick-punches," one of which is shown in Fig. 11. They are ground and lapped on the body *A* to fit the hole from which the center is to be transferred. Before they are lapped, the "tit" is formed. The emery wheel is either trued off at an angle or thrown around to produce the angle; then the punch end is ground off to form the tit. A cut is started from the outside edge of the body, this being repeated until the tit is of the correct proportions. This way of grinding the tit leaves a series of corrugations that are very liable to cause errors when the indicator point does not seat at the bottom of the indentation, but in one of the grooves of the corrugations.

In Fig. 12 is illustrated a transfer punch finished by swiveling the compound rest of the machine to the desired angle and traversing the wheel over the tit. This is the proper way to grind the tit. The undercutting is where the wheel runs into the end of the punch body, but this is not objectionable.

In Figs. 13 and 14 are illustrated opposite sides of a punch point. It is very evident that the rough side of the punch will form a rough spot that the indicator point will wear out of position, should it catch in it. In Fig. 15 are shown the punch mark and the indicator point both made to the same angle. This is common practice, but is liable to induce the error illustrated in Fig. 16. With the 60-deg. punch and the 50-deg. needle point, as shown in Fig. 17, the danger of error is less.

The dimensions given in Fig. 9 are for a prick-punch that is sensitive to the touch when finding the intersecting lines. It should be ground and stoned to an included angle of about 60 deg. While it may look disproportionately long, it will be found that the length helps one to bring the punch body approximately square with the surface to be punched. The point is strong enough to make an indentation 0.01 in. deep, which is deep enough for an indicator point to work in.

DRAWING LINES TANGENT TO SIDES

In Fig. 18 is illustrated the scribing of a circle tangent to the sides of an angle. The scriber, Fig. 3, is a piece of drill rod equal in diameter to the circle to be scribed. The end of the scriber is, after hardening, ground off at an angle. The sides of the guide pieces *A* and *A'*, Fig. 18, which guide the point, must be square with the surface plate. These guide pieces *A* and *A'* may be clamped either to the surface plate, or to the work or to a piece of ½ x 3 x 4-in. flat ground stock, and against the sides of the piece to be scribed, which is also firmly attached to the flat stock. The adjacent sides of *A* and *A'* guide and support the lower edge of the scriber, Fig. 3, as it is held near the apex of the angle where they meet. At the same time that the scriber is pressed against *A* and *A'*, Fig. 18, and down upon the work surface, it is twirled with the fingers to cause it to scribe the circle. A center-punch mark can, by the use of the guide *A* and *A'*, be placed, if wanted, by using a transfer punch, Fig. 11, instead of the scriber, Fig. 3.

Linseed Oil and Kerosene for Cutting

By U. S. WILLIAMS

I have just read an article in Vol. 46, page 652, on linseed oil for cutting. I had a little experience of my own some time ago.

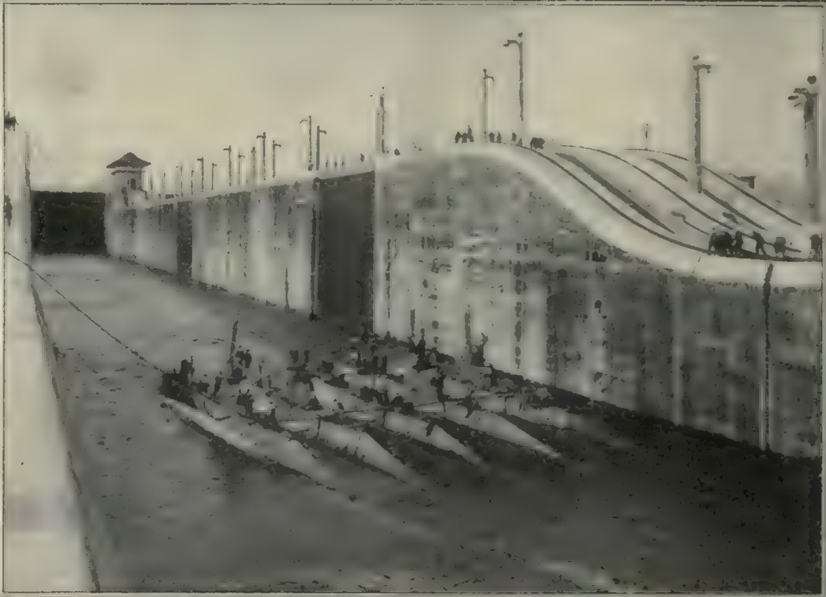
I had a number of rings to finish, most of them steel; but among them were some iron rings, and I could not get a finish. I tried linseed oil, but it did not help. Then I tried kerosene, and the result was a good finish on every iron ring, even on those with dirt in the grain.

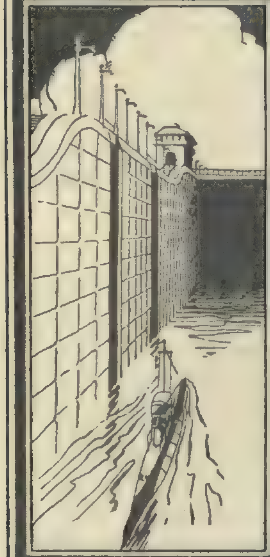
Drydocking Submarines

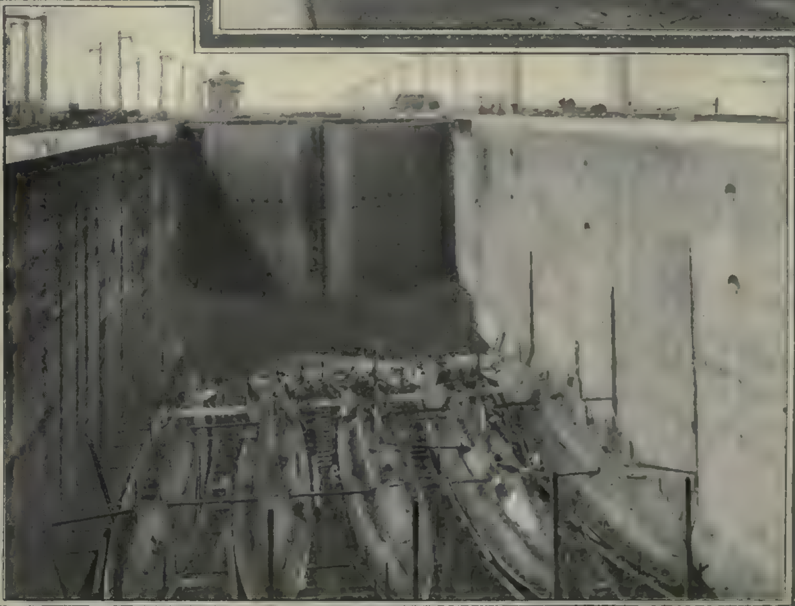
DURING the construction of the regular dry docks at the Balboa shops of the Panama Canal, the lock chambers of the canal were found useful on different occasions for the dry docking of various vessels, dredges, cranes and other floating equipment.

At the present time the subject of submarines is a very live one, as it is likely to be for a long period to come, and for this reason the accompanying illustrations, which show the docking some time ago (1915) of a flotilla of Class C submarines, should be of general interest.

The five boats entered the middle east chamber of Gatun Locks. The controlling lines were handled from the dock walls, and

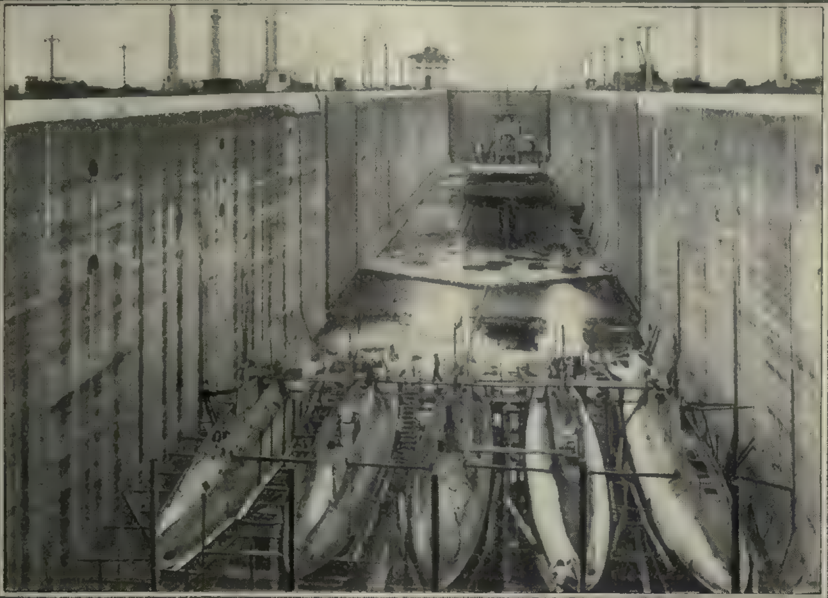




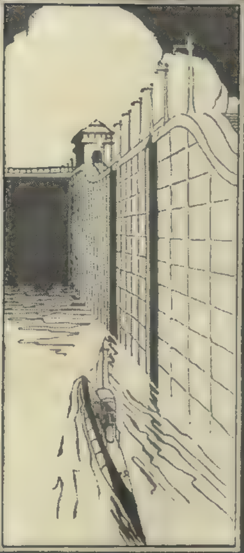


in the Gatun Locks

By Frank A. Stanley



One of the views shows the submarines still on their cradles and nearly submerged. This condition was brought about by the docking of the big ladder dredge "Corozal" in the same chamber of the locks, which necessitated the watering of the chamber to a sufficient depth to float the dredge into place for docking.



the struts for steadying the hulls and spacing the vessels properly in relation to one another were made ready for use by the crews. Then the five submarines were landed on their cradles in the upper lock chamber. Here the hulls were moored fore and aft and the struts placed, the boats being arranged for the dry-docking process.

Mr. Wood's Shop—He Needs the All-Around Man

By Robert C. Heinmiller

Mr. Wood is a machine-tool builder. Turret lathes are his specialty. One afternoon, while reading a current issue of the *American Machinist*, he came across an article that caused his brow to wrinkle and a look of astonishment come across his face. He sat thinking for several minutes and then rang for his superintendent. When the superintendent appeared, Mr. Wood said, "Dan, take a look at this article and tell me what you think of it," and handed the open magazine across the table to the superintendent. Dan seated himself and read the title, "Sammy's Shop—Who Wants the All-Around Man?" He smiled to himself and then continued to read.

"Well?" asked Mr. Wood, when Dan had finished the article. The superintendent leaned back in his chair and said:

"Mr. Wood, that may all be true for cornsheller manufacturers, but show me a machine-tool builder who does not take every all-around man he can get. Besides taking all he can get, he in many cases trains them through an apprenticeship system, as we do here. When he does get a good all-around man, he doesn't use him for a machine hand. He puts him in a more responsible position. You don't have to go out of our own shop for a number of illustrations on that point.

"Our apprenticeship system turns out all-around machinists and not machine hands, you know that. What have we done with our all-around men, our graduate apprentices and men who have served their time in other shops? Let me relate a few cases in our shop, some old and some new.

"You know we had some trouble filling Jerry Lark's place as employment supervisor after he took that new position. We've an all-around man in there now, a graduate apprentice, and he is doing fine.

"Now about our foremen, assistant foremen and inspectors. In the drilling-machine department our foreman and his two assistants are all-around men, graduate apprentices. The foremen and his assistant in the instrument department are also graduate apprentices. The foreman in the planing department is a graduate apprentice. The foreman of our drafting room is a graduate apprentice. Many of our inspectors are graduate apprentices, all-around men.

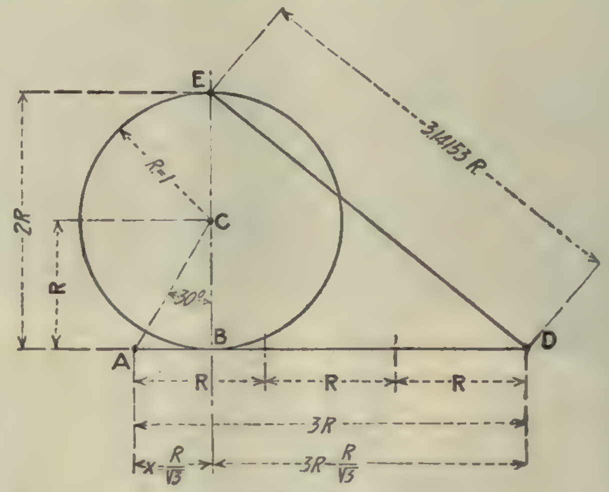
"Now, let me state a few recent cases. Bill Gager wanted several men for his estimating and special-tool department, so he took some of our graduate apprentices. Will Woodrow, who worked on that special Canadian job and was later made shop instructor for our apprentices, served his time in one of the shops in the city. When we wanted an all-around man for night superintendent, we picked Will, and in his place we put another graduate apprentice, an all-around man. And the apprentice boys in our shop now will be all-around men when their four years are up. None of them should have any difficulty finding work in any of the machine-tool companies.

"So you see, Mr. Wood, it's very clear that somebody wants the all-around man, because somebody needs him, even if the cornsheller manufacturers don't. When Sammy's job becomes vacant because of death or old age, what will Mr. Brown do? I believe he'll come around and look for one of those all-around men to fill Sammy's shoes rather than take one of the machine hands from his own shop."

Method of Laying Out Graphically the Circumference of a Circle

By E. Part

Solution—From the center of the circle C to the left, lay off 30 deg. and draw a tangent to the circle at B, intersecting AC at A. From A step off three times the radius R, intersecting the tangent at D. Now connect D with E by a straight line, which will be one-half the circumference of the circle.



THE CORRECT LAYOUT

Proof:

$$AB = X = \frac{R}{\sqrt{3}}$$

Then we have the right triangle BDE, and for the hypotenuse DE we get:

$$DE^2 = \left[3R - \frac{R}{\sqrt{3}}\right]^2 + [2R]^2 = \left[\frac{3R\sqrt{3} - R}{\sqrt{3}}\right]^2 + 4R^2$$

$$DE^2 = \frac{27R^2 - 6R^2\sqrt{3} + R^2}{3} + 4R^2$$

$$DE^2 = \frac{27R^2 - 6R^2\sqrt{3} + R^2 + 12R^2}{3} = \frac{40R^2 - 6R^2\sqrt{3}}{3}$$

$$DE^2 = R^2\left[\frac{40 - 6\sqrt{3}}{3}\right]$$

and finally for DE we get

$$DE = R\sqrt{\frac{40 - 6\sqrt{3}}{3}} = 3.14153R$$

Or

$$AB = X = R\ tan\ 30^\circ = 0.57735R$$

Then we have

$$DE^2 = [3R - 0.57735R]^2 + 4R^2$$

$$DE = \sqrt{9R^2 - 3.4641R^2 + 0.3333330225R^2 + 4R^2}$$

$$DE = R\sqrt{9.8692330225} = 3.14153R$$

Series for Draftsmen and Designers

The Draftsmen's Blacklist*

BY CHARLES M. HORTON

NOT long ago, two men were journeying eastward between Harrisburg and Philadelphia. One had boarded the train at Harrisburg, while the other had got on at some point farther west. They were seated together in the smoker; and as men will in these circumstances, they eventually drifted into conversation. The talk at first was general—the war, and then some more war, and then some more war. Presently it swung around to vocations, whereupon the fact came out that both of these men were draftsmen. That settled it. Though unorganized, draftsmen have a kind of freemasonry of their own. Each sat low on the back of his neck; each began to talk about his experiences. In this talk it was revealed that one of these men was headed for Philadelphia, in response to a letter, to see about a job. He mentioned the name of the company. Instantly the other sat bolt upright. "Don't you go there!" he shot out, grimly. "I've worked for those people, and I know others who have worked for them. That company is a mean crowd." And he proceeded to state why he thought so. "If you're headed for Philadelphia," he concluded, "go to So-and-So, down on Sucha Street. I've worked there, and I know them. They'll treat you white. But that other crowd—well—" And he trailed off again into an exposition of what and what not the other crowd was.

A certain young man whirled into an office building in a quiet section of Manhattan one morning in response to a newspaper advertisement for a draftsman. As he whirled in at the door, he encountered a young man emerging from the elevator. The first young man glanced at the second young man, saw the kind of morning paper that was sticking out of the other fellow's coat pocket, hesitated a moment, decided, stopped the man.

"Were you up to see about that job of drafting?" he asked.

The other looked puzzled; understood; smiled and nodded his head.

"I was," he said. "But you're wasting time if *you* go up there. They have an outside rate that you wouldn't work for. Times have changed—but the guy up there don't know it. He says if you dropped a brick off a roof anywhere in this town you'd hit at least three draftsmen. Maybe you would. But two of them would be tracers calling themselves draftsmen, and the other would be one of those draftsmen who never held a job longer than three weeks in all his life. But go ahead up! Don't take my word for it. He's a sarcastic guy that's proud of his teeth—both of them."

The other asked what that fixed maximum rate of pay was and then joined the Samaritan in a rush for the front door. They met a third party coming in, who was also carrying a newspaper containing that selfsame advertisement. He looked at them understandingly, and they stopped. Ensued practically the above conversation. Whereupon, not two, but three applicants made their exit out of that building.

"I've got a chance to make a good change," said a draftsman, one morning, taking into his confidence a man who had worked beside him for some time in this drawing room. And he showed his co-worker a letter. "Five dollars more a week, and railroad fare refunded in full after I have remained with them for a month." The other man read the letter, and then he handed it back. "You'll never get that refund," he declared solemnly, "because you won't stay long enough to meet the conditions. I never worked for those people, but I've got a brother who once did, and I'm telling you that you'd better stay where you are. You know as well as I do that this company is all right. And you know I wouldn't steer you wrong. But take it from me, stay away from that job." And he went on to tell what he knew about the other organization, their way of handling help, what the chief had done once to a draftsman, and all interesting facts concerning them that were of vital interest to the man. Needless to say, the draftsman who was contemplating a change stayed where he was.

There you have, roughly, what constitutes a draftsmen's blacklist. It is not a record written in black and white. It might be better for the concerns listed—and there are many of them—if it were. Someone sometime might pass the list on up to organization heads

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where it would do good. But the thing is not written. For the men whom it seriously concerns, draftsmen at large, it is a record engraved more deeply, however, than any mere written record could ever be. The thing is stamped in the minds and hearts and souls of the fraternity. In a way, it is more effective as a deterrent than any list, since the vagaries and whims and meannesses of any given concern, as established in the memory of any one draftsman, can be set forth convincingly, through the glorious power of exchanged thought in conversation, whereas these same vagaries and whims and meannesses, printed, would be more or less lacking in vividness and virility.

It is an all-powerful institution. It travels from coast to coast and from mouth to mouth; and while it is, as it were, underground, it is a far greater factor in the labor difficulties that some organizations have today in their drafting rooms than the heads of these organizations dream. It is a big and vital thing. It is so big and so vital that it behooves engineers and chief draftsmen everywhere to place their ears close to the ground and listen.

There was a draftsman once working for a concern. He was a man who had one bad habit. He could not get to work in the morning on time. His record showed up pretty bad. He was late anywhere from a minute to ten minutes, five days a week. The chief warned him frequently, because otherwise he was a good man. But all to no avail, seemingly. Then one evening, in a fit of irritation and right after paying him off, the chief discharged the man.

Now, there was no excuse for that man's lateness. And he deserved what he got—his discharge. All that of itself was all right. But the chief made one bad mistake. He should have given the man some kind of notice. But he did not. He was sore—and deservedly—and he fired the draftsman without a minute of notice. The man was out on the streets—where, probably, too, he belonged—and his last record was against him. He had trouble getting another job, and he walked the pavement a good many weeks before he finally did secure one. Sore? He was as sore as the thumb the amateur carpenter hit when he was striking at the right nail. The chief had forgotten himself—his position—his poise. He had not quite measured up to his job in this crisis. And he certainly paid for it later.

One after another of his draftsmen, remembering the sudden fate of their late brother—take it either way—gave up their positions and sought jobs elsewhere. Their sympathy was not with the draftsman. They knew that he deserved what he got; only, they knew also that he did not deserve the way in which he got it—no mortal man does. But they certainly did sympathize with themselves and feared similar treatment, should their conduct appear to warrant it in the eyes of the chief. They all stood from under.

The chief suffered in other ways. He found himself having trouble engaging new men. He advertised generously, but he got few applications. He tried the trade journals and was more successful than in the local papers. But he had troubles. He had troubles because not only the man whom he discharged, but all the other men who left him were passing along the word to others in their line that Chief So-and-So, of the So-and-So Company, had fired a man without a minute's notice. Draftsmen naturally duck that kind of job.

Another instance: There was once a concern which had the reputation among draftsmen that, if a man worked there, he almost invariably lost one or more of his drawing instruments. Not a big thing in itself, and certainly it was no fault of the management. That instruments disappeared frequently, however, was none the less true. I say it was no fault of the management. I retract on that a little. It was indeed the management's fault if draftsmen were given no place—no drawers—in which to lock up their instruments over night. No such place was provided. As to the missing instruments, it was at length discovered that one of the sweepers was helping himself nights to the instruments and later pawning them for what he could get. But that did not save the company from being black-eyed for a long time. Draftsmen who had worked there and suffered losses told of those things, and so the word was passed out along the line to places and distances but little imagined by the officials.

Men in the shop know what it is to suffer this way, more so than do draftsmen, and talk about it more freely. The rawest individual I know of is a machinist who has lost one or another of his tools in a shop. He beats the air in wild despair and otherwise calls down vengeance upon the crook. Tools cost money and money is a d—— hard thing to get. Ergo, duck a job where you lose tools or instruments.

But to return: In these United States there are two or three large concerns that a draftsman of experience would as soon work for as enter a state penitentiary—but not a minute sooner. They bear unsavory reputations. It may not be their fault that they do. Yet where there is smoke there is certain to be—or at least to have been—some fire. Perhaps it is owing to some one of the minor executives in these organizations. But whatever it is, the fact remains, draftsmen of experience will not work within their walls. Blind advertisements answered by draftsmen will bring letters of inquiry from these concerns, but the letters almost invariably remain unanswered—the draftsman will not even enter upon correspondence with the firms. And all because of the effective workings of the blacklist. Someone at some time has worked there, a man known to the draftsman who answered the blind advertisement; and because he has faith in what his fellow-draftsmen tell him about a concern, he refuses to consider a job with such an employer and thus subject himself to like treatment. In these stirring times he does not have to. May they—the prosperous times—never grow less.

A man about to quit an organization once asked for a letter of recommendation. Whether through petty chagrin or peevishness because the man was leaving, the chief draftsman told him that letters of recommendation were no longer the thing. The draftsman knew that already. Yet for reasons of a purely personal nature he wanted a letter of recommendation. He was a good man, and he had served the organization well and faithfully. But the chief turned him down on his request. The result? Draftsmen two thousand miles away eventually heard of it—and bore it in mind, or rather had it refreshened in their minds, whenever a job with that particular organization was offered. That may sound a little far fetched. In fact, it does—I admit it. But it will not, if one will consider the work and training and nature of draftsmen as a body.

To begin with, draftsmen jobs, for the most part, are in sections, in spots, with the names of concerns who regularly employ draftsmen well listed among the fraternity. A man may tell me that he works in Schenectady, say. Instantly I know that he works either for the General Electric or the American Locomotive Works. There are other draftsmen jobs in that town, I well know also; but they are very minor and may be left out of consideration. Also, a man may tell me he works in Pittsburgh. Instantly a host of large concerns flood into my mind. I can name at least ten that employ men, and a great number of men, regularly. And so it goes. The big—the very big—concerns are three; the lesser in proportion. Of these big concerns I naturally, having been in the game a number of years, have heard many favorable and unfavorable reports. Separating the chaff from the wheat—not a difficult thing, if one knows draftsmen—I go after the job or stay away from it, according as I feel it to be to my interests. Draftsmen as a rule are honest. The work makes them unafraid of the truth. All scientific work does. One may dabble in medicine and in law—yea, even in the clergy—and, in time, grow a little afraid of the truth. Doctors sometimes refrain from telling the precise truth about a patient, even as lawyers refrain from the truth at times for directly opposite reasons. And the clergy, as we all know, have to practice the most skillful diplomacy at times, among a scrappy and factional congregation, in order to hold their posts. But not engineers—not draftsmen.

To know that two and two makes four, to know well the immutable laws of nature, means to know also the littleness, the picayune-ness, so to speak, of man in dishonest relation to man, compared with the grandeur of nature as a whole. Nature is truth, and once one begins to dabble in her laws, as draftsmen do every day they work at their jobs, truth will prevail among them—is the natural thing. It becomes a habit of thought with them, just as it becomes a habit of thought with them to know that certain formulas give known results.

And so—to repeat—draftsmen as a rule are truthful. Regarding their work, regarding the places where they have been employed, regarding the places where they at the moment are employed, they almost invariably speak the truth. It is a part of their nature. It is recognized as such among one and another of their kind. Therefore, when one draftsman informs another that a certain concern refuses to grant vacations, or that another concern has a meanly disposed chief draftsman, or yet a third concern makes its draftsmen supply thumb-tacks and pencils and rubbers, or still a fourth concern works its draftsmen nine hours a day, or a fifth concern demands three and four nights a week overtime without additional pay, or a sixth concern discharges men without notice, or a seventh concern has as its chief (for reasons nobody need state) a man who wants only dubs working under him—I say, when these facts are set forth between draftsmen around the country, almost any draftsman will believe them, unless he happens to have personal knowledge to the contrary. And even then he will proceed with caution. The other man may have been working under a different administration—one now in control.

Therefore, to sum up, granting that a man has a perfect right to run his institution as he sees fit, so long as he keeps within the bounds of the law, he nevertheless can well afford to give consideration to the personal rights and needs and characteristics of men to whom he finds it necessary to grant employment. The modern tendency is to do this. Employees no longer are regarded as just so many tools with which to bring a business to success. They are regarded today as aids, fellow-workmen, men all going the same way, men treading the same path with owners and executives. Executives will kick out of a concern with some mighty strange excuses and refrain from taking other connections with equally strange excuses. It is not at all peculiar, then, that workmen should do likewise. Money means as much to one man as it does to another—high or low. It is simply a means to happiness. It is not more. Draftsmen covet happiness just the same as any other brand of being; and happiness, as everybody knows, cannot always be attained with money. Other things—many of them—are necessary. One of them is secured by pleasant contact with mankind, not only in one's social circles, but also in one's circles in business—where mankind, at least in this country, spend most time.

So the concern that offers most in the way of happiness to an employee, both in money and surroundings, is the concern that gets the greatest number of efficient men on the payroll. And the concern with the greatest number of efficient men on its payroll is the concern that produces the best work and the greatest quantity of work. And so, taken altogether, humane treatment of employees is a mighty good investment in dollars and cents. It even pays to be more than humane—as some few big industrial heads have learned and are still learning.

The draftsmen's blacklist is a reality, though it should not be. It is the writer's hope that the day will not be far distant when the reports going around among draftsmen circles and others will sound an optimistic note the equal of Stevenson in his most kindly moments. Said Stevenson: "The world is so full of a number of things, we all ought to be as happy as—automobile manufacturers."

We are, at times. Then again, we are not so happy, especially when a chief draftsman swoops down on us and demands in gruff language why we dare be so human as to gaze for five minutes out of the window, when what we ought to be doing is keeping our nose about an inch from the drawing board and otherwise giving a good imitation of a machine tool actuated by a belt from a motor that gets its juice from the unceasing flow of waters over Niagara. But the time is coming—the time is coming.

Steel Hands for Machinists

Of especial interest at this time are the steel hands used by Andrew Gawley, who works in the tool crib of the Fisher Motor Co., Orilla, Ontario.

While lying in the hospital after the removal of both his hands, he designed the type of steel hand shown in Fig. 1. With these he can do almost any job around the shop, such as operating a drill press, as shown in Fig. 2, tightening nuts, throwing belts and the like.

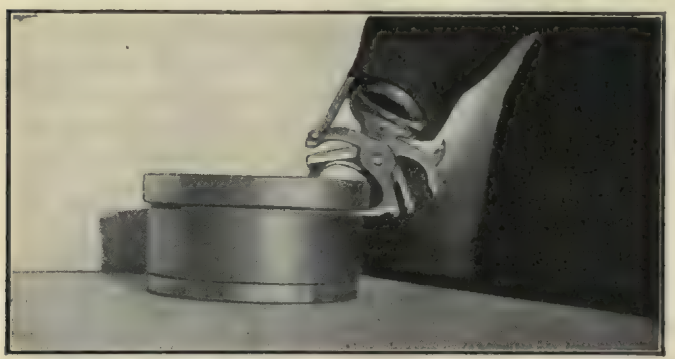


FIG. 1. STEEL HAND GRIPPING A SHELL ADAPTER

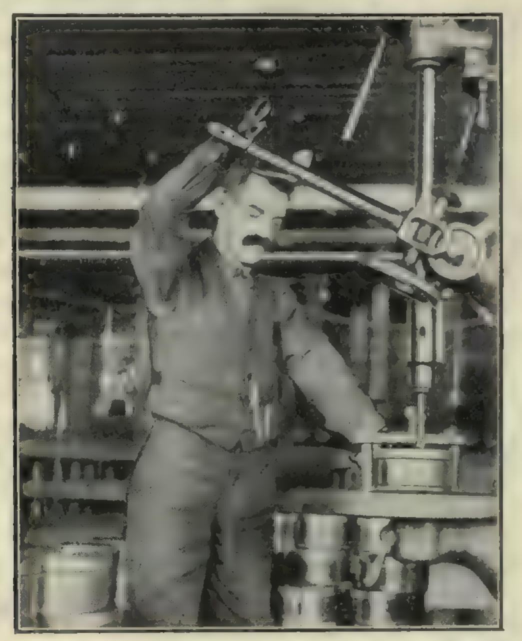


FIG. 2. OPERATING A DRILLING MACHINE

At his regular work in the tool crib he not only handles all the tools, jigs and fixtures needed, but also keeps written records of a simple nature.

Annealing Hard Spots in Oxyacetylene Repairs

By Charles L. Brand

Manager Supply Department, Davis-Bournonville Co., Chicago, Ill.

I noticed a communication on page 694, Vol. 46, from G. Handyside, Buffalo, N. Y., and do not agree at all with him. Further, I believe that he will get into all sorts of trouble if he follows the method outlined.

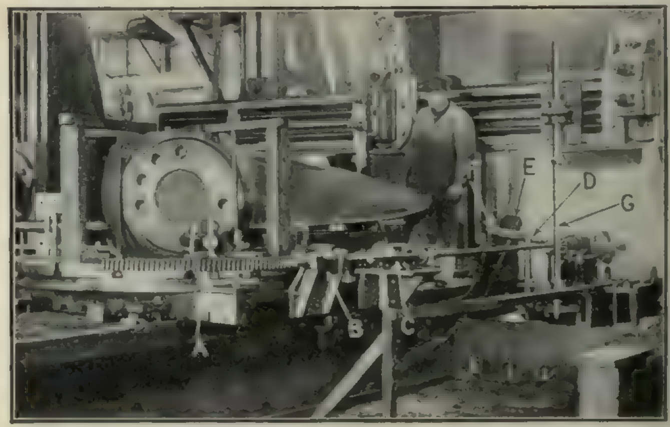
Mr. Handyside states that "the cast-iron filler is apt to have hard spots that cannot be machined." It is true that many of the cast-iron welding rods on the market are of poor quality and not at all adaptable to oxyacetylene work. The manufacture of such a rod is a specialty.

Where cast-iron rods are manufactured to the analyses of reputable concerns, consideration is given to the molding, cooling and cleaning as well as to their chemical contents. If a welder purchases his welding rods from a reputable concern, known to be familiar with these requirements, he will obtain rods that are free from hard spots and other impurities.

I read the comment by the editor and thoroughly agree with it. The aim in the production of a welding rod for either cast iron or steel is to reduce the sulphur content to the lowest point possible, and I believe the practice of putting sulphur on a weld as suggested by Mr. Handyside would be detrimental.

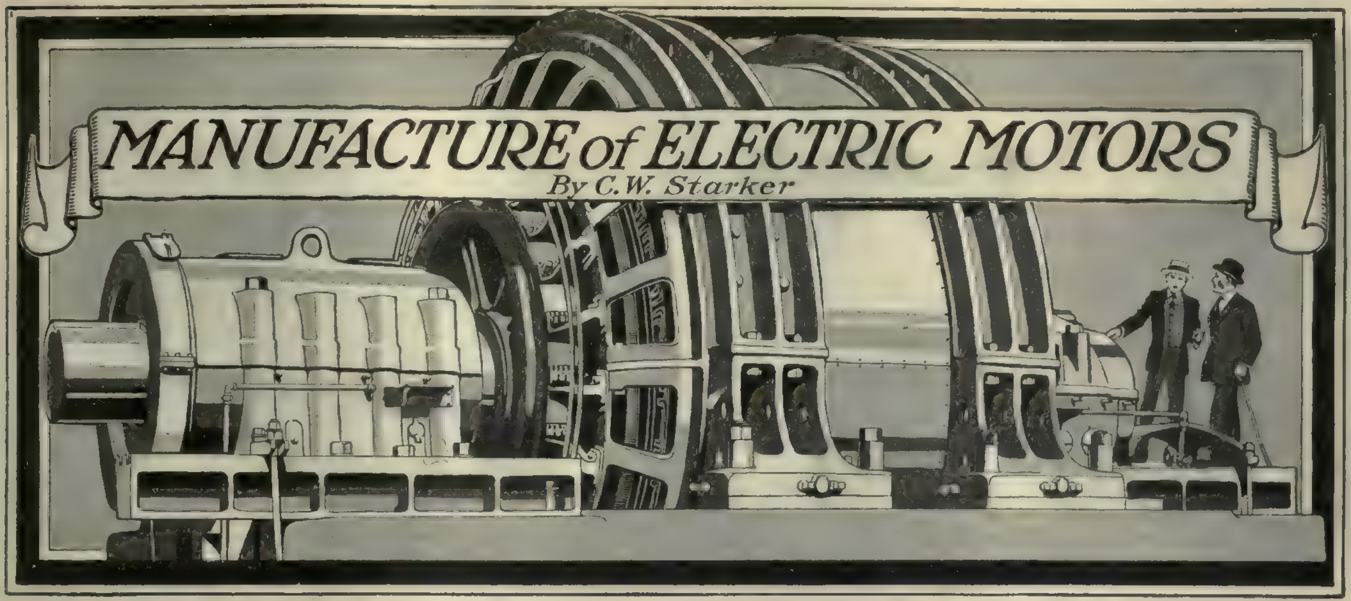
Planing Large Propeller Blades at Mare Island

A large planer fitted up to handle propeller blades is shown. This machine is in use in the Mare Island navy yard, Vallejo, Calif. The propeller to be machined is mounted on a rotary table having the segment *A* bolted to it. The circular feeding movement is obtained through the worm *B*, a series of gears and the shafts *C*, operated by means of a ratchet and lever *D*. This lever is moved at the end of the reverse stroke by means of the cam *E*, bolted to the planer table, which contacts with the roller *F* on the end of the lever, forcing it upward and rotating the shaft *C*.



LARGE PLANER FOR MACHINING PROPELLER BLADES

A series of gears connect the shaft *C* and the shaft *G*, so that the down feed of the tool takes place simultaneously with the rotary feed of the table.



MANUFACTURE of ELECTRIC MOTORS

By C.W. Starker

I. Introduction

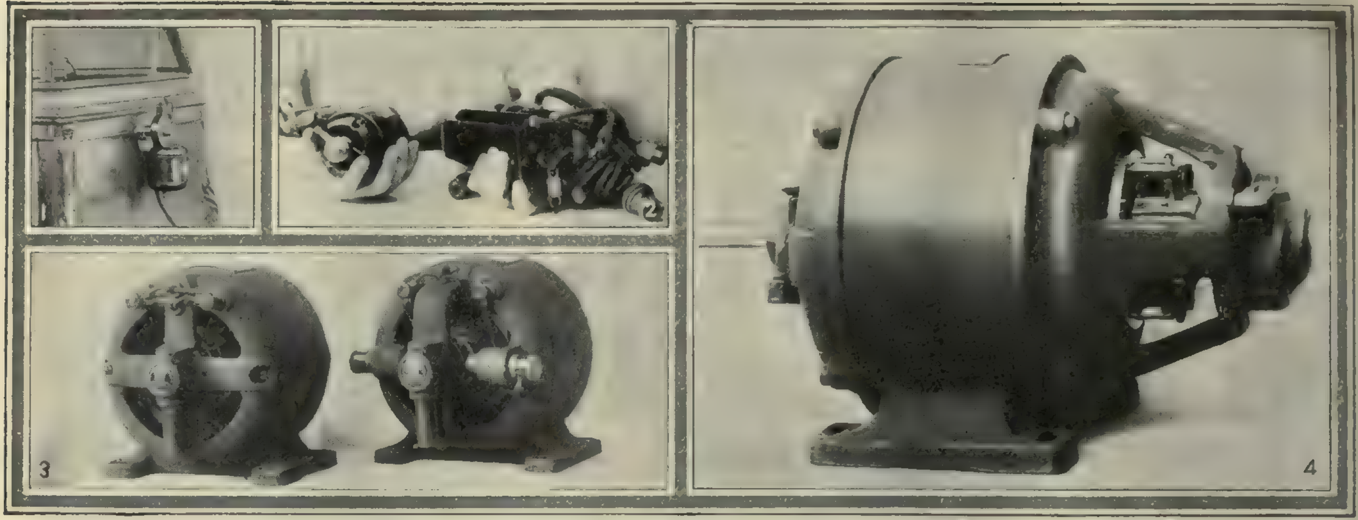
SYNOPSIS — *This article and succeeding ones describe the manufacturing methods in use at the East Pittsburgh plant of the Westinghouse Electric and Manufacturing Co. These methods are probably indicative of general shop practice in this field and, therefore, should prove of general interest. The first installment takes up the subject as a whole, giving an idea of its scope. Later installments will treat the various individual groups of motors and show the methods in use at the Westinghouse shops.*

ELECTRIC motors are divided into two groups, industrial and railway. The term "industrial motor," as generally applied, covers a very large range of motors from fractional-horsepower motors of the smallest size to the great machines of many thousand horsepower capacity. One of the smallest motors produced is a dentist's motor having an over-all length of approximately 3 in., a diameter of 1¼ in. and a weight of about 4 oz. It is not rated in horsepower, but probably would deliver about one five-hundredth of a horsepower. Similar, but considerably larger, motors are made for dictaphones and graphophones, Fig. 1. As an example of the other extreme may be cited the large steel-mill motors. One constructed quite recently, and perhaps the largest motor ever built, shown as the headpiece of this article, has a normal capacity of 7000 hp. and 6600 volts at the very slow speed of 81 r.p.m., and a maximum capacity of 30,000 hp. The weight of this machine is approximately 600,000 lb.; the outside diameter is about 17 ft. and the over-all length 28 ft. Other industrial motors of even greater size for the electric propulsion of battleships are being built or are under consideration.

The wide range of motors demanded makes it apparent that, in manufacturing, all of these sizes cannot be built in the same department and with the same facilities, but that subdivisions according to size are necessary. Electrically, industrial motors might be divided into the two groups of direct and alternating current, but from a manufacturing standpoint it makes little difference whether the machine is designed for the one current or the other. The size is the natural dividing line that governs tool equipment, floor space, crane facilities, etc. Furthermore, the smaller sizes, which are sold in large numbers, are produced on a quantity basis, while with increasing size the quantity decreases, until a point is reached where the large machines are "built" rather than manufactured. The term "motor," at least in the case of medium-sized industrial motors, also includes generators, exciters, etc., for from a manufacturing standpoint there is no difference between these machines and motors proper. The divisions, therefore, usually made in the manufacture of industrial motors are: (1) Small or fractional-horsepower motors for both alternating and direct current, having a capacity of less than 1 hp. or the corresponding kilowatt capacity in generators, Figs. 1, 2, 3 and 4; (2) medium-sized industrial motors both alternating and direct current, ranging in capacity from 1 or 2 hp. to approximately 100 hp., Figs. 5, 6 and 7; (3) large industrial motors covering sizes above 100 hp. and up to approximately 1000 hp., Figs. 8 and 9; (4) a separate works division, also, is required in large electrical works for building motors of 1000 or more horsepower. In addition to these, of course, separate departments, or altogether separate factories, may be required for the manufacture of motor specialties such as fan motors, automobile starting motors, lighting generators and units of these types, Figs. 10 and 11.

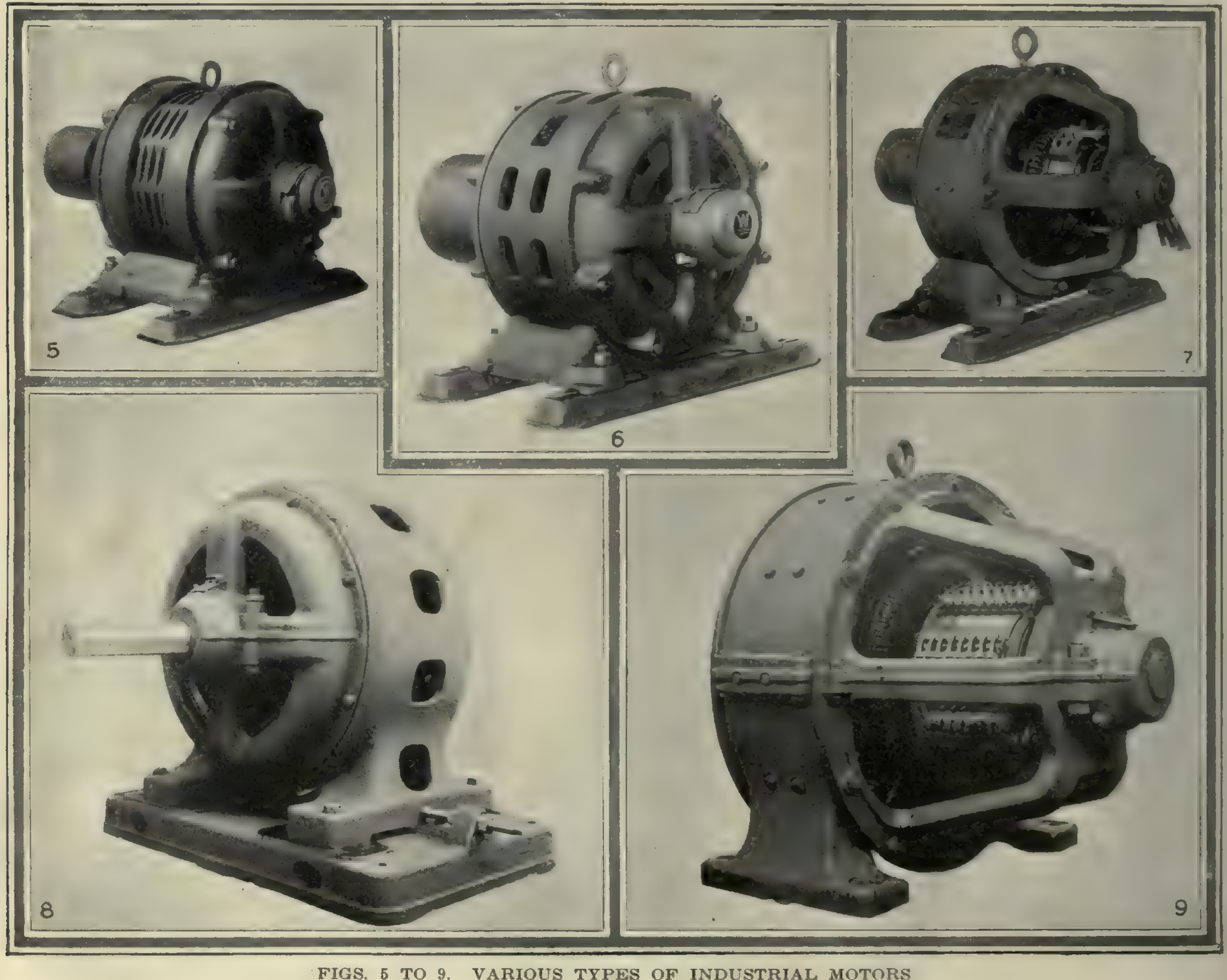
TYPES TO BE CONSIDERED

In this article we shall consider only that class of motors which is most interesting to the reader, as it comprises those of perhaps the broadest general application—namely, alternating- and direct-current motors in capacities of from 2 to 100 hp. Such motors, often known as general-purpose motors, are used to drive all sorts of machinery, machine tools, pumps, blowers, elevators, hoists, cranes, conveyors and crushers in cement mills or brickyards, planers and saws in woodworking shops, spinning frames, twisters and knitting machines in the textile industry, coke- and ore-handling devices



FIGS. 1 TO 4. TYPES OF SPECIAL SMALL MOTORS

in the coal and steel industry and other applications. In order to cover such a variety of industries and applications, it is necessary to have a large number of types differing not only in capacity and kind of current, but also in voltage, speed and performance, as they have different requirements as to efficiency, temperature, overload capacity and starting torque. In the case of direct-current motors, series of shunt characteristics are to be determined, and there are also variations in the mechanical construction. The motors may be open, Figs. 5, 6 and 7; inclosed, Fig. 12; vertical, Fig. 13; etc. They may be belted, coupled or geared, the latter either with a separately mounted jackshaft or having a back-gear attachment integral with the motor, as in Fig. 14.

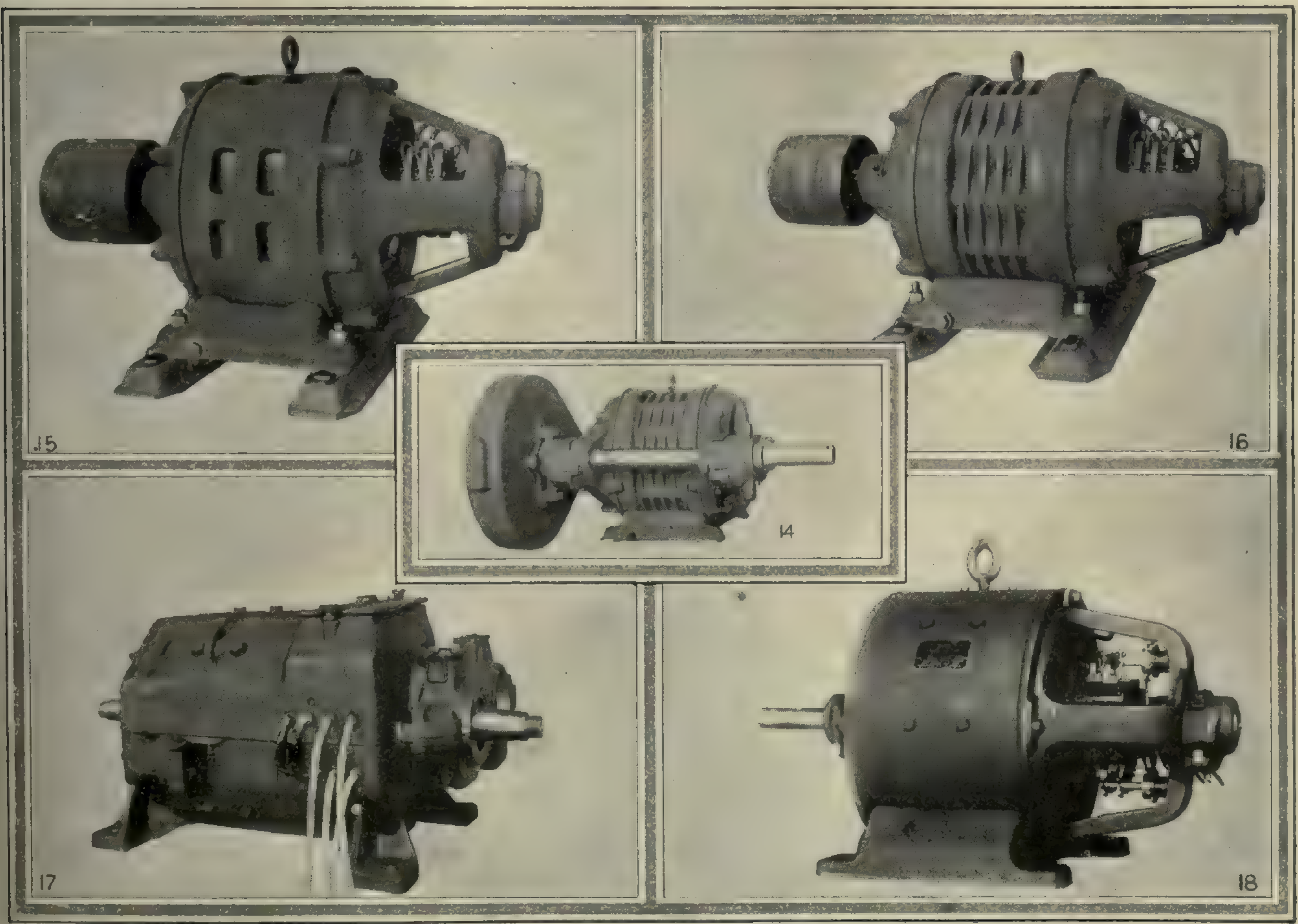


FIGS. 5 TO 9. VARIOUS TYPES OF INDUSTRIAL MOTORS
Figs. 5 to 7—Medium-Sized Motors. Figs. 8 and 9—Large-Sized Motors.

FIGS. 10 TO 13. A NUMBER OF INCLOSED MOTORS
Figs. 10 and 11—Special "Starter" Motors. Fig. 12—Inclosed Motor. Fig. 13—Vertical Motor

Direct-current motors are usually built for 115, 230 and 550 volts, occasionally 600. In special cases, such as for plating and welding, motors of particularly low voltage are required. Alternating-current motors are usually wound for 110, 220, 440 and 500 volts; also, a certain percentage for 1100 and 2200 volts. These alternating-current motors may be built for single phase, three phase or two phase, and a frequency of 25 or 60 cycles, or, in special cases, such as for export, for 40 or 50 cycles. They may be of either squirrel-cage, Fig. 15, or slip-ring type, Fig. 16, depending on the starting conditions required. A range of motor speeds must be provided for, extending from a maximum of 3600 r.p.m., as used on vacuum cleaners or woodworking machinery, to the slow speeds, 400 r.p.m. or less, for driving blowers and fans.

There are further important modifications according to the class of service for which the motors are to be used, as, for instance, adjustable-speed direct-current motors for machine-tool work, which are built in speed ratios of two to one, three to one and four to one; then there are special rugged types for crane and mill serv-



FIGS. 14 TO 18. SEVERAL MOTORS FOR SPECIAL WORK
Fig. 14—Motor with Integral Reduction Gears. Fig. 15—Squirrel-Cage Type Motor. Fig. 16—Slip-Ring Type Motor. Fig. 17—Special Crane Motor. Fig. 18—Special Reversing Motor

ice, Fig. 17; especially designed reversing motors for operating planers, etc., Fig. 18. The time ratings may vary from 15 min., 30 min. or one hour to continuous load at a given temperature rise, according to the requirements.

Some of the principal requirements have been enumerated, and a few of the mechanical modifications have been presented in the accompanying illustrations in order to impress upon the reader the particular conditions prevailing in the motor industry. From a manufacturing and investment point of view, a very serious handicap lies in this enormous variety of product demanded in even the single subdivision of medium-sized industrial motors. All these modifications require something special—different tools, different parts, different materials to be kept in stock. And the very reason why electric motors are so generally used—namely, their flexibility and adaptability to conditions and requirements—is at the same time a handicap to the industry.

The very flexibility of motors frequently leads users to demand more modifications and variations from standards, such as different bearings (split instead of solid), different shaft extension, or even motors that are altogether different from the standard. With other manufactured articles the buyer is quite accustomed to taking the standard product of the market, but in the motor industry approximately 60 per cent. of the output is special—that is, differing in some way from the standard machine—in spite of the fact that thousands of different capacities, motor speeds, etc., are covered by the standard list. That this condition in the end is to the disadvantage of the motor user in the form of costs and deliveries is apparent.

From the foregoing it is evident that in the manufacture of motors the aim must be to use as many parts as possible in common for different lines of motors and, further, to arrange the manufacturing equipment, storekeeping and production systems in such a way as to be best adapted to the existing variety of product. These points can be brought out by a detailed description of the manufacture of each of the various component parts of the class of motors under consideration. These will be considered in future installments of this article.

Location of Cam Followers—I

By ARTHUR B. BABBITT

SYNOPSIS — *The question of ease with which a cam may do its work is an important one. In many cases the portion of the revolution in which the action takes place is predetermined and cannot be increased in order to reduce a sharp angle of cam curve. The location of the follower in cases of this character is important and many times may convert what otherwise might be a hard-working cam into one that will run without shock or vibration.*

THE angle of wedge of a cam curve and the angle of pressure on the roller may usually be varied by changing the location of the cam roller in relation to the axis of revolution of the cam. Probably the simplest way to reduce the wedge angle is to increase the distance between the center of the camshaft and the follower. In Figs. 1 and 2 are the outlines of two cam curves, each having the same stroke and the same angle of action. The advance is accomplished in each example during one-fourth the revolution of the camshaft, and each curve will produce a uniform motion of the follower. The difference between the conditions governing the two solutions is the distance between the center of the camshaft and the nearest approach of the cam roller to the center of rotation of the cam. It will be readily seen that the cam curve shown in Fig. 2 will work more easily than that shown in Fig. 1.

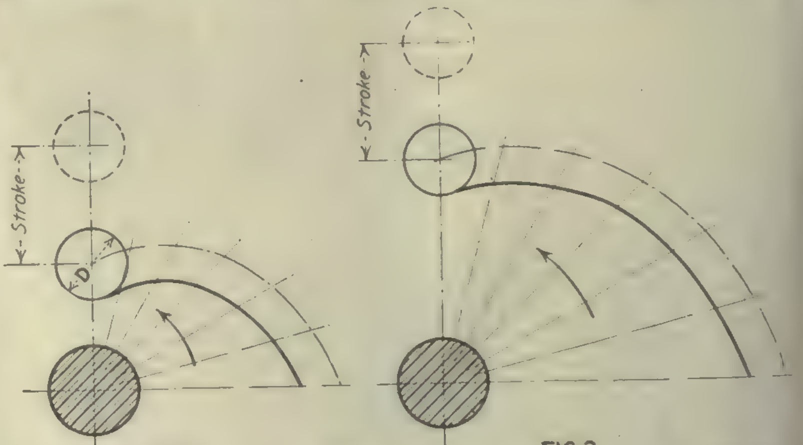


FIG. 1 FIG. 2

FIGS. 1 AND 2. DISTANCE OF THE FOLLOWER FROM THE CAM CENTER

In Fig. 3 is a portion of the cam curve illustrated in Fig 1, showing the wedge angle and the method of obtaining it. The curve *A D*, Fig. 3, is a portion of the cam curve, and *A B* is the tangent to that curve at the point *A*. The arc *A E* is the arc of revolution of the point *A* about the center of the cam, or point *O*. The line *A C* is tangent to *A E* at *A*. The angle *B A C* may be considered as the angle of a wedge that for the instant is acting upon the center of the roller and tending to force it along the line of motion of the follower.

The angle of the wedge at this point in the sketch is about 33 deg. When we move the roller out as in Fig. 2, the angle of the wedge at the beginning of the stroke is reduced materially. This is shown by Fig. 4, in which the curve of the cam is the same as that of Fig. 2. In Fig. 4, *A D* is the cam curve, and *A B* is the tangent to this curve at the point *A*. The arc *A E* in this illustration is the arc of revolution of the point *A* about *O*, and *A C* shows the tangent to this arc at *A*.

The angle *B A C* is the angle of the wedge acting upon the point *A*. The measurement of this angle, indicated by the shaded portion in the illustration, shows it to be about 20 deg. The beneficial effect of moving the lowest portion of the cam roller away from the center of the cam is clearly demonstrated by these two illustrations.

When the cams have rotated through an angle of 45 deg. from the positions shown in Figs. 1 and 2, they will occupy the positions shown in Figs. 5 and 6 respectively. The wedge angle when the cam curve is in this position may be determined by constructing a tangent to the curve of the cam and measuring the angle made by this tangent with a perpendicular to the instantaneous radius of the cam which is drawn from the contact point to the center of the cam shaft. The line *G H*, Fig. 5, is the tangent to the curve of the cam, and *G K* is the perpendicular to *G O*, the instantaneous radius, or a line from *G* to the center of the cam. The angle *H G K* is the wedge angle of the cam, and the angle *H G L* is the angle of pressure against the roller.

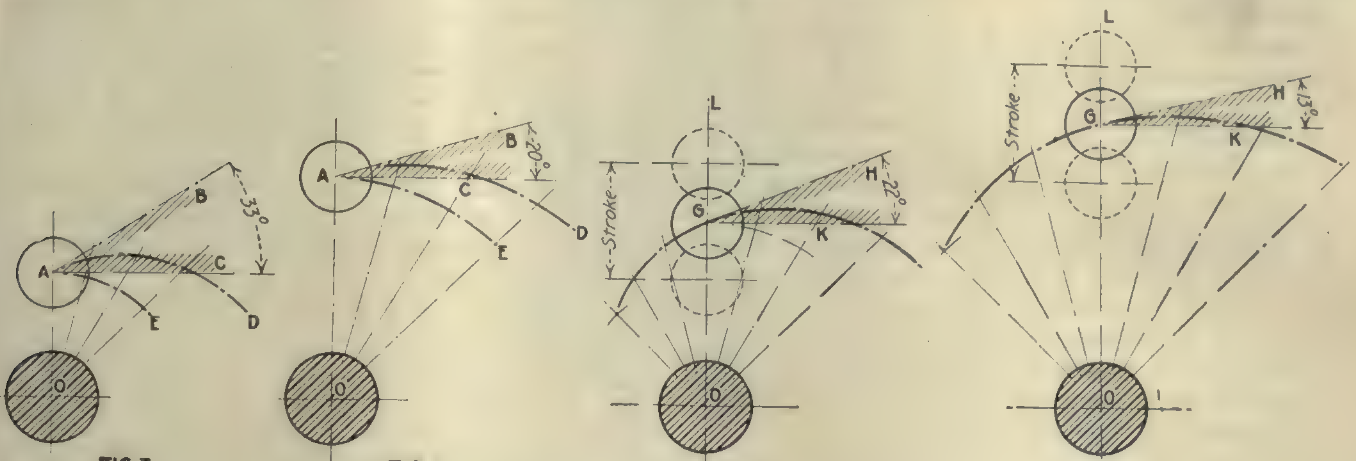


FIG.3 FIG.4 FIG.5 FIG.6

FIGS. 3 TO 6. COMPARATIVE WEDGE AND PRESSURE ANGLES AT POINTS ON CAMS IN FIGS. 1 AND 2

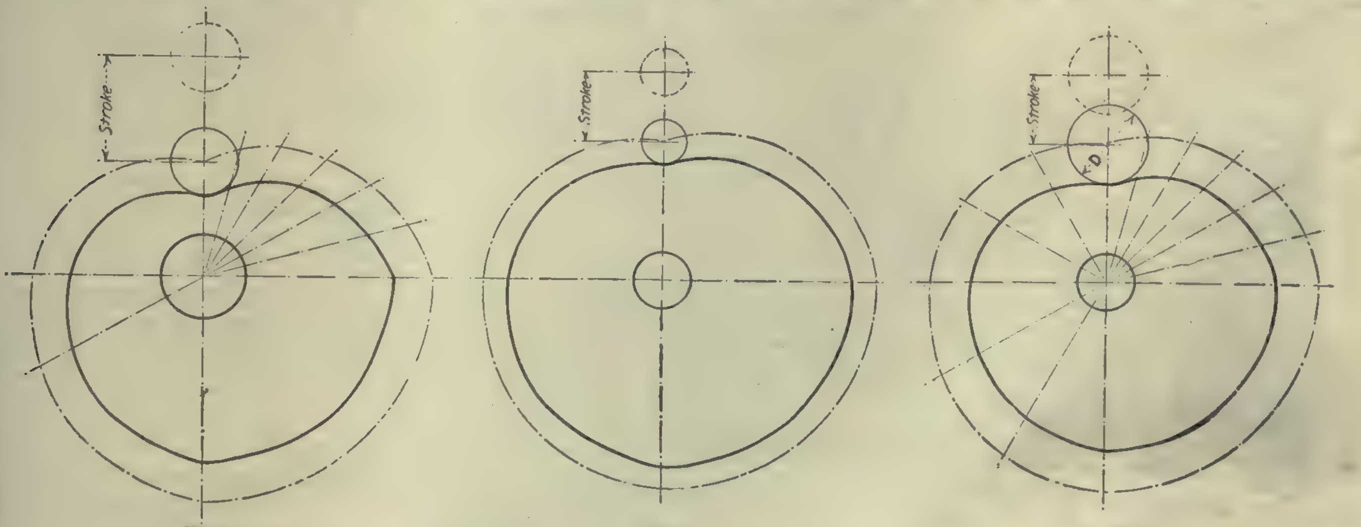


FIG.7 FIG.8 FIG.9

FIGS. 7 TO 9. INFLUENCE OF FOLLOWER DIAMETER ON WEDGE AND PRESSURE ANGLES FIGS. 1 AND 2

In Fig. 6, using the same method, we have the angle *H G K* the wedge angle and *H G L* as the pressure angle. With the conditions under which these particular problems are drawn, the wedge angle in Fig. 5 is 22 deg., while that in Fig. 6 is only 13 deg. These conclusions emphasize the fact that the angle of the large cam will cause it to work more easily, with less shock and vibration and with less side pressure on the follower.

When a cam is enlarged to reduce the wedge angle, we add two new conditions that require attention: First, we have a heavier cam for which more accurate balance is required; second, the roller will make more revolutions per minute on its stud. Inasmuch as the stud requires replacement more frequently than any other portion of a cam mechanism, the added revolutions per minute may introduce a serious problem. Because of the small diameter of roller usually employed, the revolutions of the roller on the stud are correspondingly high; and where the roller runs in a groove, instant changes in direction of motion are also necessary at the ends of the stroke of the cam. On the disk cam, where the return is accomplished by means of a spring, this reversal of motion of the roller does not have to be considered.

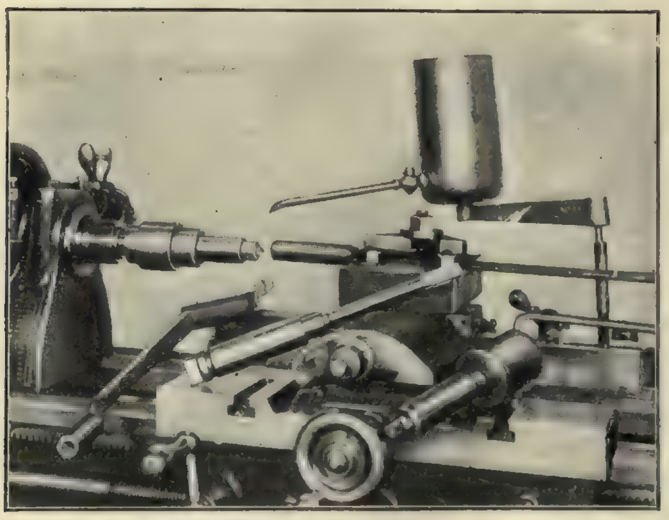
In Figs. 7 and 8 we have a comparison of two cams that have the same curves for the advance as those illustrated in Figs. 1 and 2. The statement of conditions governing the layout of the entire cam is: Advance during one-fourth of a revolution, rest during one-fourth of a revolution, return during one-half of a revolution. With cams working under these conditions and using cam rollers of the same size, the ratio of revolutions per minute of these rolls will vary directly as the length of the cam curves.

In Fig. 8 the length of the cam curve is to the circumference of the roll as 7⅓ is to 1, while in Fig. 7 the ratio is only 4½ to 1. Therefore, the roll in Fig. 8 will make about 63 per cent. more revolutions per minute than that in Fig. 7.

Assuming the camshafts to be making 120 r.p.m., then the cam rolls in Figs. 7 and 8 will make 540 and 880 r.p.m. respectively. This gives a decided increase in revolutions due to the change in diameter of the cam. In Fig. 9 the cam is laid out with the same conditions as in Fig. 8, but an increased diameter of cam roll is employed to reduce the revolutions per minute. With the conditions shown in this figure, the cam roller will make 3¾ revolutions for each revolution of the camshaft. Again assuming the camshaft to be making 120 r.p.m., the roll would be making 450 r.p.m. By this combination we secure an easier-working cam by reducing the wedge angle, and also reduce the number of revolutions of the cam roll on its stud.

Machining Emergency-Brake Levers

A method of machining emergency-brake levers for automobiles is shown herewith. A Millholland quick-change chuck is placed in the spindle of a 14-in. lathe, and the necessary drills, reamers and centering tools are fitted with quick-change sockets. The hole for the thumb release on the handle of the lever is centered, drilled and reamed at one setting of the piece. A cast-iron block mounted on the compound rest provides the means for clamping the lever, and the power feed to the carriage is used in the drilling operation. The centering and reaming operations are done with the hand feed.



MACHINING EMERGENCY-BRAKE LEVERS

The quick-change chuck shown permits the lathe to run at continuous speed, and the lathe need not be shut down to change tools. For this purpose the carriage is backed away so that the tools will clear the work. The collar of the chuck is moved toward the spindle nose to release the locking pin, and the tool is withdrawn. The change tool is inserted, the slide pushed forward and the tool locked in place.

Tapping Bronze Feed Nuts

By J. B. Murphy

Recently we had ten small bronze feed nuts to tap for a 10 x 32 U. S. thread. These nuts were to be used in the construction of a precision graduating machine, and the threads were required to be accurate and smooth.

At first we tried an ordinary 10 x 32 tap, but, although this tap was ground especially for this job, this method had to be abandoned before even one of the nuts was tapped, for the bronze would stick to the tap and clog between the teeth, tearing the threads. I nearly spoiled the nut with this tap.

Next we tried grinding a very long lead, or chamfer, on the tap, leaving about three threads full size; the flutes were undercut, to give a hook to the cutting edge of the lead. This also failed, due to the bronze sticking to the lead, just as it stuck to the teeth of the first tap.

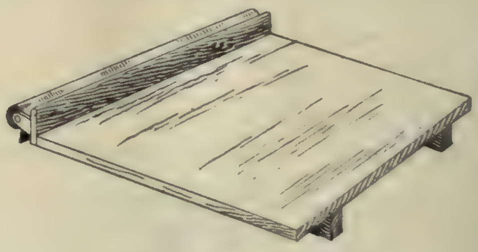
At the third try we found the way to tap these bronze nuts accurately, smoothly, and what was equally important to us, quickly. We also avoided the annoying tap breakage, usually incidental to tapping bronze. Three taps were used, but of different sizes and the same pitch. First we followed the drill with an 8 x 32 tap. This took a light cut, and the metal did not stick to the tap. We followed this tap with a $\frac{3}{16}$ x 32, which cut the thread deeper and, like the 8 x 32, cut easily and freely.

Lastly, the sizing tap, a 10 x 32, was put through, bringing the threads to size. Of these three taps, not one "picked up" metal. They all cut freely and produced a perfectly true and smooth thread. Nor was there, at any time, the slightest danger of a tap breaking. It seems, in tapping a tough, clinging metal, the best all-around method is to use taps of different diameters, but the same pitch of course; the smaller taps are then used to sort of rough out the threads, while the larger taps gradually bring the thread to size and produce the finish.

Drafting-Table Cover

By Oliver Martin

I know of no more convenient cover for the drafting table than a roller shade. It has the great drawback, however, that loose tracings are drawn into the roller occasionally and thus mysteriously disappear. In order to avoid this, I mount the roller shade on a strip of wood about the same length as the table; and this strip of wood I screw on the rear edge of the table. The upper edge of the strip should be from 2 to 3 in. above the top of the table. It does the trick—try it.



DRAFTING-TABLE COVER

WOMEN in the MACHINE SHOPS

SYNOPSIS—*An outline of some of the problems involved in employing women in machine shops, the experiences of some who have already made a beginning, the question of what women can do, what they require in the way of accommodations, instruction, working hours, wages and, last but not least, the output that may be expected if they do enter the shops.*

By Fred H. Colvin

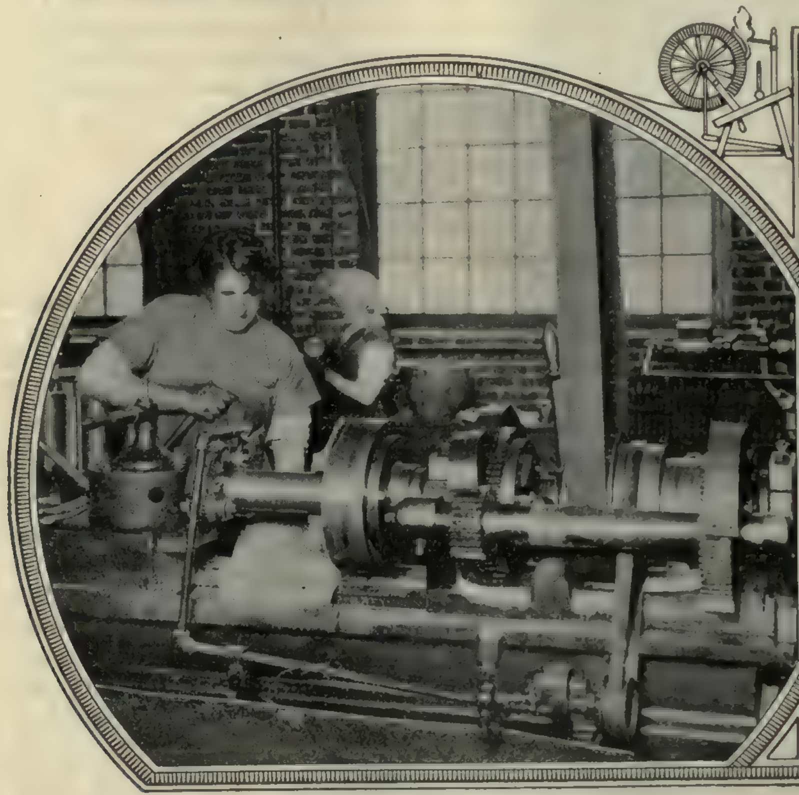
WE ARE such creatures of habit and are so slow to grasp new or different phases of an idea which may not be new in any sense that we are a bit shocked at the thought of women running machines in the shop. Yet we have not been at all disturbed by seeing women in the textile mills or in paper-box factories, and we quite forget the fact that watch factories and typewriter shops have for many years employed women in large numbers. True, this work is light; and we are apt to think of work in the machine shop as being heavy, although a little careful consideration will convince us that much of it is well within the strength of the average woman. But regardless of our previous ideas of "woman's sphere," which is a favorite theme with conservatives of all kinds, women have already entered the machine shop, and it is only a question of time when their number will be increased by hundreds and thousands. The draft will take thousands of men out of our shops; and in order to maintain production this loss must be met from the most available source. Therefore, we must utilize women on as much of the work as possible, after training them to do it.

SHELL WORK ON A LATHE

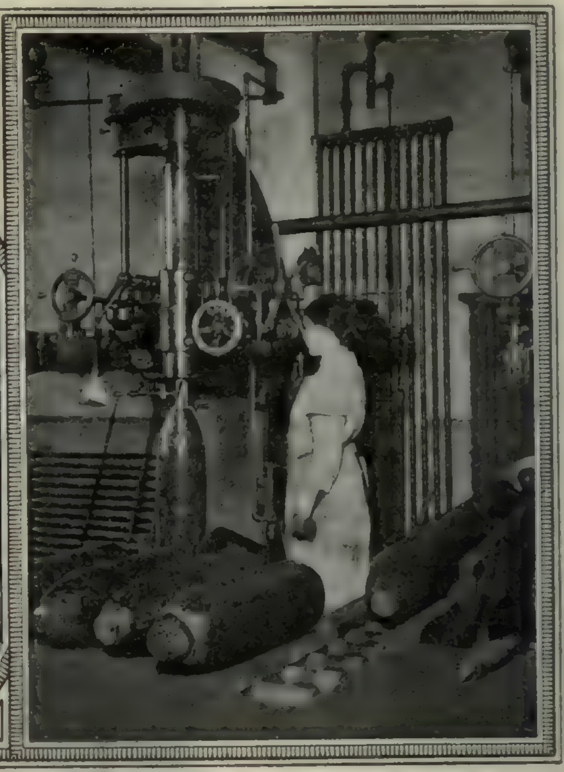
Before discussing the numerous problems that confront the introduction of women into the shop, it is well to get a clear idea of the reasons for so doing and also to consider the effect on the industry when the present emergency shall cease to exist. It has been charged in the past, and too truly in many cases, that women have been employed to replace men because they could or would work for a lower wage and thus enable the underselling of a competitor. Present-day conditions do not offer any excuse for such discrimination, as it is wholly a question of maintaining or increasing production rather than of reducing prices; and no manufacturer with even a semblance of patriotism wants to increase his profits at the present time at the expense of the self-supporting women who must in many cases bear the burden of domestic battle against prevailing prices for foodstuffs and other necessities. Nor will they do anything to lower the standard of wages to which their men who are fighting the country's battles must return when it is over, if indeed they return at all. The real problem, then, is how to utilize women in the machine shop so as to maintain or increase production of necessary articles, and this involves a careful consideration of what kind of women to get; where to get them; how to teach them; how to arrange the work; and what shop changes it may be necessary to make.

For it must be remembered that whatever adds to the comfort and peace of mind of the worker, even if it seems foolish and unnecessary, adds to the production of the shop; and it is production we are after rather than the proving or disproving of any preconceived notions or prejudices of our own.

In order to see exactly what has been done and is being done in the way of utilizing women in the machine shops that are now busy in various kinds of work, I visited a number of such well-known shops as the Brown & Sharpe Manufacturing Co., Colts Armory, Remington Arms Co., Winchester Repeating Arms Co., Yale & Towne, Taft-Peirce, Worcester Pressed Steel Co. and others, all of whom are using women.



WORK ON A SHELL BASE



DRILLING FORGINGS

Social prejudice has prevented many good women from going into the shop and relegated them to the department store and the office, which are supposed to be more genteel and respectable in every way, even if the remuneration is often considerably less. Here again the question of "woman's sphere" has been a handicap not only to women, but to the community as a whole, and emphasizes the fact that the sphere of any human being is to do the work at hand which can be done best for all concerned. This social prejudice has been to a large extent the result of the coarsening effect of improper shop or factory conditions in the past, of insufficient consideration for the privacy of the women workers, and to the old czar-like power too often bestowed on the foreman and minor shop executives. This condition is happily passing in most places and with it most of the prejudices and loss of social caste.

Under proper shop conditions, which means ample and modern lavatories, lockers and restrooms, courteous treatment and fair play, employment managers are having no difficulty in securing women of the better class, daughters of foremen and others in the shop, widows of shop men and women from other industries where working conditions and wages are less attractive.

It is of course more difficult for an old shop to rearrange its accommodations than for a new shop to build them in the first place, but it must be done and is being done very successfully. In most cases a matron is employed for the restroom and to act as an arbitrator or counsel for the women in case of friction. We must revise many of our arbitrary notions of shop arrangement when we introduce a temperamentally different element into it, and this step may even help us in managing men when we fully appreciate its significance.

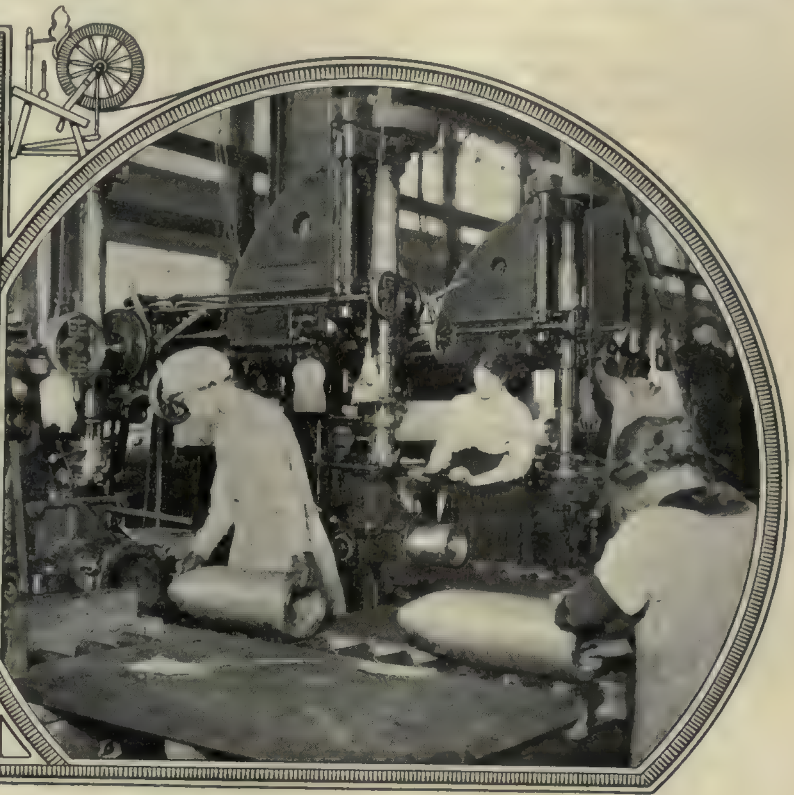
A very frequent question is, What can the women do? The answer in most cases is that she can do anything which a man of the same physical strength, intelligence and experience can perform satisfactorily.

Few will probably ever become all-round machinists, although probably many more than we think might be capable of it. But few men today become all-round machinists either, and just as the average man you take into the shop can be taught to handle repetition work on the miller, drilling machine, hand screw machine, grinder and small lathe, so can the average woman be trained to your work and just as easily. Some shops insist that the women learn more readily and become expert in less time than men. In most cases they are taught by men and seem to prefer it, yet there are cases where women instructors are used very successfully. The main point seems to be that a woman assumes that the man knows his business, but the woman instructor must prove her right by showing unusual skill.

Women are secured by advertising, but also very largely by acquaintance with other women in the shop. A notice on the bulletin board is generally enough.

In many shops, especially those employing men who can handle almost anything in the shop—it will be necessary to rearrange the work by dividing it up into the simpler operations, just as would be the case with men of equal inexperience. This may be necessary even where the product is not of such nature as to make this method economical under ordinary conditions. But these are not ordinary conditions, for this is a time to try the real qualities of any shop manager in utilizing such labor as can be obtained; and it is more a test of management than of labor in a large majority of cases.

TURNING WORK



METHODS OF HANDLING SHELLS

Machine work will have to be arranged for the women in most cases, and the machines set up and tooled, as for inexperienced men. Cutters must be ground and reset for them. Some of the women may become experts in time and be able to do this for themselves, just as in the case of some men operators, but it cannot be counted on to any extent for some time, and provisions must be made for setting up the work.

Proper shop facilities include the lavatories, restrooms and lunchrooms, where necessary. The hours of labor are limited to 54 hours a week in most states, and many find an even shorter week more advantageous. This feature, however, is governed to a great extent by local custom and conditions. Even where the hours are nominally the same as for the men, it is often the custom to have the girls stop work five or ten minutes before the men, to give them the opportunity to get out before the crush. In many cases, too, separate exits are provided where the number warrants it. Little courtesies and considerations of this kind attract the more desirable type of women and assist output, and this is what we are looking for, quite regardless of our preconceived notions. If geraniums and canaries will increase production, it is good policy to have them.

Stools or chairs should be provided where possible, and short rest periods are found advantageous in many places. This, of course, is one of the Taylor principles for men as well as women and works well at times. These little conveniences and attentions have much to do not only with securing the better type of women, but in preventing that bane of manufacturing, a large labor turnover. This is also affected by the wages paid and the limits that are put upon earnings.

Employers who have not had experience with women in the shop are often troubled as to the adaptability to their work, the amount of instruction required, the output and the length of service. The experience with all whom I consulted seems to be that the average woman can adapt herself to almost any work that a man of similar strength and intelligence can handle, that she learns just as rapidly and that her output will compare favorably in every way. This simply bears out the experience with women in offices. Employment managers tell me that the average length of service is longer than with men; their experience places it at about a year as against six to eight months for men. It of course varies with the locality and business conditions.

In one Eastern city the head of the Board of Trade, who is a particularly long-headed and far-sighted man, became interested in the problem of properly housing women who came from other localities. At his suggestion prominent women of the Young Women's Christian Association engineered the starting of large, homelike boarding houses, with efficient matrons in charge. Particular attention was paid to selecting matrons of different temperaments, so that younger women, or those preferring a somewhat lively household, could be looked after by matrons who appreciated this phase of human nature and who would enter into the spirit of a lively home. Some, on the other hand, might prefer a very staid and quiet place, and these, too, could be accommodated in boarding houses of the other type.

In all this work, however, it was deemed better not to have either the Board of Trade or the Young Women's Christian Association appear in any active capacity, so as to avoid all suspicion of either exploitation or undue institutional guidance. Human nature seems to be so constituted that it is much easier to overlook an occasional lapse when the boarding house is being run by an individual than when it is controlled by a manufacturer or an institution of some kind. This arrangement has worked out very well; and although there is a tacit understanding that unavoidable financial discrepancies will be looked after by either or both of the institutions named, I understand that such action has not been necessary except as to advancing funds for the purchase of necessary furnishings to make the houses attractive and homelike. It often happens that careful attention to these little phases of human psychology goes a long way toward making a success and avoiding a failure.

THE QUESTION OF WAGES

The very logical theory of equal pay for equal work does not seem to be questioned when it comes to setting piece prices, but for various reasons it is not universal when it comes to the day wage that is paid during the instruction period or when piecework is not possible. One employer, for whom I have the highest regard and who takes the problem very seriously, advocates the lower wage at the start so as not to lure girls into the shop solely on account of the money involved. He feels a personal responsibility when a girl leaves her home in another town and does not feel justified in offering special inducements in the shape of high wages at first. This does not of course apply to the woman or girl who must go to work for one reason or another, but he sees no way to discriminate and believes in getting them on piecework as soon as they show that they are really in earnest.

Other manufacturers say very frankly that as long as women can be hired for a lower wage they will not pay the same as for men, while still others acknowledge an agreement with makers of boxes and other work done by girls, not to pay a higher day wage than prevails in those trades, on account of disturbing wage conditions in the town. They are evidently not familiar with the fact that the Wall St. district in New York pays a much higher wage for both clerks and stenographers than is paid anywhere else in the city, without materially affecting the city as a whole. It simply means that Wall St. gets the cream of the men and women available and that the rest accept the regular scale because they cannot find employment in Wall St. And it would work out in the same way in the shop. The day wage is not so important, however, as long as piecework is adopted as soon as a girl is proficient and is paid at the same rate as the man.

In nearly all the shops visited, no attempt has been made by either the management or the women themselves to wear anything but the usual costume. Skirts are as a rule short, but at least no shorter than many seen on the street. Dark clothes naturally predominate, and large aprons or even outer skirts are quite common.

Some, however, consider it a good plan to wear out old clothes of all kinds; and a few fancy waists and other dressy gowns are to be found, very much as the men formerly wore out frock coats and other fancy suits.

A few shops encourage the girls to wear a small, neat cap to protect their hair from dirt and also keep in the stray locks from possible danger. This is particularly true in grinding and polishing rooms, even though exhaust fans are provided.

The Worcester Pressed Steel Co. has encouraged its shop girls to wear overalls, believing them to be safer, more comfortable in every way than any sort of skirt can possibly be. The company first purchased three pairs of neat and well-made women's overalls and offered them to the first three girls who would wear them at their work. Quite naturally, three of the younger girls were the first to accept the offer, and as a result practically every girl in the machine shop is now wearing overalls and liking them in every way. They are fully as modest as the average dress, allow perfect freedom both standing and sitting, without fear that an undue amount of hosiery is exhibited to the passerby. Very stout girls do not take kindly to them, but even they fall into line after the good points of the overalls become apparent.

One feature to be guarded against is not to allow the girls in the office to snub the shop girls, or otherwise make them feel that they are in a different class, particularly from any difference in the occupation or dress. This question of social caste is one that must be carefully handled if the best classes of women workers are to be obtained.

THE DEMAND FOR WORKERS

The demand for workers will probably cause more and more shifting as time goes on and more and more men leave the shops for war service of one kind or another. It is quite probable that men in offices will become a rarity and that many office men will go into the shops, leaving their places to be filled by girls. These girls can probably be obtained from the many colleges that have some sort of business course—girls who would hesitate a long time before going into the shop on account of family tradition and other foolish notions of social standing.

There is no reason, however, why shopwork should not be made to appeal just as strongly as the department store or box factory and be far and away ahead of the average laundry as a desirable place to work. By choosing women as carefully as possible, making the shop conditions attractive and the remuneration greater than they can get in any other industry with a similar amount of effort and of training a high class of women can be had for the machine shop. In some cases, notably the Remington Arms Co., of Bridgeport, Conn., school teachers and nurses are being attracted by the wages as well as the working conditions, preferring work in the shop to staying at their regular occupations.

The question of what women can do in the shop has been answered in a general way by saying that they can do anything which can be done by a man of similar strength and experience. To be more specific, I am giving a list of occupations that has been prepared by a committee from the employment department of the Winchester Repeating Arms Co., as well as other suggestions as to executives, accommodations, rate of pay, night work, training and hours of labor. This information is particularly valuable coming from a firm that has already had considerable experience with woman labor, especially in the cartridge-making department.

Report of Employment Department of Winchester Repeating Arms Co.

It was decided that women could be used at once, replacing men, in the following shops: Assembling B, 40 women for subassembling; gun shop B, 26 women for spring job, assembling and filing; gun shop D, 10 women for filing and benchwork; corner and polishing, 75 women for polishing. At a later date 60 more could be used when a production of 2000 rifles a day is reached.

In addition to these particular jobs, the classification of all work was reviewed, and it was recommended that women could be substituted for men in the following trades. The personnel division should work with the manufacturing shops in this matter and try to place women in these positions:

Adjusters (1, 2 and 3)
Armature winders
Assistant foremen
Assistant overseers (planning, preparation, inspection, production, scheduling, etc.)
Assemblers
Assemblers (bolt)
Assemblers (cases, cartridge)
Subassemblers (92, 94, 38)
Assemblers (leaf sight)
Assemblers (small parts and stock)
Assorters (chief sorter)
Automatic screw machine (chief operators)
Bench hands
Bookkeepers
Bottom sealers (chief packers)
Brass inspectors (chief inspectors)
Bullet swaging
Bundlers
Burrers
Clerks (car reports)
Clerks (checkers)
Clerks (cost and pay)
Clerks (dispatching)
Clerks (gage)
Clerks (label)
Compositor
Comptometer operators (chief operator)
Corner and polishers
Counterborers
Counters
Crimpers
Detailers
Drillers
Enamel work
Errand boy (?)
Extractors (bullets)
Extractors (powder)
Extractors (primers)
Extractors (wads)
Field inspectors
Filers
Filers (cornerers)
Filers (to gage)
Filling tubes
Finishers (female)
Forewoman
Gagers (bullet)
Gagers (shell)
Gas annealers
Gluers (labelers)
Groove shakers
Groovers (bullet)
Headers (large)
Headers (small)
Helpers
Inspectors (barrel, outside finish)
Inspectors (bullet covers)
Inspectors (overseers)
Inspectors (female)
Inspectors (grinding)
Inspctors (machine cuts)
Instructors
Labelers
Machine operations (chief operations)
Matrons
Messengers (chief errand boys)
Millers (hand)
Numberers (receivers)
Operators (automatic screw machine, Brown & Sharpe)
Operators (comptometer)
Operators (cutting-off machines)
Operators (hand, screw machine)
Operators (machine)
Operators (magneto separators)
Operators (planning boards)
Operators (press)
Overseers (inspection)
Overseers (planning)
Overseers (preparation)
Overseers (production)
Overseers (scheduling)
Packers
Packers (bottom sealers)
Planning overseers (chief overseers)
Planning-board operators (chief operators)
Pocketing
Polishers (barrels)
Polishers (bolt breech)
Polishers (miscellaneous)
Polishers (receivers)
Polishers (sights)
Preparation overseers (chief overseers)
Press feeders
Press operators (chief operators)
Primers
Primers (hand)
Punching
Qualifiers
Reamers (hand)
Reducers
Re-inspectors
Riveters
Rubbers (stock)
Schedule overseer (chief overseers)
Scheduler
Scrubbers
Scalers, bottom (chief packers)
Setting up wheels (polishing)
Shellacking
Slotting screws
Tin solderers
Sorters (metal)
Sorters (scrap)
Sorters (shells)
Spring benders
Spring workers
Stampers, steel
Stencilers
Stenographers
Stock clerk (chief clerk)
Straighteners (bayonets)
Straighteners (shells)
Subforemen
Supply clerk (chief clerk)
Sweepers
Tallymen (clerk)
Tappers
Tappers (hand)
Teamsters
Testers (concentricity)
Testers (primers)
Tool-crib clerk (chief clerk)
Tracers
Tube Fillers (chief fillers)
Typists
Varnishers (chief finishers)
Washing windows
Weighers (chief clerk)
Weighers (bullet)
Window-curtain makers

It was felt that the question of foremanship and other executive control must be taken care of by the securing of proper women executives and matrons and that we should have women who would be responsible for all girl employees and who probably would require a good salary, as is now being done in the cartridge department.

In most of the shops where we could put women, there are at the present time sufficient accommodations, or at least accommodations that could quickly be made available for women, so that this should not give us very much concern.

It was felt that, wherever possible, women employees should be segregated from men; but if it should become necessary or advisable to put women on operations where they could not be segregated from men without the movement of machinery, this difficulty should not be allowed to stand in the way of placing women on these operations.

The committee was unanimous in feeling that, during the period of this war, all women pieceworkers replacing men should receive the same piece rates as men.

1. Many of the women whom we want to get will have families to support while their male supporters are engaged in military duty, and they should be entitled to receive as much as they would receive through their male relatives.
2. The English are paying women pieceworkers the same rate as men pieceworkers; and in cases where a flat rate is paid, they receive the same rate as the lowest rated men.
3. In the cases of many fine operations, women would undoubtedly secure a greater output than men, and this increased production alone would offset any more money that they would be able to make. The corner and polishing shop is an example of this.

It was felt that nightwork would be of doubtful advantage to the company—that is, to employ women at night to any great extent. In shops where they would be completely isolated, it might be advantageous; but it would necessitate very sharp supervision, and owing to the rest periods which they must have, it is doubtful if it would be advisable.

The training of new female employees must be done by the present force of operators now engaged in those trades into which women operators would go; for instance, if women are to be engaged in assembling, they will have to be taught by men operators who are now assemblers. In addition to this, however, the suggestion was made that a section of the new shop be set aside for the training of new women operators.

No recommendation as to hours of labor was made, as it was felt that this was a matter of company policy which had already been decided; but if possible the working day should not exceed eight hours.

THE PROBABLE OUTPUT

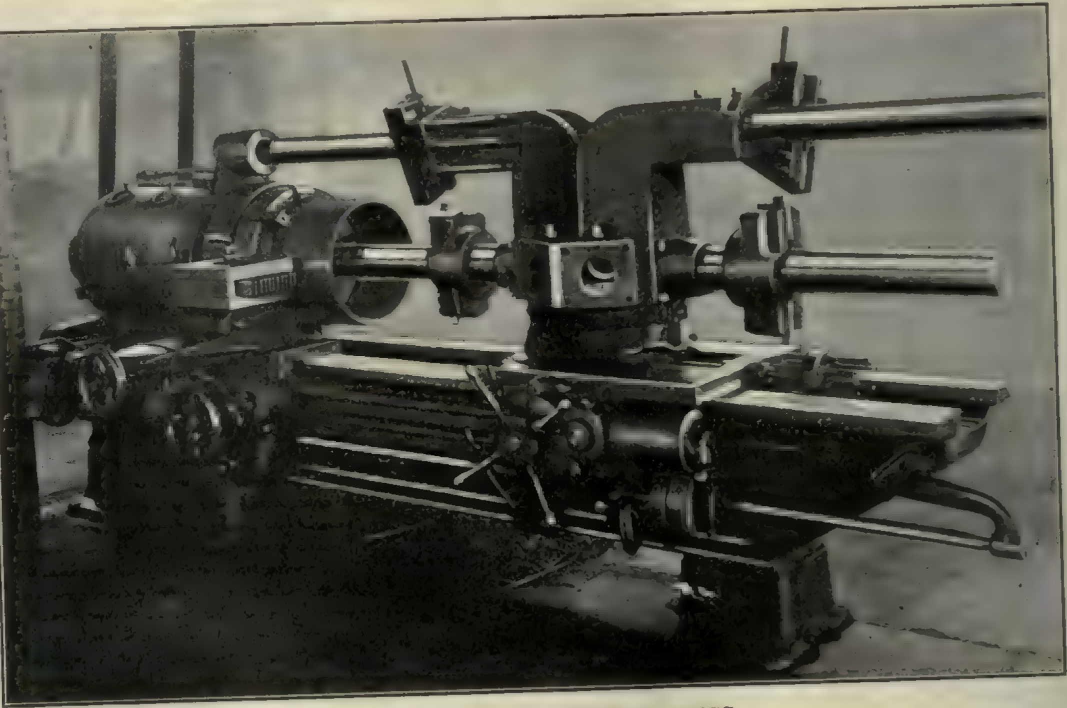
The question of the amount of output that may be expected from a woman running a machine seems to be answered in almost every instance in a very satisfactory manner. In no case was it reported that the output was smaller, and in a number of operations a larger output was recorded. This is accounted for in many ways, the most common explanation being that the woman is willing to work harder and more steadily than the man at the same kind of job and that the monotony of repetition work does not affect her as badly or at least in the same way. If this is true, it may perhaps be explained by the fact that the work is new to the woman and consequently has more novelty in it. For another reason, the average woman does not expect to stay at the business many years, even though her expectations be not realized. Then too, among the older workmen who have stood piece-rate cuts when the earnings exceeded a dead line, this memory acts as a governor that is not present among either men or women who are new in industry. This method of management is, fortunately, becoming less common than it was a few years ago. All these matters may very readily have a bearing on the question of output, and the true measure of the amount of work cannot well be taken until women have been in the shop for several years. It seems very probable however, that the output secured will compare very favorably with that obtained from the men. The experience of employers seems to be that women will probably lose a little more time through sickness or indisposition than men. This loss is, however, usually more than offset by their coming to work Mondays instead of tapering off from a prolonged celebration over the holiday. It is also stated in almost every case that the women's restrooms require more attention than is the case with the men. They are said to be more careless about picking things up, although this is difficult to realize when we consider how the average man leaves his things lying about the house for his wife to pick up and put away. Matrons and cleaners can of course look after this without difficulty, but it is a point to be watched rather closely if all reports are correct in the matter.

By no means all the problems that are likely to come up have been stated, but those mentioned may be of some help in making a start along the road. The chief requirement seems to be that we approach the problem with an open mind, realizing that except for a few differences of temperament both men and women are very much the same. It is well always to bear in mind that for equal strength and endurance, and for equal experience, there is practically no difference in the time required to teach operators or in the amount of work that will be turned out. With a little consideration, surroundings as pleasant as they can be made, fair play in the matter of foremen, work and wages, most of the difficulties will disappear.

Lathe Set-up for Turning Large Piston Rings

SPECIAL CORRESPONDENCE

The Libby lathe shown was especially fitted by the makers for machining large piston rings, from 13 to 18 in. in diameter. These piston rings are of hard cast iron, turned from the usual type of pot casting held in the lathe chuck. Two cuts are taken. The bars carrying the boring tools are guided by bushings in the spindle, and the outside turning tools are carried on bars piloted by means of a guide placed above the front spindle bearing. The rings are parted by a gang of cutoff tools in the cross-slide tool block.



SET-UP FOR LARGE PISTON RINGS

The recorded time on a lot of seventy-two 13-in. rings, first operation, $\frac{3}{16}$ to $\frac{1}{4}$ in. cut, 30 and 50 ft. per min. surface speed, and a surface speed of 50 ft. per min. for the finishing cut, was 3 min. 48 sec. per ring, using Rex AA steel.

On the 18-in. size rings the time on a lot of 50 was 3 min. 16 sec., with a cutting speed of 75 to 150 ft., $\frac{3}{16}$ to $\frac{5}{16}$ in. depth of cut, using Stellite for boring and turning and Rex AA for parting tools.

Attachment for Cutting Cams and Profiles

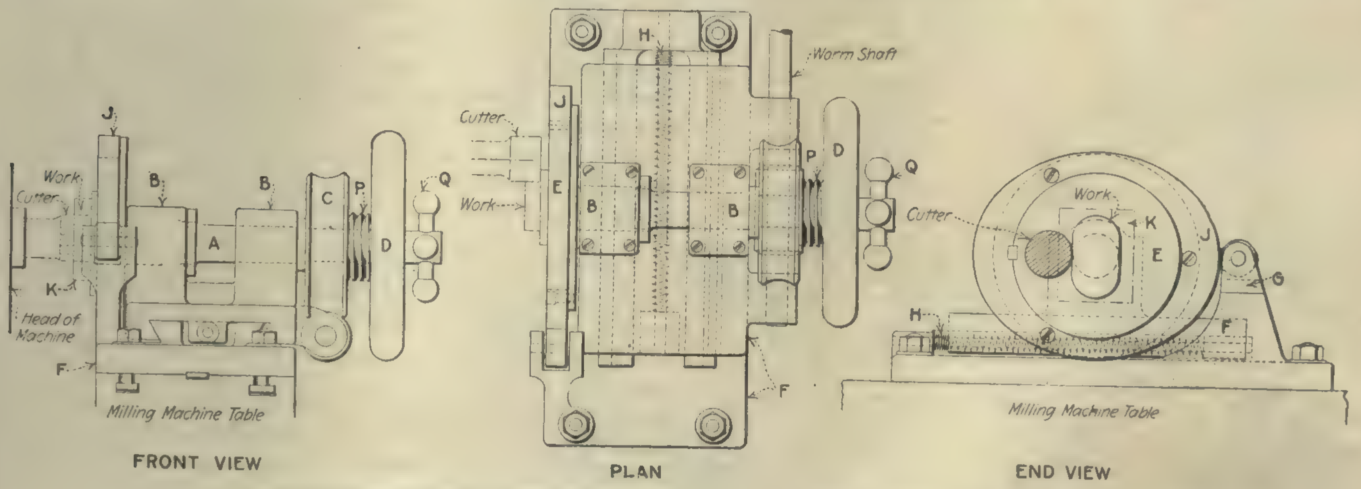
BY WILLIAM C. ROEMER

SYNOPSIS — *The attachment described and the principles of cam layout outlined do not apply merely to one special type of cam, but will be found to be of general use.*

THE cutting of cams and profiles is always troublesome and expensive unless special means are available. In cases where the number of parts to be made is too small to warrant the installation of special machinery, an attachment designed in accordance with the principles set forth in the following description, and applied to a miller, may fill the requirement at a minimum cost.

It is not the intention of the writer to enter into details of construction as applied to an individual case, but to treat the subject on a broad basis, showing how the principle of design should be employed to obtain satisfactory results. A few of the profiles that can be cut on an attachment of this kind are shown in Fig. 1. Attention is called to the profile marked *A*. Among the elements of this profile are found straight sides and sharp corners. This profile has been successfully cut to gage on an attachment of this type.

With this attachment, two movements are available for generating a profile—namely, a circular movement and a longitudinal movement. The circular movement is constant and constitutes the feed; the longitudinal movement is variable and is controlled by a cam mounted on the spindle, which carries the piece to be cut. This cam is rotated by the spindle upon which it is mounted.



FRONT VIEW PLAN END VIEW

FIG. 2. DETAILS OF ATTACHMENT FOR CUTTING CAMS AND PROFILES

The attachment in a general way embodies the features shown in Fig. 2. A fixture for holding the piece *K* to be cut is attached to a spindle *A*, which is mounted in bearings *B* and provided with means for rotating, such as a worm and worm gear *C*. A handwheel is also provided to rotate the fixture rapidly while loading. This handwheel *D* is a convenience, not a necessity, but may be dispensed with to lessen manufacturing cost. The feed may be made to operate by power by applying a pulley to the wormshaft, or by hand by providing a suitable crank handle. If a handwheel is used in conjunction with a worm and worm-gear feed, a method of disengagement must be provided, such as a disk friction *P*. Integral with the spindle *A* is the fixture and cam mounting *E*, resembling a faceplate on a lathe. The member that carries the spindle bearings *B* is mounted to slide on a sub-base *F*. This sub-base is attached to the miller table. This construction permits the fixture to move longitudinally with relation to the miller table. The housing for the cam roll *G* is integral with the sub-base *F*. A spring *H*, or weight, is required to keep the cam and cam roll in contact. The cam roll is placed opposite the cutter in order that the thrust due to cutting will tend to keep the cam and cam roll in contact. The annular face cam *J* is mounted on the spindle, as shown. The development of this cam will be described hereinafter. The miller must be provided with an adjustable positive stop. The necessity for this will be apparent if the construction and operation are followed out.

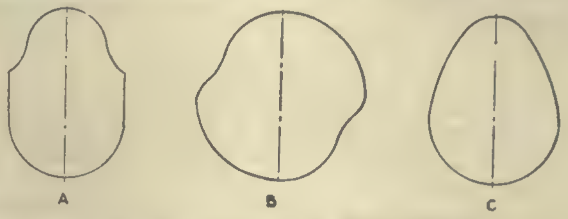


FIG. 1. VARIOUS CAM OUTLINES

The attachment operates as follows: The work-holding fixture *K*, which is attached to the spindle *A*, is rotated to a convenient starting position; and the miller table is moved forward until it engages the positive stop. This stop must be adjusted to obtain the proper depth of cut, as this point governs the distance between the center of the cutter and the center of the cam roll. The spindle is now rotated by hand or power feed, as the case may be. The rotation is constant, but the longitudinal movement is variable and is controlled by the cam *J* in such a way that the combination of the two movements will produce the required profile. The cam *J* acts against the cam roll *G*, which is fixed to the sub-base *F*. As this sub-base is in turn attached to the miller table, which is stationary, it follows that the longitudinal movement must take place between the sub-base and the fixture. In other words, the rotary movement is constant, while the amount the fixture will slide upon the sub-base is controlled by the cam *J*, whose outline is determined by the profile to be cut.

PROCEDURE FOR DEVELOPING THE CAM

The cam should be laid out in accordance with the following procedure, referring to Fig. 3:

1. Lay out the profile to be cut and locate a point within this profile about which the cut is uniformly distributed. The point thus found will be the center of the cam. The object of locating this point centrally is to reduce the longitudinal movement to a minimum, thus making a smoother working cam.

2. With the point found as directed above as a center, describe a circle whose diameter will represent the outside diameter of the cam. This diameter should be as large as possible.

3. Divide the circumference of the cam into as many parts as required and draw radial lines through the cam center, intersecting the circumference on the opposite side. Uniform spacing is not essential. The extent of the subdivision in a large measure determines the accuracy of the cam and the facility with which it can be made. At such portions of a profile where the outline changes abruptly, it is advisable to make the subdivision quite small in order to insure a more accurate cam outline. This condition is shown by the lines *XY*.

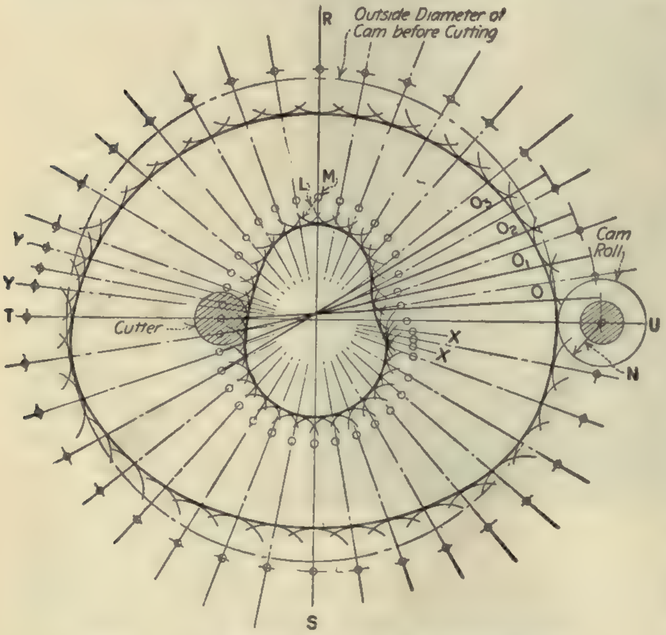


FIG. 3. OUTLINE OF CAM DEVELOPMENT

4. Determine the diameter of the cutter. This diameter should be as large as possible. Locate a point on each radial line by using the radius of the cutter and striking an arc tangent to the profile at that point. This operation is shown by the arcs *L*, locating points *M* as indicated.

5. On the radial line at which the required profile is nearest the cam center, strike an arc tangent to the outside diameter of the cam, on the opposite side of the center, whose radius is equal to the radius of the cam roll, as shown at *N*. The normal distance between the cutter center and the cam-roll center *O* is thus found. To cut the required profile, it is obvious that this center distance must be the same for all positions. Using this distance as a radius and the respective cutter centers *M* as centers, strike a series of arcs, in each case cutting the radial line upon which the center is located, as shown by the arcs O, O_1, O_2, O_3, etc. When all cam-roll centers have been located, arcs are struck from these centers, using the cam-roll radius *M*. A line drawn tangent to these arcs will give the required cam outline.

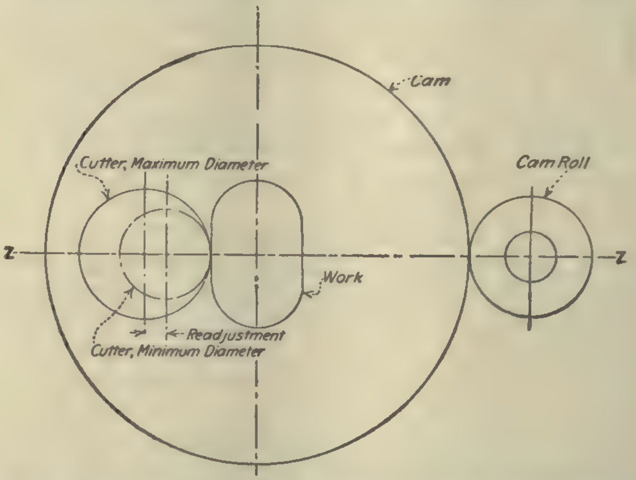


FIG. 4. ILLUSTRATION OF THE POINTS OF TANGENCY

The cam cutting can be simplified by making the design on a large scale and noting how nearly a series of true radii will give the required cam outline. The radii and centers thus found by trial can be measured and transferred to the cam blank. The above factors being determined, the cam cutting can be readily and accurately done with the aid of a circle-milling attachment.

INFLUENCE OF CUTTER DIAMETER UPON PROFILE

The development of the cam outline involved two factors—the cam roll radius and the cutter radius. It will be noticed that the points of tangency of the cam face and the cam roll are approximately on a line with the cam center at all times. The point of tangency must therefore be on a line passing through the center of the cam and the center of the cam roll. This relation does not exist between the cutter and the work except at such points where a line perpendicular to the cut forms a right angle with a line that passes through the center of the cam and the center of the cam roll. For a profile similar to Fig. 3, this condition applies on lines *RS* and *TU*. At all other positions, the point of tangency of the cutter and the work is not the same as the corresponding points of the cam and cam roll. Referring again to Fig. 3, it will be observed that the point of maximum variation as regards the points of tangency will be midway between the positions at which they coincide.

When a cutter is ground, the reduction in diameter is compensated for by decreasing the distance between the center of the cutter and the center of the cam roll by readjusting the stop on the miller table. Further consideration will show that this adjustment will fully compensate only at such points where the points of tangency of cutter, work, cam and cam roll are in a line passing through the center of the cam. This condition is shown by Fig. 4. Here, all points of tangency are shown on the line *ZZ*. Fig. 5 shows the relative positions of the cutter, work, cam and cam roll when the points of tangency are not in a line. The enlarged view shows by dot and dash lines how this condition affects the profile. In this view the error is exaggerated to show the principle involved. In practice, this error is very slight in cutters of small diameter and entirely negligible when large diameters can be used.

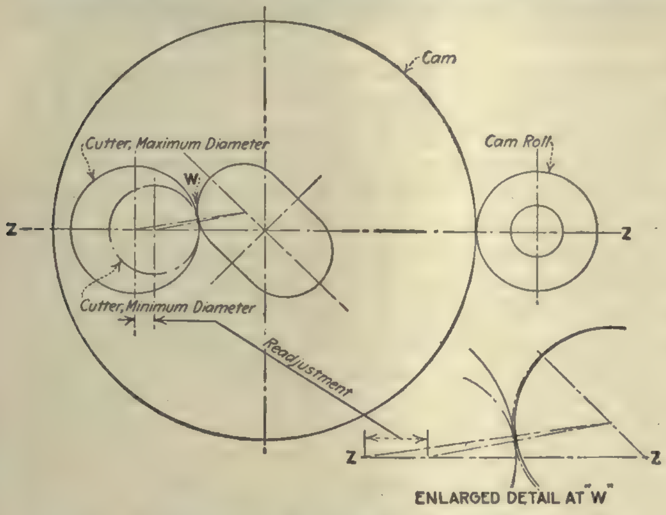


FIG. 5. RELATION OF PARTS WHEN POINTS OF TANGENCY ARE NOT IN LINE

Due to the condition shown by Fig. 5, cutters less than one inch in diameter should be avoided if possible. If the profile demands a cutter of small diameter, it is advisable to base the development of the cam on a normal diameter. This will produce a profile subject to a maximum and minimum tolerance.

Influence of Centrifugal Force on the Pulling Power of a Belt

BY J. H. VAN ARKEL

Increasing the pulling power of a belt by an increased arc contact may not always give the desired results. The question came up, Will a changing of pulleys from 30-in. diameter to 36-in. diameter, with 500 r.p.m., give an increase in the horsepower transmitted by the belt?

The following calculations made by using the formulas given in one of the standard works on belting show the results that would be obtained. The factors to be considered are the cross-section of the belt, which for convenience is taken as ¼ x 4 in., or 1 sq.in.; the arc contact, which for equal driven and driving pulley is 180 deg.; and the coefficient of friction, as found by the formula

$$f = 0.54 - \frac{140}{500 + v}$$

The actual pulling power of the belt, which is the resultant of the different forces acting on the belt, may be found by the following formula:

$$p = \frac{(10^{0.00758/f\theta} - 1)(2A - 0.00061036v^2)}{2 \times 10^{0.00758/f\theta} + 1}$$

For a 30-in. pulley at 500 r.p.m., v equals 3927 ft.; and for a 36-in. pulley, 4712 ft. Then

$$f = 0.54 - \frac{140}{500 \times 3927} = 0.51;$$

θ = Arc contact in degrees;

A = 240, a value depending on the tension of the belt under working conditions.

$$10^{0.00758/f\theta} = 10^{0.00758 \times 0.51 \times 180} = 10^{0.6995}$$

or

$$0.6995\ log\ 10 = log\ 0.6995$$

The corresponding number is 5.007, or 5. Substituting the above values, we have:

$$p = \frac{4(2 \times 240 - 159.76)}{11} = 116.5$$

and the horsepower transmitted equals

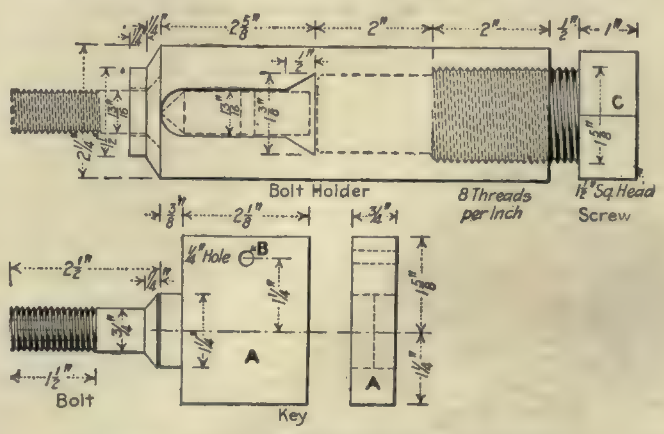
$$H = \frac{pv}{33,000} = \frac{116.8 \times 3927}{33,000} = 13.8$$

Calculating in the same way for a 36-in. diameter pulley, we find $p = 94.4$, and $H = 13.4$, showing that the belt would transmit less power than in the first place. Under 2000 ft. per min., this centrifugal force need not be considered, but at speeds higher than 4000 ft. a steady decrease in the pulling power of the belt, under equal conditions, will be found.

Holder for Countersunk Head Bolts

BY EDWIN CHAPMAN

The device shown is for holding ¾ x 2½-in. countersunk head bolts while the thread is being cut in the bolt cutter. The holder, which is made of machine steel, case hardened, is securely clamped in the jaws of the bolt cutter with the slot in a vertical position, and extending ahead of the jaws. A bolt is then inserted into the slot, either from the top or the bottom, and pushed forward into the countersink.



HOLDER FOR COUNTERSUNK HEAD BOLTS

The hardened key *A* is then put into the slot until the ring *B* rests on the holder. This brings the knife-edge of the key into line with the bolt head.

The screw *C* at the rear is then tightened, causing the knife-edge of the key to sink into the head of the bolt and preventing it from turning. To remove the bolt, the screw is loosened and the key lifted out; when the bolt is pushed back, it will drop out.

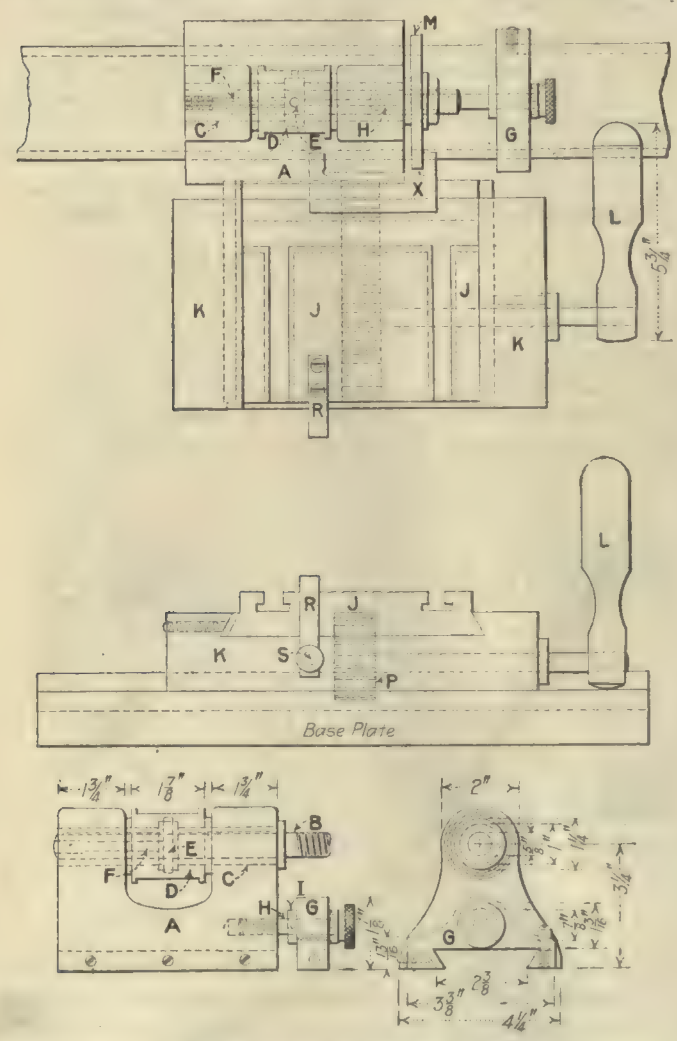
IDEAS FROM PRACTICAL MEN

Gage-Grinding Machine

By W. E. Chambose

Two machines or fixtures similar in general construction to the one shown were built a number of years ago for the sole purpose of grinding gages. They were found to be convenient and rapid.

At *A* is the grinder head and at *G* the sliding member, or platen, which is operated by the rack and pinion *P* and fitted to the base *H*. The head is movable on the ways, and the whole outfit is mounted on a cast-iron baseplate.



THE GAGE-GRINDING MACHINE

In practice the gage to be ground, shown at *X*, is clamped to the platen *J*. The grinder head is then brought to position for the wheel to engage the work. The straddle clamp *G* is then secured to the ways and the wheel fed to its cut by the graduated screw *H*.

The slide *J* is operated by the hand lever *L*. The depth of the cut is regulated by the stop *R*, the adjustment being made by the knurled-head screw *S*. One side of the gage being ground, the head is moved to the other side, or face, of the gage and the operation repeated. The work remaining in the same position insures the faces being ground parallel to each other, provided the same care is taken as would be the case when using any other method or machine for the same work.

The spindle *B* runs in the bronze bushings *C*. These bushings are made long enough to project beyond the inside faces of the casting to within about ½ in. of each other, thus forming the bearing for the driving pulley *D*. A slot in the spindle allows the pin *E* to pass through with clearance all around. The pin is a light drive in the pulley. This arrangement provides a means for driving and also takes the belt pull off the spindle, thus insuring greater accuracy.

End play is taken up by the adjusting screw *F*, in the rear end of the spindle. This screw bears on the pin *E*, and as pressure is applied the pulley is forced against the collar, and the flange on the shaft is brought up to its bearing on the face of the casting, thus effectually taking up all end motion. No provision is made for wear of the bushings, although this could easily be provided for in the usual way with taper bushings and threading the collar.

The height of the platen *J* is such as to bring the center line of the work in line with the center of the spindle.

Drawing Hollow Brass Balls

By Henry Ginsburg

A job that I had to make recently, a hollow ball of sheet brass about 4 in. in diameter with only a ½-in. hole, recalled Mr. Smith's interesting article on page 27, Vol. 46, on hydraulic drawing of shells and impels me to ask him for the tools and method he used for drawing up the shell shown at *G*, in Fig. 3 of his article.

The quantities required in my case warranted no expensive tools, and a satisfactory job was obtained by spinning in halves, piercing the hole in one and soldering. Of course, where a seamless shell is required this would not be permissible.

The new seamless army canteen is an example of such work and one that has a special interest just now. Is anyone familiar with the method by which it is made?

Value of Mathematics to Toolmakers

By Gustave A. Remacle

I will describe a striking example of the disadvantage of not knowing how to apply even elementary trigonometry in the shop. The lack of knowledge, in this instance, resulted in error and loss of time on the part of the toolmaker who was making the gage, while the ability to solve the simple problem enabled me to detect the error and save a friend from the discomfiture of turning in an inaccurate gage. I will not discuss the method of building the gage, as that is apart from the purpose of this article.

When the toolmaker received orders to make several gages, he was given a blueprint that I have duplicated in Fig. 1. It will be noticed that *A*, *B*, *C* and *D* are the gaging points, which must be worked to within 0.001-in. limit. After deciding upon the method of making the gage, the toolmaker made a templet, Fig. 2. The purpose of this templet was to determine the accuracy of form and location of the gaging point *A*, Fig. 1, in relation to the other gaging points. This templet was built up of two pieces *A* and *B*, which were soldered together as shown in Fig. 2. While the making of the part *A* was simple enough, much time was lost in trying to make the part *B*. As this part was for the purpose of gaging the point *A*, Fig. 1, which seems to be the most important gaging point of the gage proper, it can be seen that it was of prime importance that the part *B*, Fig. 2, should be made correctly.

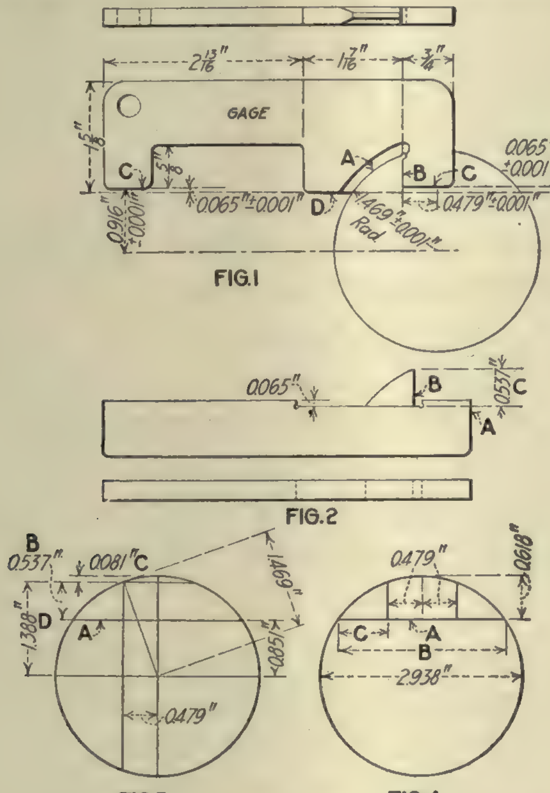


FIG. 1
FIG. 2
FIG. 3
FIG. 4

FIGS. 1 TO 4. A PROBLEM IN GAGEMAKING

The toolmaker was a good workman, inasmuch as he usually made good tools; but handbooks with their reference tables and formulas were to him a mystic code. However, after much labor and manipulation with height gage, dividers, hammer, prick punch and so on, he produced the piece. He had laid off the lines and worked to them as closely as possible. I felt sure that he did not keep within the 0.001-in. limit allowed for error; therefore, I figured what the dimension *C*, Fig. 2, should be. This dimension obtained, I checked his templet and found that he had accumulated an error of 0.009 inch.

In Fig. 3 I have shown the simple manner in which I determined the dimension *C*, Fig. 2. I scribed a circle and laid it off, as shown. Subtracting the dimension 0.065 in. from the dimension 0.916 in., I obtained the dimension 0.851 in., Fig. 3. I then saw that in order to obtain the dimension *B* it was simply necessary to determine the dimension *C*, add this to 0.851 in. and subtract the product from the radius of the circle, 1.469 in. As the radius of the circle is equal to the hypotenuse of the triangle, a known dimension, and as one side of the triangle is also known, the other side of the triangle is easily found. This gave me the dimension *D*, or 1.388 in. Thus, $1.469 - 1.388 = 0.081$ in., or dimension *C*. Therefore, $1.469 - (0.851 + 0.081) = 0.537$ in., which is the dimension of the piece.

An excellent method of machining such a templet to size is illustrated in Fig. 4. A piece of flat stock may be turned to 2.938 in. outside diameter, then sawed off below the line *A* and ground to dimension, 0.618 in. The dimension *B* may then be carefully determined, and from this dimension 2×0.479 in. is subtracted. The remainder divided by 2 equals the dimension *C*. Surplus stock may be sawed off and the piece ground to dimension *C*. This will finish the piece.

Design of Laps for Small Holes

By Gustave A. Remacle

Referring to Mr. Ackerman's article on page 758, Vol. 46, the type of lap described by him possesses some very good qualities, but may be improved slightly without altering the general principle of construction.

In constructing such a lap, the smaller hole should be drilled to a depth slightly beyond the farthest extremity, while the larger hole should be drilled to a depth midway between the extremities of the slots. It is at the point where the larger hole terminates that the greatest expansion of the lap takes place. If the point of greatest expansion is midway between the extremities of the slots or nonexpandable portions of the lap, then when the lap is expanded, it will taper gradually and evenly from the center to the portions of the lap that do not expand. If, on the other hand, the point of greatest expansion is located too near either of the points that cannot expand, then the lap will increase too abruptly in size, and this is a condition to be avoided.

If facilities are at hand for slotting the lap with a small circular saw, three slots should be made in preference to any other number. A three-legged stool is the only kind that can be guaranteed against rocking, and likewise a lap with three slots is the only slotted lap that may be guaranteed against rocking. If a lap contains four slots, uneven expansion will cause it to bear at only two opposite points, thus permitting a rocking or wabbling action that is undesirable, while one containing three slots will surely touch at all three points.

I have obtained excellent results with this type of lap, bell-mouthed holes being easily avoided.

Wanted—A Master Hand

An Editorial

ONE of the main indications of a well-ordered business is a thorough co-ordination of its various activities and a hearty co-operation of its different departments. And this is of vital importance in time of business stress or in critical periods.

Yet this co-ordination and co-operation, which are so vital to the vigorous prosecution of the war to a speedy finish, are notably lacking in many of the preparations that are now under way.

Work is being duplicated by different committees; gage inspection is being scattered instead of centralized; the army and navy bid against each other for delivery and occasionally in price; red tape, seniority and precedent stand in the way of the hearty co-operation that makes for the most efficient conduct of any business.

We do not question the motives of any of the men who are engaged in the work. But hell is said to be paved with good intentions. What we need now, and will need for two or more years to come, is Results. The same kind of results that any business man would demand of his assistants in a crisis which meant success or failure of the concern.

If his assistants did not pull together, he would not discharge them all and deprive himself of their experience, but he would get a manager who knew how to handle big problems and who could secure the co-operation of all departments, using drastic methods if necessary.

England solved the problem by appointing Lloyd George as Minister of Munitions. Not because he understood the theory and technicalities of artillery and ammunition, but because he knew how to handle men, because he knew how to use the technical talent that was available, because he knew how to tackle a big problem in a big way and to get things done.

We entered this war April 6, 1917. Look up the serial number of the Springfield rifle of this date and the serial number of the Springfield of today and see how many have been delivered during these vital five months. Ask the Ordnance Department how many of the new U. S. Enfields are ready for the National Army that is now gathering. Ask the Ordnance Department how many Lewis machine guns, the discarded American invention whose merits were recognized abroad but not at home, are ready for our use. Ask the Ordnance Department how recently and how many times the gages have been changed for the new rifle cartridge. And with all of these questions ask them—WHY.

Is it not time we profited by England's example, when we know that delay means the loss of precious lives and added cost of the war?

We have plenty of trained talent available. There is none better in any country of the globe. There are excellent men among the officers of both the army and the navy as well as among civilian engineers. But the present bureaucratic system makes it impossible for them to co-operate so as to secure the best results. A master hand is needed in the shape of an open-minded executive with wide experience in co-ordinating different departments and in handling big business problems in a broad way.

Such an executive should have ample funds available for any kind of war work that may become necessary, without waiting for Congress to pass special appropriations for each specific purpose.

He should give periodical accounting of such expenditures, but should not be hampered by lack of available funds for immediate work.

With such a man in control, we feel sure that Congress can be depended on to be extremely liberal with appropriations. It is not to be blamed for questioning appropriations as long as the present unsatisfactory and inefficient methods continue.

We are all stockholders in this great corporation known as the United States of America. Let us insist on applying at least as good methods as we demand in our own business, which becomes insignificant in comparison. The time has come to put the right man in charge of all munitions and end the inevitable delays and inefficiency of the present system. The right man will utilize all the experience of valuable men now in the work and as many more as may be necessary.

Delays mean needless loss of life, unnecessary sorrow and suffering, and war taxes that may be avoided.

SHOP EQUIPMENT NEWS

Moline Cylinder Boring and Recessing Machines

The Moline Tool Co., of Moline, Ill., is now marketing the engine-cylinder boring and recessing machines illustrated.

Fig. 1 shows the No. 7 boring machine equipped with four boring heads, but these may be removed or added to as conditions require. In order to save time, a mechanism is incorporated which gives a quick approach of the cutters to the work and a quick return to the starting point after the completion of a cut. Safety stops are provided to prevent an overtravel of the heads in either direction. As will be noticed, the saddle is counterweighted, differential pulleys being used to reduce the size of counterweight required. The thrust on both the driving worms and the elevating screws is carried on ball bearings. The rapid feed is operated by separate pulleys and belts.

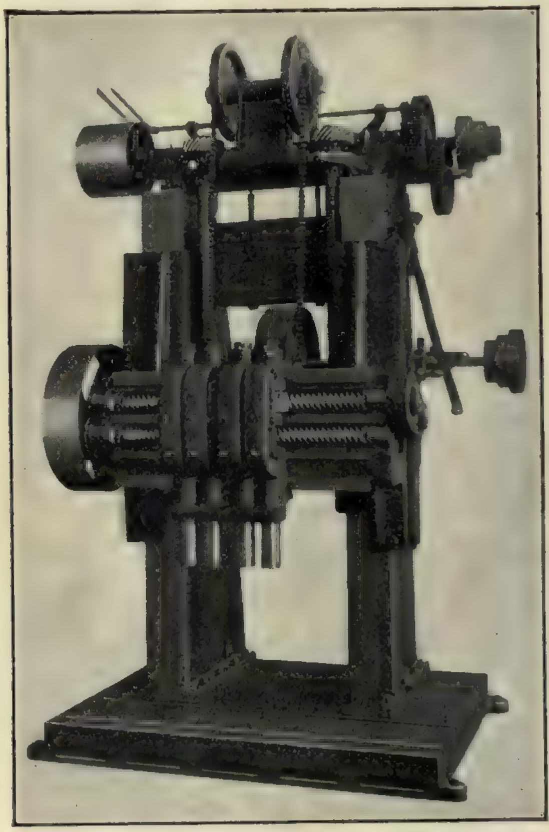


FIG. 1. CYLINDER-BORING MACHINE

Number of spindles, as required; countershaft speeds, 300 and 500 r.p.m.; maximum tool travel, 28 in.; maximum distance from base to bottom of crossrail, 5 ft.; maximum distance between centers of outside spindles, 32 in.; positive stops for up and down movement; two belts, one for feed and one for cutters; floor space, 7 ft. 6 in. by 6 ft.; weight boxed, 12,000 lb.

Fig. 2 illustrates the cylinder-recessing machine. It is shown equipped with six spindles, but it may be adapted to work with a less number of cylinders if so desired. On this machine the boring head is stationary, the table and work being elevated, an adjustment that is accomplished either by power or by the large spoked handwheel at the front of the machine. On the end of the shaft carrying the rapid elevating cams is a crank that operates the recessing cutter feed. Beneath the table, which is provided with T-slots, is a shaft carrying worms meshing with wheels on the two vertical screws giving the fine vertical table adjustment. The uprights are of T-section, and the base is cast in the form of a pan to catch the lubricant and prevent it from being wasted.

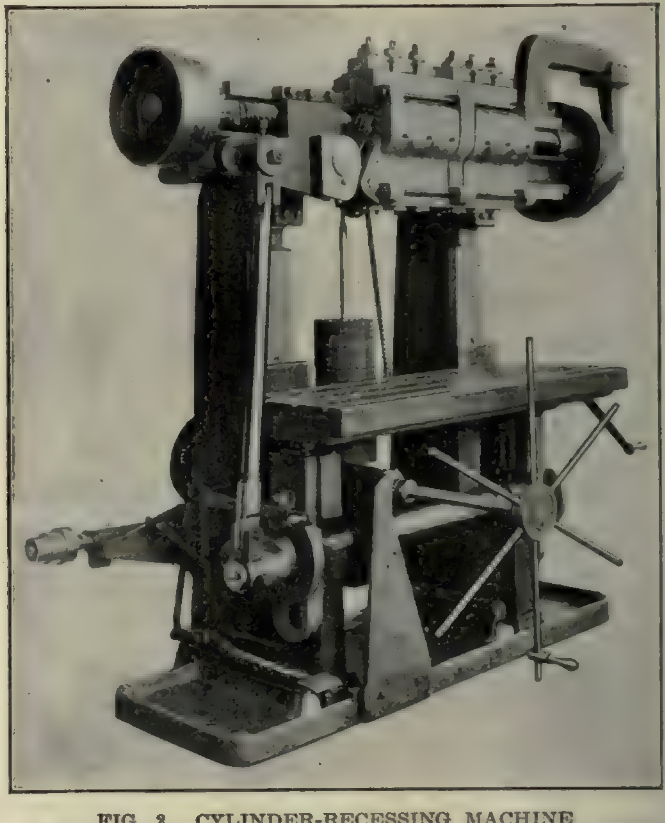
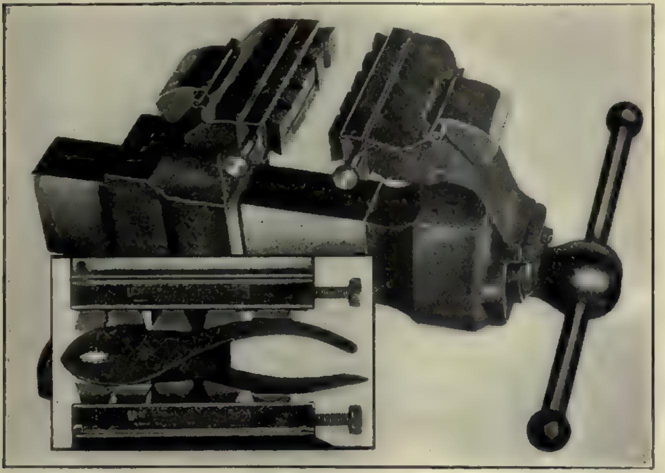


FIG. 2. CYLINDER-RECESSING MACHINE

Number of spindles, six or less; diameter of countershaft pulley, 12 in.; diameter of driven pulley, 20 in.; speed of countershaft, 420 r.p.m.; floor space, 72 x 48 in.; weight boxed, 7500 lb.

Universal Vise Equalizer

The Universal Equalizer Co., Bell Block, Cincinnati, Ohio, is marketing the vise attachment shown in the illustrations. The device is applicable to any ordinary machine-shop vise and permits the holding of pieces of irregular shape or form. The insert shows it gripped on a pair of pliers. It will also hold round work up to the capacity between the jaws.

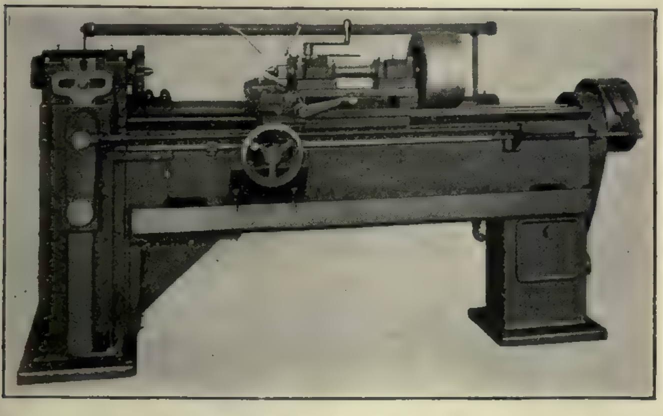


VISE EQUALIZER AND THE WAY IT WORKS

It will be noticed that the small grips at one side have a specially shaped corner, which is used for gripping small round stock. Tapered parts may also be held. The same principle is used for planer and milling-machine and shaper sets. The latter is provided with a special leveling device for setting work to a taper or for permitting the operator to level up uneven castings and at the same time grip them from both sides.

Moline Worm-Hobbing Machine

A novel worm-hobbing machine is being placed on the market by the Moline Tool Co., Moline, Ill. This machine has adjustments that enable it to handle work up to 56 in. in length and 13 in. in diameter. It uses a straight hob that is automatically fed into the worm, the latter being completed upon one revolution. It is possible to handle worms up to 6 in. in length and with pitches up to 8 without difficulty.



HOBBING MACHINE

Maximum length of thread, 6 in.; maximum distance between centers, 56 in.; pitch cut, up to 8 right or left; maximum diameter of work, 13 in.; ratio of reverse, 2 to 1; speed of countershaft, 350 r.p.m.; diameter of hob pulley, 12 in.; diameter of countershaft drum, 4 in.; diameter of pulley, 13 in., floor space, 96 x 36 in.; weight, 4300 lb.

The machine is practically automatic in action. The only operations necessary are to place the work between centers and throw in the feed lever. Another important feature of this machine is the mechanism that controls the lead of the worm being cut. The ratio of the lead on the setting bar (shown at the left in front of the headstock) to the lead of the worm is 22 to 1, so that a variation of 0.022 in. in setting up the bar will show a variation of but 0.001 in. in the lead of the finished worm. The pulley that operates the hob is driven from an overhead drum which permits the belt to travel as the carriage is moved to different locations on the machine bed.

Davis Close-Coupled Lathe

The machine shown in Fig. 1 has been designed to meet the requirements of a modern toolroom. The bed is ribbed transversely with heavy, double-wall crossgirts, regularly spaced, to resist strains. The rear end is made to permit sliding the tailstock off without disengaging the clamping bar or removing the bolts.

The headstock is a heavy one-piece casting having solid boxes with front and rear walls brought up to the center line of the spindle, thus tying the whole head together in a most substantial manner. The gear guards are made integral with the head and form a cover for the cone. In the top of the gear guard is mounted a brake for stopping the spindle.

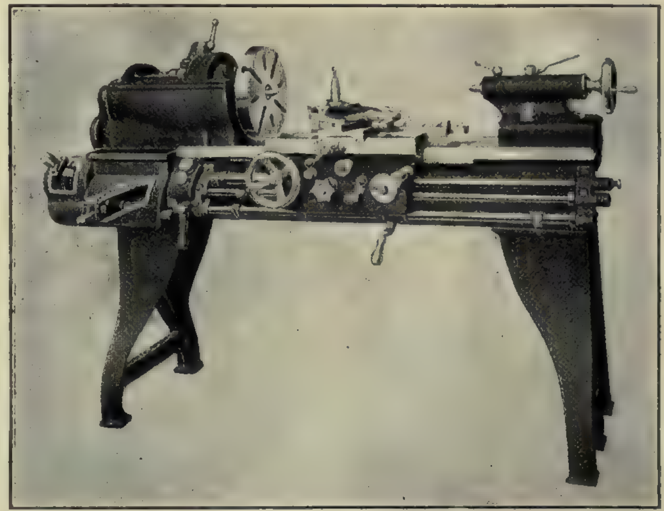


FIG. 1. CLOSE-COUPLED LATHE

Swing over bed, 14¾ in.; swing over carriage, 8¾ in.; distance between centers with 5½-ft. bed, 27⅞ in.; hole through spindle, 1½ in.; front bearing, 3.02 x 4 1/16 in.; rear bearing, 3.09 x 2 31/32 in.; centers, No. 8 Jarno; cone diameters, 4 to 9 in.; width of face, 2⅛ in.; back-gear ratio, 8 to 1; spindle nose, 2⅜ in. in diameter, 6 threads per in.; diameter tailstock spindle, 1⅝ in.; travel of tailstock spindle, 6 9/16 in.; cuts thread 1½ to 80; capacity of center rest, 3⅝ in.; floor space, 28 in. by 6 ft.; net weight, 1450 ft.

The spindle is made from high-grade crucible steel, turned all over and ground to micrometer size. A 1½-in. hole is bored its entire length, with the front end bored to No. 8 Jarno taper.

The back gears are placed under the headstock at the front end of the spindle, as shown in Fig. 2. This arrangement applies the drive from the cone through the gears without the long eccentric shaft and quill used on most cone-driven lathes, thus eliminating all torsional strains. The back gears are brought into mesh by a handle placed on the front at the right of the gear box, making it unnecessary for the operator to reach over the cone, as in the old construction.

The carriage has a bearing on the ways of 19¼ in., with a crossbridge 6 in. wide. The compound-rest swivel base is graduated and provided with four clamping bolts for locking in position. Full-length taper gibs are provided in both cross and compound slides with an end screw and adjustment for taking up wear. The apron is of the double plate type, with two bearing supports for all shafts.

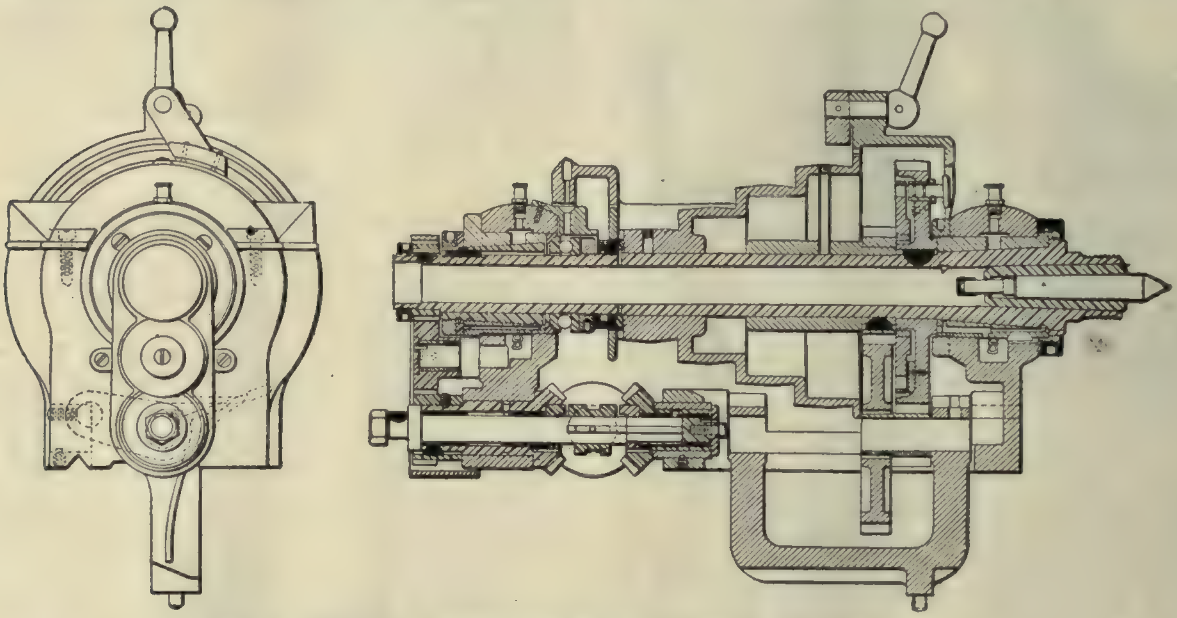


FIG. 2. DETAILS OF HEAD, SHOWING POSITION OF BACK GEARS

Screw cutting provides for a range of threads from 1½ to 80 per inch, including 11½, instantly obtained through the quick-change gear box. Thirty-six leads are regularly supplied, but others can be cut by changing gears on the quadrant. The lead screw is 1¼ in. in diameter and is guaranteed for accuracy, the maximum error allowed being 0.001 in. in 12 in. The lead screw is used only for cutting threads and can be locked out when not in use, so is not subjected to unnecessary wear.

The feeds are obtained through an independent feed rod and the quick-change gear box, without the use of lead screws. They are 36 in number and vary from 4½ to 240. The feed rod can be locked in or out by means of a clutch placed next to the gear box.

The automatic stop for the carriage is obtained through the same rod that operates the reverse mechanism. Adjustable collars permit the lathe to be used for duplicate or shoulder work. The tailstock is cut away on one side to permit the compound rest to be set parallel with the bed. It is very heavy and substantial and is locked to the bed by two ⅝-in. bolts. The upper part is arranged for setting over for taper turning.

The alignment of a lathe is a difficult thing to maintain, unless great care is exercised to see that the lathe always stands perfectly level. If the lathe is bolted to an uneven floor, it cannot turn nor bore true. To guard against disalignment a foot is placed in the center of the right leg, which carries the lathe on a three-point support. This assures the lathe being free from strains due to bolting, or even standing on an uneven floor. To overcome any rocking tendency, the outer ends of the right-hand leg are supplied with adjusting bolts, which can be screwed down until they just touch the floor without taking any of the weight.

The regular equipment consists of a 5-ft. 6-in. bed, large and small faceplates, compound and steadyrests, one set of round centers, double friction countershaft and the necessary wrenches.

At an extra cost a taper attachment, draw-in chuck and collets up to 1 in. in capacity, oil-pan bed, oil pump, follow rest, transposing gears for cutting metric threads and relieving attachment for backing off taps and milling cutters will be furnished.

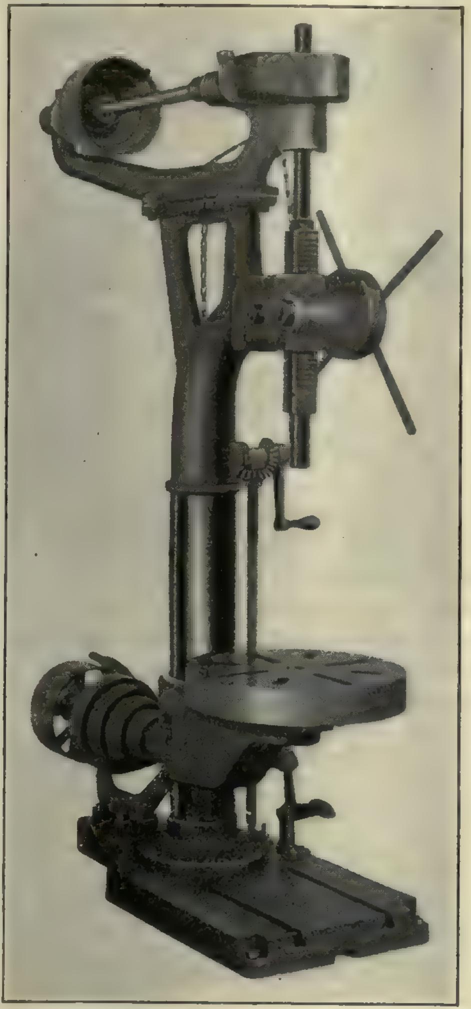
A motor mounted over the headstock and geared to the spindle through a train of gears which provide four mechanical changes of speed obtained by sliding clutches will be furnished when specified with order. A further range of speed is obtained through the motor, which should have a variation of from 500 to 1500 r.p.m.

This machine was described on page 214, under the head "The Davis Close-Coupled 12-Inch Lathe." The specifications, however, were not correct, and the lathe was credited to the wrong concern. It is being manufactured by the Davis Machine Tool Co., Inc., Rochester, N. Y.

Moline 20-Inch Drilling Machine

The illustration shows a 20-in. drilling machine that is now being marketed by the Moline Machinery Co., Moline, Ill. The machine is intended especially for manufacturing purposes and is supplied with either power or lever feed, as desired. The spindle is driven by a worm and gear, a construction that has been used in order to insure smoothness and quietness of running.

The usual type of swing table is provided, which allows work to be fastened to the base of the machine.



MOLINE 20-INCH DRILLING MACHINE

Spindle traverse, 8½ in.; maximum distance spindle to base, 39 in.; maximum distance, spindle to table with table at its lowest point, 24 in.; diameter of sleeve, 2¾ in.; speed of lower cone, 500 r.p.m.; capacity, drills to center of 22-in. circle; taper hole in spindle, Morse No. 4; shipping weight, 750 lb.

Elevation of the table is accomplished by means of a crank and gear-driven screw. A belt shifter is placed on the rear of the lower cone pulley shaft and is operated by a foot lever which may be seen at the right side of the machine.

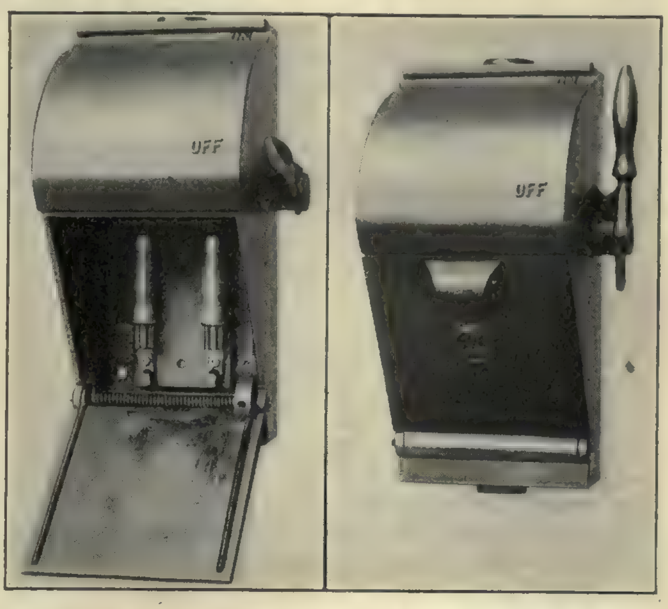
Westinghouse Safety Switch

The knife switch illustrated, which is so constructed that all live parts are totally inclosed and inaccessible except in case of real need, is the product of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn. The device consists of an ordinary single-throw knife switch and fuse holders inclosed in a cast-iron box with an operating handle outside of the housing.

The box is designed for conduit connection and has a partition separating the switch blades from the fuses. The upper, or switch, compartment can only be opened by removing two machine screws, while the door to the fuse compartment may only be opened while the operating handle is in the off position. When the door of the fuse compartment is open, it is impossible to close the switch. Means are also provided for locking the switch handle in position to prevent tampering by unauthorized persons.

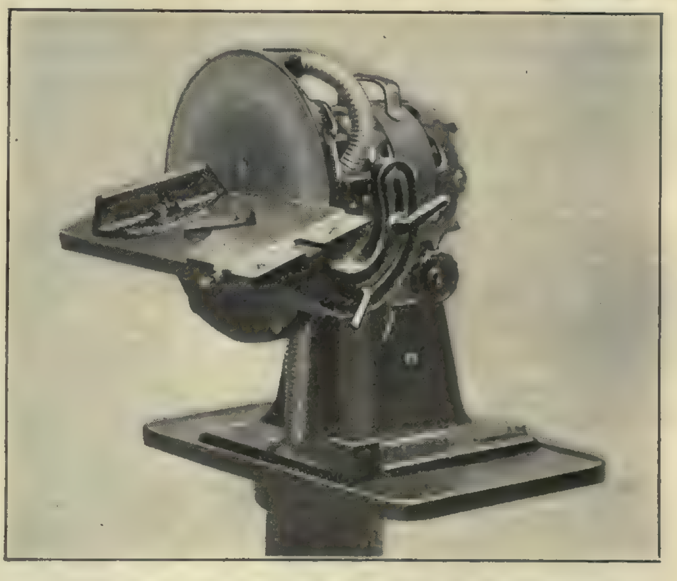
"Pioneer" Disk Grinding Machine

The 15-in. disk for woodworking grinding machines, shown in the illustration, is the product of Carter & Buchholz Co., Inc., Syracuse, N. Y. It is particularly adapted for patternmaking, cabinetmaking and other fine woodworking establishments and may be utilized in making joints, fitting bevels, grinding draft on patterns and other similar types of work.



FIGS. 1 AND 2. WESTINGHOUSE SAFETY SWITCH WITH FUSE-COMPARTMENT DOOR OPEN AND CLOSED

A self-contained automatic vacuum dust-removing system is installed, which collects the dust and carries it to the hollow base of the machine. The tilting table is operated by a small handwheel, and a graduated gage is provided. The end thrust on the disk shaft is carried by a ball thrust bearing. A centering gage is also supplied, which permits the handling of core prints, bosses and like work. The machine is also made in the 9-in. size.



DISK GRINDING MACHINE FOR WOODWORKING

Swivel of table, 15 deg. up and 45 deg. down; horsepower of motor, 9-in. machine, ⅓; 15-in. machine, ½; size of table, 9-in. machine, 5 x 11½ in.; 15-in. machine, 7½ x 19 in.; rise and fall of table, 9-in. machine, 4½ in.; 15-in. machine, 7½ in.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Hotel Powhatan, Washington, D. C., Sept. 15, 1917—We are breaking traditions and precedents so rapidly that many of the new movements along this line receive scant attention. The breaking ground for the projectile and armor-plate plant at Charleston, W. Va., however, is such a huge undertaking, involving as it does something like fifteen million dollars, that it deserves more than a passing notice, particularly as it is to become a permanency among Government institutions.

As pointed out by Secretary Daniels, the breaking of ground to erect a plant for the making of projectiles and armor plates is a complete declaration of a new national policy in the making of weapons of war. It is the beginning of the fulfillment of the belief that the Government itself must be able to manufacture all kinds of weapons needed for national defense and the maintenance of national rights. This does not necessarily imply that the Government must be the sole manufacturer of munitions, but it does mean that it must have facilities for whatever it needs in whole or in part, as conditions demand.

This subject has been agitated for something over twenty years, being first emphasized by Senator Tillman, who was then chairman of the Naval Affairs Committee, when Congress even went so far as to make an appropriation for such a plant; but this appropriation had a string to it that was stronger than the Congressional authorization, and the plant itself failed to materialize.

DATE FOR COMMENCING OPERATION

The most interesting part of the proposition at the present time is that it is expected to have the projectile factory in operation next April and that the armor-plate plant will begin to turn out its products within 18 or 20 months. This plant will also serve as a laboratory for experiments both in armor plate and in projectiles, and any secrets that may be discovered in this connection can in this way be kept solely for the use of the American navy and the nation. It is to be hoped that care will be taken to secure the very best mechanical ability of the country for this work, so that the plant may be conducted on a thoroughly business basis and be entirely free from the bureaucratic red tape that has heretofore surrounded so many institutions of this kind. This is perfectly possible under the proper organization, and we have faith that the Secretary of the Navy will take the proper steps to insure management of this kind.

The old saying about "distance lending enchantment" is a very human failing that has probably existed since the race began. At the present time this seems to be true in some quarters with regard to the work being done by the National Physical Laboratory in England and by our own Bureau of Standards in Washington. The former is being loudly praised in some quarters for the great assistance it has been to the British Government during these years of stress, while the Bureau of Standards is being criticized as rendering comparatively little assistance. It is perfectly true that the National Physical Laboratory has done excellent work and deserves great credit therefor, but it is hardly fair to our own Bureau of Standards to criticize its alleged inactivities without knowing some of the excellent work that has been and is being done by it.

In addition to developing the process of making optical glass and of actually manufacturing it in sufficient quantities to relieve the anxiety of both army and navy, the bureau has also made many tests of materials and of instruments for both army and navy use.

INSPECTION DEPARTMENT FOR GAGES

There has also been organized, under Dr. Louis A. Fischer, a gage-inspection department for measuring and approving master gages for all sorts of munition work. This department has been carefully organized and is being well equipped as rapidly as possible, with the understanding that it is to be headquarters for all inspection of master gages needed by the various branches of the army service.

This department of the bureau is well organized and equipped to do this work; but unfortunately different ideas as to policy have cropped up, and there seems to be an attempt in several other quarters—namely, some of the arsenals—to make themselves the inspection department for the whole army or some of its branches. This duplication of work, as well as of men and equipment, is most unfortunate, and it is hoped that the proper coöperation will soon take place for the best interests of all concerned.

From all the information that seems to be available, the principal work of the National Physical Laboratory has been the establishment of a large gage-inspection department, such as was planned for by our own bureau, and an extensive research into the metallurgy of steel and other metals for use in projectiles and in the construction of various munitions of war. The laboratory has undoubtedly done excellent work, but from all appearances our own bureau has been engaged in a more diversified program and has been helpful to both army and navy in a wider range of subjects.

There is of course a tendency in all scientific research to look for and to demand workmanship and specifications much nearer perfection than it is possible to maintain commercially. These demands are probably helpful in pointing out the ideal and as suggesting improvements to be made in instruments of various kinds. It is, however, one of the weaknesses of any scientific institution that is given the task of inspecting commercial work, and it is a serious defect to be carefully guarded against. This very carefulness might make it an ideal place to inspect master gages, but the same demand on commercial work would reject many instruments perfectly well suited for the work they are required to perform. It is of course difficult for a man accustomed to scientific research to see things from the commercial point of view; but it is absolutely necessary in the inspection of products for everyday use and especially in times like these. Instead of striving for perfection the aim should be to see how little work and fine finish are necessary in order to secure perfect functioning of the piece under consideration.

This is not a criticism of the Bureau of Standards any more than of any other scientific institution of a similar kind. It is only a suggestion that, if the bureau is called upon to inspect airplane or other instruments, its inspecting staff shall thoroughly understand that they are not searching for perfection, but only for a sufficient quality of either material or workmanship to perform satisfactorily the duties required.

FRED H. COLVIN.

The Mechanic and the Draft

BY D. BAKER

The experience of the past few weeks—namely, the calling of eight men from our drafting department, which consisted of ten men—leads the writer to wonder if our Government is about to make the same mistake that England, France and even our common enemy, Germany, did at the beginning of the war. Is it forgetting that this is an age of machinery and that the war is a war of machines, a war that will be fought fully as much by the skilled mechanic, the engineer and the tool designer at home, as by the man of muscle and brawn at the front? Is it forgetting that even now there is a shortage of certain materials, not only at the front, but at home, which can only be made by the trained man working at the bench and machine?

Of the men who have been drafted from our organization there is no doubt that some might be spared. They might easily be replaced by others fully as efficient, for some were young men fresh from school, beginning their first year of actual practice—students yet, more dependent upon us than we upon them. But, on the other hand, two were among our best men, men of years of practical training, with the technical education to back up their experience, men such as are spoken of as one in a thousand. They are thorough mechanics, and with exceptional abilities as designers, either one or both of which not only require an inborn natural ability, but many years of training.

Are we thoughtlessly to sacrifice such men at the front, where they at the best can hardly be of more use than their brothers of little or no training? If this is to be done, what will be the result? In the instance cited, a tool-designing department of originally ten men, working on one of the most important of war materials, 3-in. shrapnel and high-explosive shells, will be left with but two men, one a blueprint boy who is below the conscription age and the other a tracer who is beyond the age. If other firms of a like nature have suffered in anything like the same proportion, the result will be just this, the one man in a thousand type will become the one in ten thousand.

To laymen, those men from other walks of life who, for the most part, make up the local exemption boards, these conditions are little apt to be apparent, and men will be chosen with little regard to their actual value to the country. On the other hand, to the mechanical superintendent, and especially to those of us who have had to recruit an entire organization within the space of a few weeks or months in order to meet the present war conditions, the taking away of men of this type is keenly felt, for we know how almost impossible it is to replace them.

As applying to this condition, the writer was interested a few years ago in an article that appeared in one of our leading trade journals. The statement was made that, if a large factory were obliged to increase its force of toolmakers to the extent of fifty first-class men, it would have to hire and try out at least a thousand men before getting the required number. Offhand, this seemed a large ratio; but the writer, a little later, made inquiry among a number of his friends, tool foremen, in charge of from fifty to a hundred toolmakers as to their opinion on this subject. The average of their replies was that it required the try-out of about fifty men to get one really first-class all-around toolmaker. The same inquiry made during the past year brought forth the information that it required anywhere from sixty to seventy-five men to produce one exceptional toolmaker. Actual experience by the writer in hiring toolroom help has fully borne out these statements.

As this is the case, and as these men are the material from which our present and future designers are made, and as the exceptional tool designer is usually the step ahead of the exceptional toolmaker and mechanic, I ask, Is all their training and experience to count for nothing, or are they to be wasted by the lack of judgment on the part of exemption boards?

To my mind it goes without question that such men as these of which I speak can be of far greater service to their country in their present positions than they could ever hope to be in the trenches. If they must be drafted, if it could be assumed that they were not playing their part in the country's welfare, then by all means let them be drafted from the board or bench or other positions in which they are not considered of vital importance to the nation and be placed in shops, factories and positions where their training will count. Place them in positions where their experience will be of benefit to the untrained—those men under or beyond the conscript age whom we are breaking in to the thousands of semiskilled positions that are the backbone of our munitions supply.

Let them, by the knowledge and skill that they can impart to their fellow workers, add a hundred-fold to the efficiency of our nation. In this way, we will also conserve them for the much-needed work of reconstruction that is to follow this war.

The Standard Airplane Motor

The new aviation engine, known variously as the "Standard," the "U. S. A." and the "Liberty," has become a reality and is perhaps the best example of intensive designing, building and testing of which we have any knowledge. It shows what can be done when engineers who thoroughly understand not only designing, but manufacturing, are placed in charge of such important work. The first motor was built and in running condition in one month from the time the drawings were begun; the designing had of course been largely accomplished before this, except as to details that came up as the final drawings progressed.

Without going into technical details as to the construction of the engine, which is not desirable at this time for various reasons, we may say that, as previously mentioned, it is an excellent example of what may be called "unit" construction. This refers not only to the cylinders, which can be combined on any size of engine base that may be desired (four, six, eight or twelve cylinder, or even more), but also to the parts such as valves, pistons, connecting-rods, valve-gear, oil-pumps, water-pumps and the like, all of which can be made in quantity and assembled as wanted.

In common with most of the high-grade and lightweight engines, the cylinder is of steel, made from a special forging instead of from the solid billet, as in the case of the Gnome. This is also true of some of the other parts, the question of rapid and economical manufacture evidently being always foremost in the minds of the designers, who deserve the utmost credit. The cylinders are set at 45 deg. instead of the 60 or 90 deg. to which we are usually accustomed, and the engine as a whole has a clean and workmanlike appearance that is a joy to the engineer or mechanic who is familiar with this kind of work.

As befits a thoroughly modern engineering product, welding plays a large part in its construction, this being particularly true of the water jackets, intake and exhaust connections and of the exhaust manifold. The ignition system is particularly interesting and is one of the indications that the designers have not been hampered by tradition in any way. The oiling system is also of interest and shows a development that is both simple and efficient, using forced feed in its simplest form and, incidentally, being very economical of oil.

Rigorous tests have been made on a number of these engines under all sorts of trying conditions, including long endurance runs, tests at high altitudes and other conditions which thoroughly test not only the power, but the staying qualities, of the new engine. All these tests have proved more satisfactory than seemed possible with a new product, although it of course is not "new" in the sense of being untried as to principles, for it combines the best practice of all previous engines of this type.

And, best of all, it is probably the lightest engine yet produced, being about 2 lb. per hp., and is so designed that it can be produced in enormous quantities in a large number of shops that are accustomed to large production of high-grade machinery. The designing and development of this engine form one of the most creditable pieces of work which has yet been accomplished, and we hope to be able to credit the designers by name at some future date. Such achievements are just as praiseworthy as many of a more spectacular nature, and should go down in the annals of the war just as much as other accomplishments that certainly contribute no greater part to its successful prosecution.

Personals

Thomas S. Garrett has resigned as manager of the machinery department of Gaston, Williams & Wigmore, Inc., 120 Broadway, New York City.

W. H. Sample has been appointed to succeed W. D. Robb as superintendent of motive power of the Grand Trunk Ry. with headquarters in Montreal.

R. F. Williams, formerly connected with Manning, Maxwell & Moore, Pittsburgh, Penn., has become associated with the sales department of Sherritt & Stoer Co., 603 Finance Building, Philadelphia.

B. F. Jacops has become associated with the American Machinery Syndicate, Hudson Terminal Building, New York City. Mr. Jacops was formerly associated with the New York Export Department of the Keystone Driller Co., Beaver Falls, Penn.

Business Items

Warren, Webster & Co., Camden, N. J., moved their Detroit office on Sept. 1 to 2123 Dime Bank Building, Detroit, Mich. **A. B. Knight** is in charge as district manager.

The Presto Machine Works, Inc., some of whose gagemaking work was described in a late number of the "American Machinist," have moved from the Sperry Building and are now located at 124-130 Pearl St., Brooklyn, N. Y.

Titanium Bronze Co., Inc., has recently been organized to take over the bronze department of the Titanium Alloy Manufacturing Co. The new company will specialize in titanium aluminum bronze and in worm-gear castings for truck axles. It will also manufacture parts, die cast from aluminum bronze.

Forthcoming Meetings

The twelfth annual exhibit of foundry and machine-shop equipment and supplies will be held under the auspices of the American Foundrymen's Association in the Mechanics Building, Boston, Mass., from Sept. 25 to 28, 1917. The officers of the exhibit committee are: President, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; vice president, Benjamin D. Fuller, Westinghouse Electric and Manufacturing Co., Cleveland, Ohio; secretary and treasurer, A. O. Backert, 12th and Chestnut Sts., Cleveland, Ohio; manager of the department of exhibits, C. E. Hoyt, 123 West Madison St., Chicago, Illinois.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. W. W. Poole, secretary, 40 Central St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

The annual congress of purchasing agents, under the auspices of the national association, will be held at Pittsburgh, Oct. 9 to 11. The program includes business sessions for the mornings and visitation and inspection of industrial works during the afternoons. Special features are: Tour of Pittsburgh's principal business districts by automobile during the late afternoon of the first day, and cabaret dinner in the evening, to be held at one of the country clubs. The banquet will be held at the Convention Hotel the evening of the second day, Oct. 10, with speakers of national prominence. All purchasing agents and others interested are welcome and expected to attend and participate in the activities of the convention. Special arrangements are planned for the entertainment of the ladies.

American and Canadian engineers and architects of Norwegian birth or descent will hold an informal congress at the Chicago Norske Klub, Chicago, Ill., Sept. 27 to 29. Correspondence should be addressed to Joachim G. Giaver, Railway Exchange Building, Chicago.

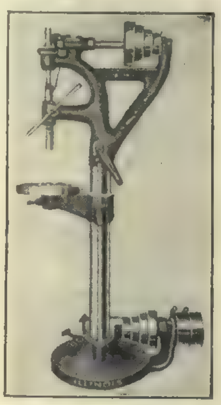
The National Machine Tool Builders Association will hold its sixteenth annual convention at the Hotel Astor, New York City, on Tuesday and Wednesday, Oct. 30 and 31.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Drilling Machine, 14-In.

W. W. Machine Works, Chicago, Ill.



"American Machinist," Aug. 30, 1917

Distance from center of spindle to column, 7⅛ in.; taper hole in spindle, No. 2 Morse; height, 68 in.; floor space, 20 x 30 in.; belt shifter, mounted on countershaft at the rear and operated by a foot lever at the left

Painting Equipment, Pneumatic (Spraco Form P-1)

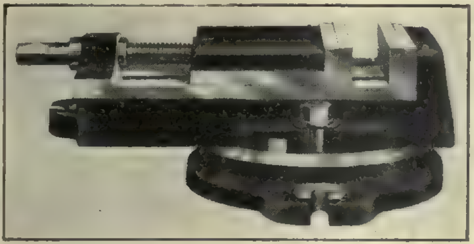
Spray Engineering Co., 93 Federal St., Boston, Mass.

"American Machinist," Sept. 13, 1917

A portable apparatus adapted for applying all kinds of liquid coatings from the highest grades of lacquer and varnish to heavy asphaltum and structural paints. Operates on compressed air at a pressure of from 35 to 75 lb. per sq.in., depending upon the material being used. Furnished with either a 3- or a 5-gal. paint container, or the gun may be removed and attached to a 1-qt. container for use on small work or where a variety of colors or materials is used. Extension pole furnished if desired

Vises, Machine

Moback Tool and Machine Manufacturing Co., 330 Atlantic Ave., Boston, Mass.

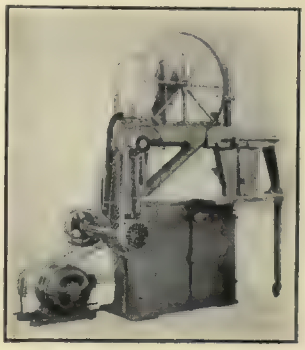


"American Machinist," Sept. 6, 1917

Made in a number of sizes and either with a swivel base, as shown, or with a plain base. Side ears are provided so that the vise may be used either way of the table. Jaws are hardened and ground and are removable

Saw, Band Re-Saw (15-R 38-In.)

Oliver Machinery Co., Grand Rapids, Mich.

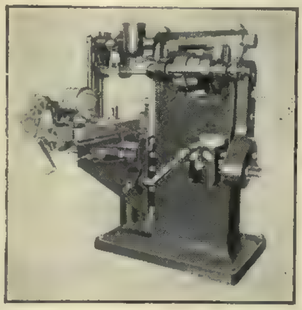


"American Machinist," Sept. 13, 1917

This machine is known as the No. 15-R 38-in. combination resaw and band-saw. Floor space, 60 x 47 in.; table, 40 x 36 in.; height of table, 40 in.; tilt of table, 45 deg. one way, 5 the other; auxiliary table, 21 x 22 in.; diameter of wheels, 38 in.; stock handled, 16 in. wide by 8 in. thick; length of saws accommodated, 18 to 20 ft.; horsepower required, 5 to 10; weight crated, 4000 lb.; drive, either belt or motor as desired

Miller (Universal No. 2)

Ford-Smith Co., Ltd., Hamilton, Ont.

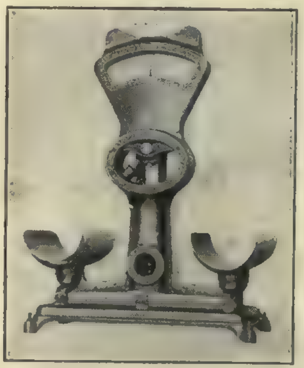


"American Machinist," Sept. 6, 1917

Working surface of table, 41½ x 10 in., equipped with three ⅝-in. T-slots; longitudinal feed, 25 in.; crossfeed, 8 in.; vertical feed, 18 in.; face of column to brace, 25 in.; diameter front spindle bearing, $2\frac{15}{16}$ in.; spindle speeds, twelve, 12 to 360 r.p.m.; diameter overhanging arm, 3¾ in.; overhanging arm to center of arbor, 8 in.; width of belt, 3 in.; feeds, nine, 0.006 to 0.055 in. per spindle revolution; floor space, 81 x 98 in.; weight, 3150 pounds

Scales, Munition and Shell

Computing Scale Co., Dayton, Ohio, manufacturer; Moneyweight Scale Co., 326 West Madison St., Chicago, Ill., sales agent

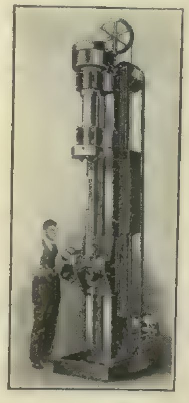


"American Machinist," Sept. 13, 1917

With this device a master or standard weight is placed in one scale pan; and when the shell is placed in the other pan, the amount it weighs either over or under the master weight may be read directly from the scale, which is graduated to read in steps of $\frac{1}{16}$ oz, for weights up to 4 ounces

Drilling Machines for Spindles

Charles Stecher Co., 1574-80 Crossing St., Chicago, Ill.



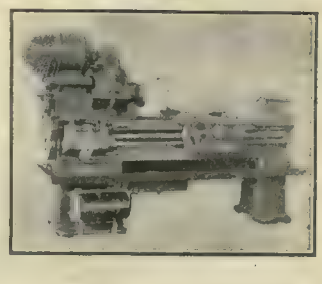
"American Machinist," Sept. 13, 1917

Designed particularly for use in boring out recoil cylinders, artillery axles and work of like nature, but is applicable to other types of work. It is similar to the machine described on page 479, Vol. 46, except that it is considerably larger, accommodating stock up to 5 in. in diameter, the maximum length of hole bored being 64 in. The spindle has two plain and two ball thrust bearings and is equipped with two chucks. The traveling head carrying the boring bar is counterweighted to permit easy operation

Lathe, Heavy-Duty 16-In.

Oliver Machinery Co., Grand Rapids, Mich.

"American Machinist," Sept. 13, 1917



A motor-driven 16-in. heavy-duty lathe to which a number of improvements have recently been added. The headstock casting has been changed, and new gear covers are furnished. A lubricant reservoir is now used on the under side of the oil pan, and oil wipers have been incorporated in the carriage. Swing over shears, 17½ in.; swing over carriage, 10½ in.; distance between centers, 38½ in.; spindle speeds, eighteen, 14 to 335 r.p.m.; feeds, 32; backgear ratios, 2.9 and 9.02 to 1; front spindle bearing, 3⅝ x 5 in.; hole through spindle, $1\frac{5}{16}$ in.; rear spindle bearing, 2⅜ x 3¾ in.; cuts threads, 3 to 46; weight crated, 3600 pounds

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Sept. 15, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$47.00	$47.00	$14.50
No. 2X Northern Foundry, Buffalo	53.00	53.00	19.75
No. 2 Northern Foundry, Chicago	55.00	55.00	19.00
*Bessemer, Pittsburgh	52.95	55.95	21.95
*Basic, Pittsburgh	48.95	53.95	18.95
No. 2X, Philadelphia	53.00	53.00	19.50
*No. 2, Valley	53.00	53.00	18.50
No. 2, Southern Cincinnati	49.90	49.90	17.40
Basic, Eastern Pennsylvania	50.00	50.00	19.75

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Sept. 15, 1917	One Month Ago	One Year Ago	Sept. 15, 1917	One Year Ago	Sept. 15, 1917	One Year Ago
Structural shapes	$5.25	$5.25	$3.25	$5.00	$3.25	$5.00	$3.10
Soft steel bars	5.00	5.00	3.30	4.50	3.30	4.50	3.10
Soft steel bar shapes	5.00	5.00	3.25	4.50	3.25	4.50	3.10
Plates, ¼ to 1 in. thick	10.00	10.00	4.50	7.00	4.00	9.00@10	3.50

BAR IRON—Prices per 100 lb, at the places named are as follows:

	Sept. 15, 1917	One Year Ago
Pitttsburgh, mill	$4.75	$2.60
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

		New York			Cleveland		Chicago	
	Pittsburgh, Mill, in Carloads	Sept. 15, 1917	One Month Ago	One Year Ago	Sept. 15, 1917	One Year Ago	Sept. 15, 1917	One Year Ago
*No. 28 black	8.00- 9.00	10.50	10.50	3.65	9.00	3.40	10.00	3.35
*No. 26 black	7.90- 8.90	10.40	10.40	3.55	8.90	3.30	9.90	3.25
*No. 22 and 24 black	7.85- 8.85	10.35	10.35	3.50	8.85	3.25	9.85	3.20
No. 18 and 20 black	7.80- 8.80	10.30	10.30	4.45	9.20	3.20	9.80	3.15
No. 16 blue annealed	8.20- 9.20	10.20	10.20	4.45	9.20	3.70	10.20	3.60
No. 14 blue annealed	8.10- 9.10	10.10	10.10	4.35	9.10	3.60	10.10	3.50
No. 12 blue annealed	8.05- 9.05	10.05	10.05	4.30	9.05	3.55	10.05	3.45
No. 10 blue annealed	8.00- 9.00	10.00	10.00	4.25	9.00	3.50	10.00	3.40
*No. 28 galvanized	10.00-10.50	12.00	12.50	5.00	10.75	4.70	11.50	4.75
*No. 26 galvanized	9.70-10.20	11.70	12.20	4.70	19.45	4.40	11.20	4.45
No. 24 galvanized	9.55-10.05	11.55	12.05	4.55	10.30	4.25	11.05	4.30

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Sept. 15, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	45%
Cleveland	40%	45%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Sept. 15, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	14.30	6.30
Chicago	13.50	5.50

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

* Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

***Special Welding Wire**

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Sept. 15, 1917	Cleveland Sept. 15, 1917	Chicago Sept. 15, 1917
Tire	5.00	5.00	4.50
Toe calk	5.70	5.50	4.75
Openhearth spring steel	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜	42%	15½%	¾ to 1½	33%	17%
½	46%	31½%			
LAP WELD					
2	42%	29½%	2	26%	12%
2½ to 6	45%	32½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	38%	20½%	¾ to 1½	33%	18%
½	43%	30½%			
¾ to 1½	47%	34½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4	43%	31½%	2¼ to 4	29%	17%
4½ to 6	42%	30½%	4½ to 6	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	38%	25%	38.8%	24.8%
3½ to 6 in. steel lap welded	18%	List	23%	39%	42.8%	27.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Sept. 15, 1917	One Month Ago	One Year Ago
Copper, electrolytic	27.00*	28.50	29.00
Tin, in 5-ton lots	62.00	63.75	39.00
Lead	9.75	11.00	6.75
Spelter	8.25	8.75	8.50

*26.50c. for last-quarter copper.

ST. LOUIS

	Sept. 15, 1917	One Month Ago	One Year Ago
Lead	9.50	10.75	5.87½
Spelter	8.00	8.25	9.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Sept. 15, 1917	One Month Ago	One Year Ago	Sept. 15, 1917	One Year Ago	Sept. 15, 1917	One Year Ago
Copper sheets, base	35.00	39.00	37.50	38.00	38.50	38.00	38.00
Copper wire (carload lots)	38.50	38.50	32.00	38.00	33.00	38.50	33.50
Brass pipe, base	43.00—45.00	43.00	46.50	46.00	45.00	44.00	45.00
Brass sheets	40.00	40.00	44.50	37.00	42.00	39.50	39.00
Solder ½ and ½ (case lots)	39.25	39.25	24.62½	39.50	24.75	39.25	24.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Sept. 15, 1917	One Year Ago
Mill	$30.00	$42.00
New York	35.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

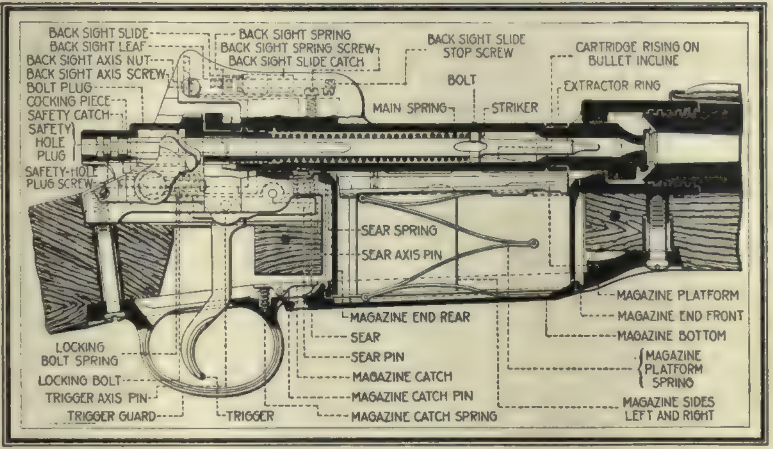
	In Casks		Broken Lots	
	Sept. 15, 1917	One Year Ago	Sept. 15, 1917	One Year Ago
New York	21.00	17.00	21.50	18.00
Cleveland	23.00	16.75	23.25	17.50
Chicago	22.50	17.00	23.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

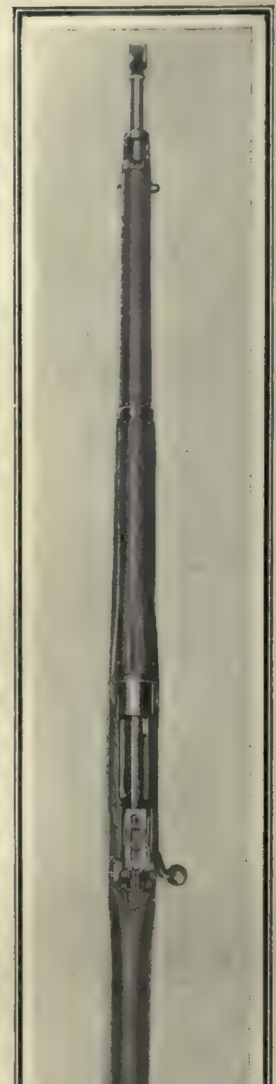
	Sept. 15, 1917	One Year Ago
New York	14.50	13.50
Cleveland	16.50	13.00
Chicago	16.00	13.50

The Modified Enfield Rifle

Model 1917



SYNOPSIS—*Owing to the fact that the Springfield rifle, model 1903, cannot be produced in sufficient quantities, the Government has decided to adopt a modification of the English Enfield rifle, chambered for our regular cartridges. This article shows the rifle and its mechanism and also describes the action.*



THE rifle that is to be used by our troops abroad is a modification of the English Enfield rifle, model of 1914, adapted to use the United States standard caliber .30 ammunition. The receiver and bolt are of 3½ per cent. nickel steel and are somewhat larger than in the United States Springfield. While differing in general design, they have the same functioning features of side ejection and rotating motion of bolt in loading and extracting.

The barrel, made of what is known as smokeless barrel steel of practically the same specifications as for the United States Springfield, is 2 in. longer than the Springfield barrel. The bayonet is 1.125 in. longer, and the assembled rifle with bayonet is 4.125 in. longer than the United States Springfield. The magazine is practically a duplicate of the United States Springfield and uses the same cartridge clip in loading, which carries five cartridges.

The rear sight is located on the top rear end of the receiver, increasing the sight radius 9.548 in. over that of the Springfield, which has the rear sight located on top of the breech end of the barrel. The location of the sight on the receiver brings it closer to the eye.

The bolt lever is shown projecting at the right. In operating the bolt, this lever is brought to a vertical position and pushed out or in. Cartridges placed in the magazine are pushed upward to the feeding mechanism

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by means of the spring shown. The bolt moves backward and forward, as moved by the operator, and rotates in the well of the body. It carries either a cartridge from the magazine or one placed by hand in front of it into the chamber and supports the head of the cartridge when fired. The bolt plug unites the parts of the bolt mechanism, and its rotation with the bolt is prevented by lugs on its sides coming in contact with the body.

The hook of the extractor engages in the groove of the cartridge case and retains the head of the latter in the countersink of the bolt until the case is ejected. The safety catch, when pushed forward, causes the mechanism to become inoperative. When drawn rearward, the end of the locking bolt enters a hole in the shank of the bolt lever and locks the bolt. At the same time the inner end of the spindle of the safety catch engages a cam cut in the cocking piece and draws the latter slightly to the rear, out of contact with the sear, and locks the striker.

The Bolt Mechanism

The bolt mechanism operates as follows: To open the bolt, raise the handle until it comes in contact with the left side of the body and pull directly to the rear until the top locking lug on the bolt strikes the bolt stop. Raising the handle rotates the bolt and separates the locking lugs from their locking shoulders in the body, with which they are brought in close contact by the gas pressure. This rotation causes the cocking cam of the bolt to force the striker to the rear, drawing the point of the striker into the bolt, rotation of the cocking piece being prevented by the rib on its lower side projecting through the slot in the bolt plug into its groove in the body. As the bolt plug remains longitudinally stationary with reference to the bolt, this rearward motion of the striker starts the compression of the mainspring, since the rear end of the latter bears against the front end of the barrel of the bolt plug, and its front end against the collar near the front of the striker. When the bolt strikes the body, the locking lugs have been disengaged, the striker has been forced about ¼ in. to the rear and the nose of the cocking piece catches in a notch at the terminus of the cam on the bolt. During the rotation of the bolt a rearward motion has been imparted to it by its extracting cam coming in contact with the extracting cam on the body, so that the cartridge will be started from the chamber. The bolt is then drawn directly rearward, the parts being retained in position by the nose of the cocking piece remaining seated in the notch in the bolt. To close the bolt, push the handle forward until the extracting cam on the bolt bears against the extracting cam on the body.

Ejection of the Shell

During the forward movement of the bolt the sear engages the cocking piece, the compression of the mainspring is completed and the nose of the cocking piece disengaged from the notch in the bolt, permitting the bolt handle to be turned down to the locked position. After firing, when the bolt is drawn rearward, the ejector is forced by its spring to the right, into the path of the cartridge, the rear end of which strikes the ejector and is ejected to the right from the body.

It will be noticed that in this system of bolt mechanism the seating of the cartridge in the chamber and the starting of the empty case from the chamber are entirely done by cams, the compression of the mainspring being accomplished partly by cams and partly by the pushing forward of the bolt. The arm may be cocked only by raising the bolt handle, pulling the bolt rearward and again closing, there being no knob on the cocking piece whereby it can be pulled back by hand.

In firing, unless the bolt handle is turned fully down, the upward projecting stem on the front portion of the sear strikes the under side of the bolt and prevents pulling the sear out of engagement with the cocking piece. When the bolt handle is turned fully down, this stem enters a slot in the under side of the bolt, permitting the complete disengagement of the sear from the cocking piece. This prevents the possibility of a cartridge being fired, and causing injury to the user, before the bolt is fully closed.

Charging the Magazine

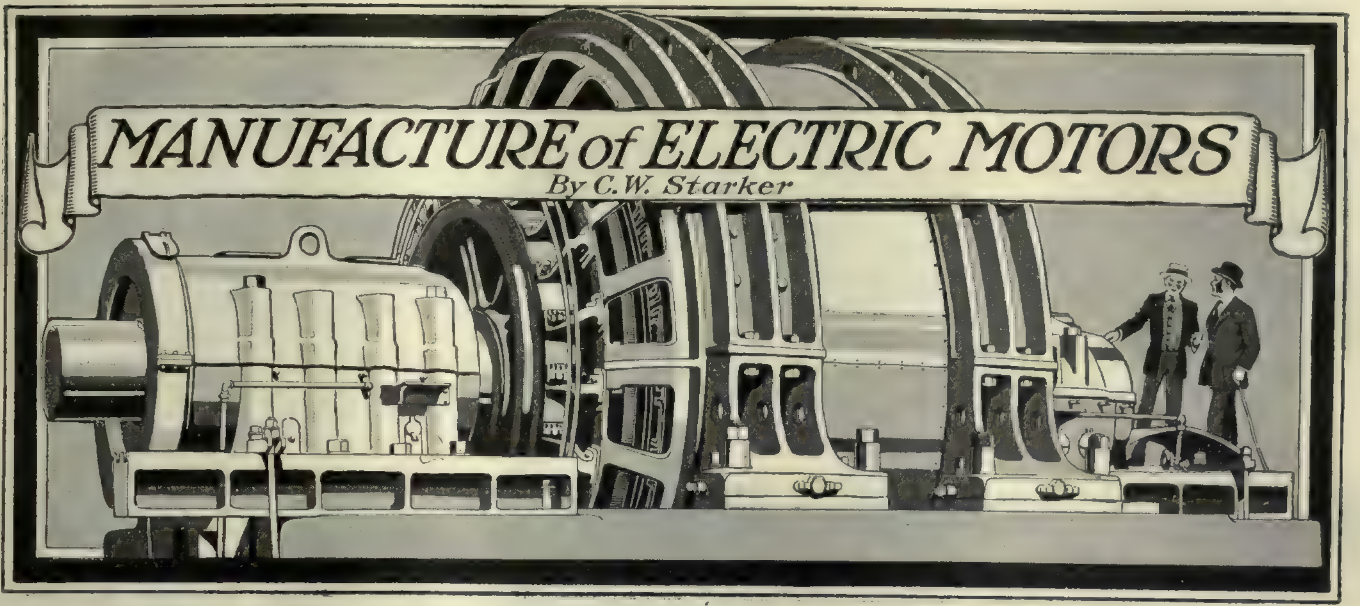
The magazine may be charged either by cartridges held in a clip, or one at a time. To fill the magazine, the bolt is drawn fully to the rear, the cartridges are inserted at the top and the bolt again closed, the top cartridge being pushed thereby out of the magazine and into the chamber. When the bolt is again drawn rearward, the second cartridge in the magazine rises in front of the bolt, and so on until the magazine is emptied. As the bolt is closed, the top cartridge is held up during its passage forward by the pressure of those below. The last one in the magazine is held up by the magazine platform, the rib of which directs it into the chamber.

The magazine chamber is made wider than a single cartridge, but not wide enough for two, so that the cartridges lie in it staggered, three on one side and two on the other, when the magazine is full. There is no magazine cutoff on this arm; and in order to use it as a single loader when the magazine is full, it is necessary to place a cartridge in the chamber by hand and then depress the column of cartridges in the magazine with the thumb while the bolt is pushed forward over the head of the top cartridge. The arm can be readily used as a single loader with the magazine empty. In magazine fire, when the last cartridge has been fired and the bolt drawn fully back, the magazine platform rises and holds the bolt open to show that the magazine is empty.

Locating Square Stock in the Miller Vise

By E. Palmquist

On page 604, Vol. 46, appears a description by A. E. Holaday of a way in which to locate square stock in a miller vise so as to have the corners in a vertical and horizontal position. To my mind, the making of the gage described was a waste of time, as an ordinary bevel protractor set at 135 deg. could have been employed, and would have been just as quick and more accurate. There is also the chance of error embodied in the locating finger of Mr. Holaday's gage. Notice the distance from the contact point with the work to the guide pins, where 0.001 in. play would surely land the job on the scrap pile.



MANUFACTURE of ELECTRIC MOTORS

By C. W. Starker

II. Forging Frame Rings, Motor Feet and Assembling These Parts

SYNOPSIS—*In the preceding article attention was called to the variety of product in the manufacture of electric motors. It is therefore essential to combine the designs in such a way that with a minimum of component parts, such as frames, bearings, punchings, etc., the large number of modifications demanded by the market may be obtained. Further, it is very desirable to adopt manufacturing processes that permit flexibility and at the same time allow production of the individual motor parts in large quantities.*

IN FRAME construction, it is an economic advantage to use the same methods and materials for motors of both the alternating-current and the direct-current types. Pressed and rolled steel have great possibilities from this point of view, and these materials are now used on a large scale for motor frames, since it has been shown that openhearth steel has many advantages with regard to the operating characteristics of the motors. For direct-current motors, the frame is used as a flux-carrying medium, and hot-rolled steel has an advantage of approximately 100 per cent. greater magnetic permeability than cast iron, and about 13 per cent. greater than cast steel. In addition, it has greater structural uniformity, which insures greater uniformity of operating characteristics, particularly of motor speed. It has greater mechanical strength, and it is free from blow-holes and hard spots, which means easier machining and no patching of defective places. Incidentally, this superior material permits a weight reduction in proportion to its magnetic qualities. Steel motor frames are shown in Fig. 19.

Fig. 20 illustrates the rolling machines and furnace that have been especially designed for this process. This rolling of frames is a rather new and interesting process, but inasmuch as it has been described before in the *American Machinist* (Vol. 44, page 63, "Pressed Steel in Manufacture of Electric Motors"), mention will only be made of the fact that the rings are rolled hot and formed to perfect circles on this machine, which is operated by an electric motor. The piston rams shown in the photograph are operated by hydraulic pressure, their purpose being to form the ends of the slab and to hold the rings in position on the mandrel while being rolled. All handling of the slabs from the point where they enter the furnace, at the rear, to the point where the hot slab enters between the rolls is done automatically by compressed air. In regard to the flexibility referred to above, it will be noticed that any diameter, width or thickness within the limits of its capacity can be rolled on this machine by using certain standardized sizes of mandrels.

In the case of alternating-current motors, where the frame does not serve as a flux-carrying member, but merely as a casing to support the primary punchings, the same process and material may be used to advantage, as the great mechanical strength of the steel plate compared with cast iron is particularly desirable in these motors. For purposes of ventilation, openings are punched into the straight slab while it is cold. These frames with punched holes are shown in Fig. 19. This punching is done on a 500-ton hydraulic press, four holes being punched at a time in plates from 1 to 1¼ in. thick. This process also has several advantages from a storekeeping and production standpoint, as a stock of slabs, Fig. 21, represents a much smaller investment than frame castings on which a considerable amount for foundry labor has been spent; and complete independence of foundries and outside concerns is secured.

For reasons similar to the foregoing, steel plate has been very successfully employed for several years past in the manufacture of pressed-steel motor feet; and the idea of standardization and adaptability to quantity manufacture, combined with great mechanical strength, is here further developed. For these feet, steel plates up to ½ in. thick are formed on 1100-ton hydraulic presses, into the stiffest possible section. The shape of the pressed-steel foot as applied to the motor is shown in Fig. 22. For a detailed description of this manufacturing process, see the article in the *American*

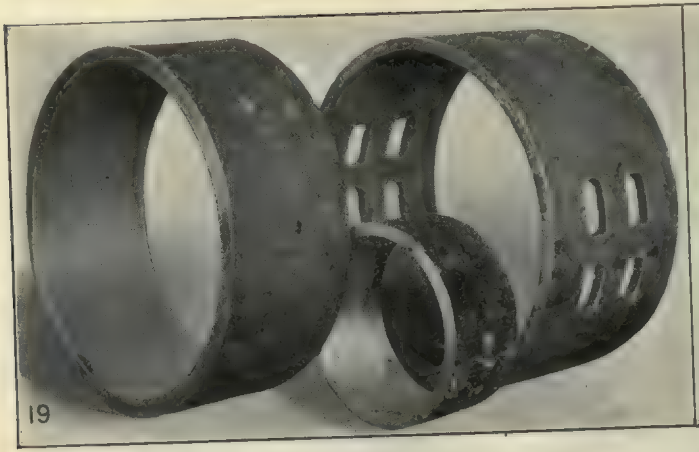


FIG. 19. ROLLED-STEEL FRAME RINGS

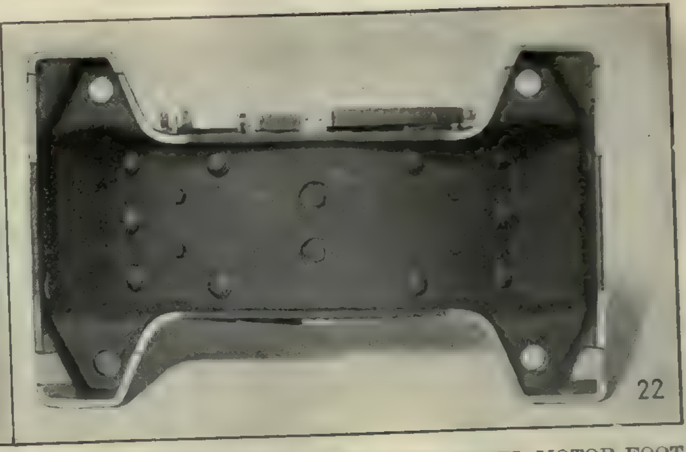


FIG. 22. BOTTOM VIEW OF PRESSED-STEEL MOTOR FOOT

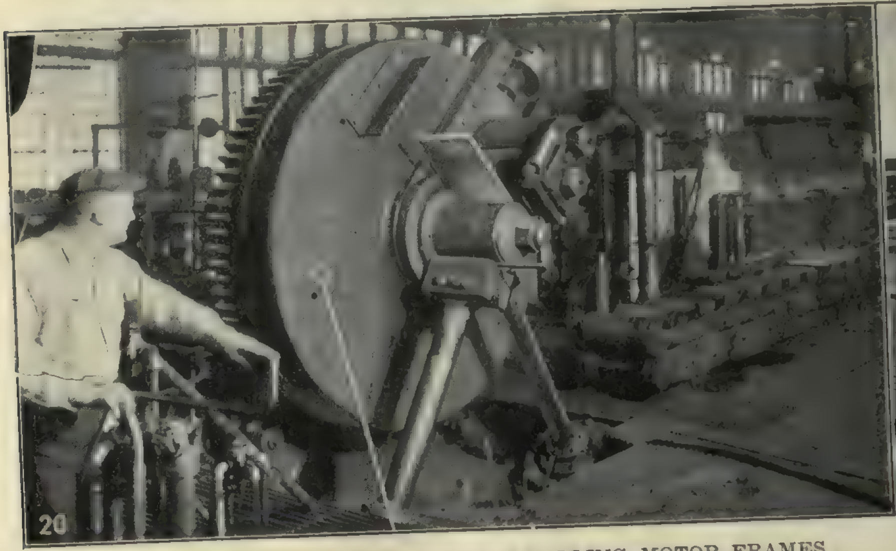


FIG. 20. MACHINE AND FURNACE FOR ROLLING MOTOR FRAMES

FIG. 21. STORAGE OF STEEL SLABS

Machinist, Vol. 44, page 63, in which also particular reference was made to the hydraulic riveting method employed. This method has proved extremely successful in securing between the motor foot and the frame ring a type of joint that can be relied upon in the most severe service for which electric motors are used, such as steel mills and street-car operation. Fig. 23 illustrates the 100-ton hydraulic press used for this work.

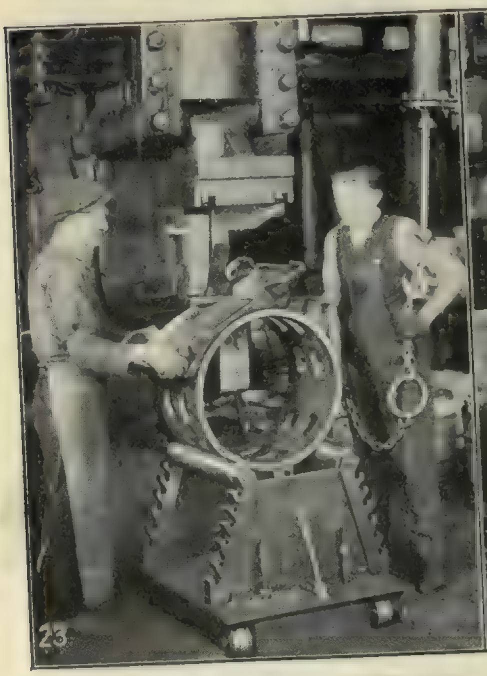


FIG. 23. RIVETING FOOT TO FRAME

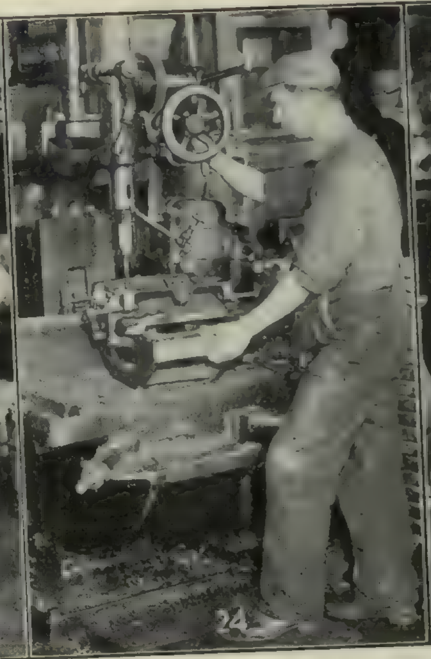


FIG. 24. DRILLING MOTOR FEET

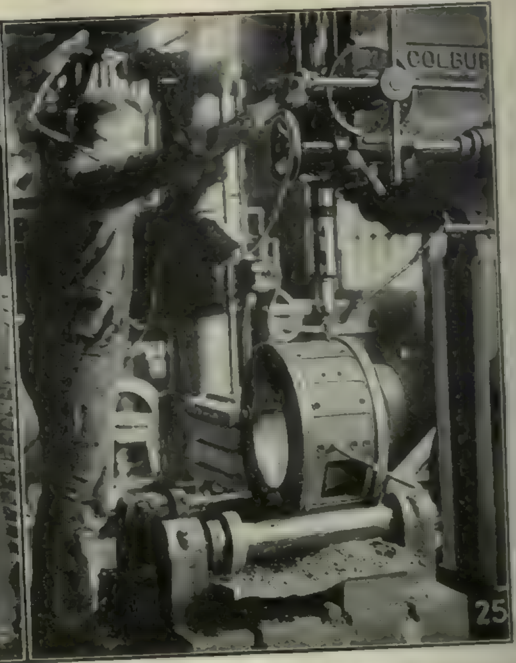


FIG. 25. DRILLING HOLES IN FRAME RINGS

The drilling of motor feet and frame rings for receiving rivets is done on high-speed drilling machines, shown in Figs. 24 and 25. All the drilling is of course done with jigs, so as to secure perfect interchangeability of all parts.

Referring again to the flexibility of the design and manufacturing methods, it is apparent that such motor feet may be used interchangeably between alternating-current and direct-current motors, or those of various characteristics such as single phase, polyphase, etc., and that vertical motors are readily obtained by omitting the feet, or that inclosed motors may be made by omitting the piercing of the vent holes in the frame.

Certain standards have been adopted for width of frames. These vary, for example, for alternating-current motors in steps of 2 in. for widths of from 8 to 16 in. The different widths are used according to the motor characteristics to be obtained.

Hardening Formed High-Speed Cutters

By William S. Hudson

In your columns I recently noticed letters referring to the hardening of high-speed steels. The method advocated was to pack the tool in powdered charcoal and heat to varying degrees, not specifically stated.

Some time ago I had cause to experiment along these lines and found that the results were not altogether satisfactory. Tools were packed in charcoal in a cast-iron tube, placed in a gas furnace and heated from cold.

Temperatures over 1900 deg. F. were found to fuse the outside of the tool, completely ruining its form. Temperatures of 1750 to 1800 deg. F. produced a satisfactory surface hardness, but after the surface had been ground away the tool was not hard enough to give good results. This effect I attributed to overcarbonization of the steel. This also would account for the tendency of the cutters to crack when left too long in the furnace.

I found that by extremely careful heating according to steel makers' specifications, with special regard to the condition of the atmosphere in the furnace, it was possible to obtain a fairly high degree of hardness in a furnace kept at 2100 deg. F., without damaging the surface of the tool. I did not, however, have an opportunity of testing the actual performance of the cutter in use.

I have also tried a powder (called "HeTzy" and supplied by the Bennett Metal Treating Co., Elmwood, Conn.), that I understand has been used with success by makers of high-speed steel cutters. The cutter to be hardened is packed in this powder and thoroughly heated at a temperature of from 1700 to 1750 deg. F., then quenched in oil; small pieces may simply be allowed to cool off in the air. I tried regular lathe tools hardened in this way and found that on cast iron and bronze good results were obtained, but the tool failed when cutting tough alloy steels.

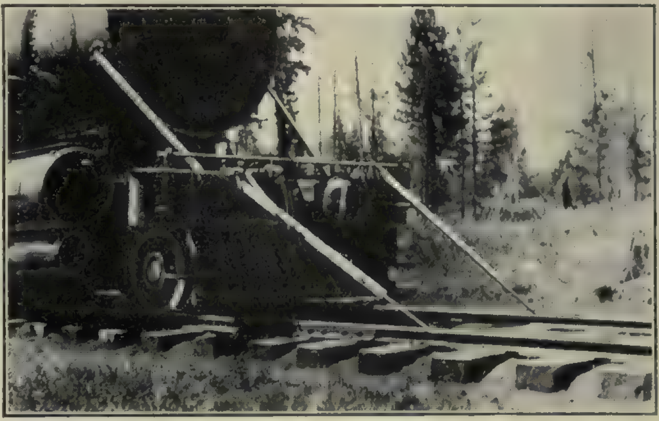
There appears to be some doubt as to whether high-speed steel can be hardened successfully at low temperatures, when packed in charcoal or similar powders, and claims to success should be accepted only after tests have been made of the cutting powers of tools so hardened against tests under similar conditions of tools hardened by the high-temperature method. However, as any such method would result in considerable economy in manufacture of high-speed steel cutters, it should be of great value if those who have made tests along these lines would publish the results. Personally, I believe that best results can be obtained by roughing the cutter as nearly as practicable to its desired form, hardening as recommended by steel makers, and then obtaining the exact size and form by grinding, provided, of course, that it is possible to produce the desired form in this way.

Cleaning Railroad Rails

By C. L. Edholm

Rigging up a steam pipe so as to conduct a jet of live steam to a point where it would do the most good, solved the problem of clearing a California railroad right-of-way that had been invaded by millions of caterpillars.

The horde of pests had taken possession of the lumber camps and tracks, and in fact the whole country about the McCloud River Ry., and were not only a nuisance but a serious danger to traffic. The steel rails afforded a convenient promenade for the insects, so that the tracks were alive with countless thousands of soft creeping things, and the result was that when a train passed the rails became so slimy that no traction was made. On a grade the brakes refused to hold, and the trains were as hard to manage as a skidding automobile.

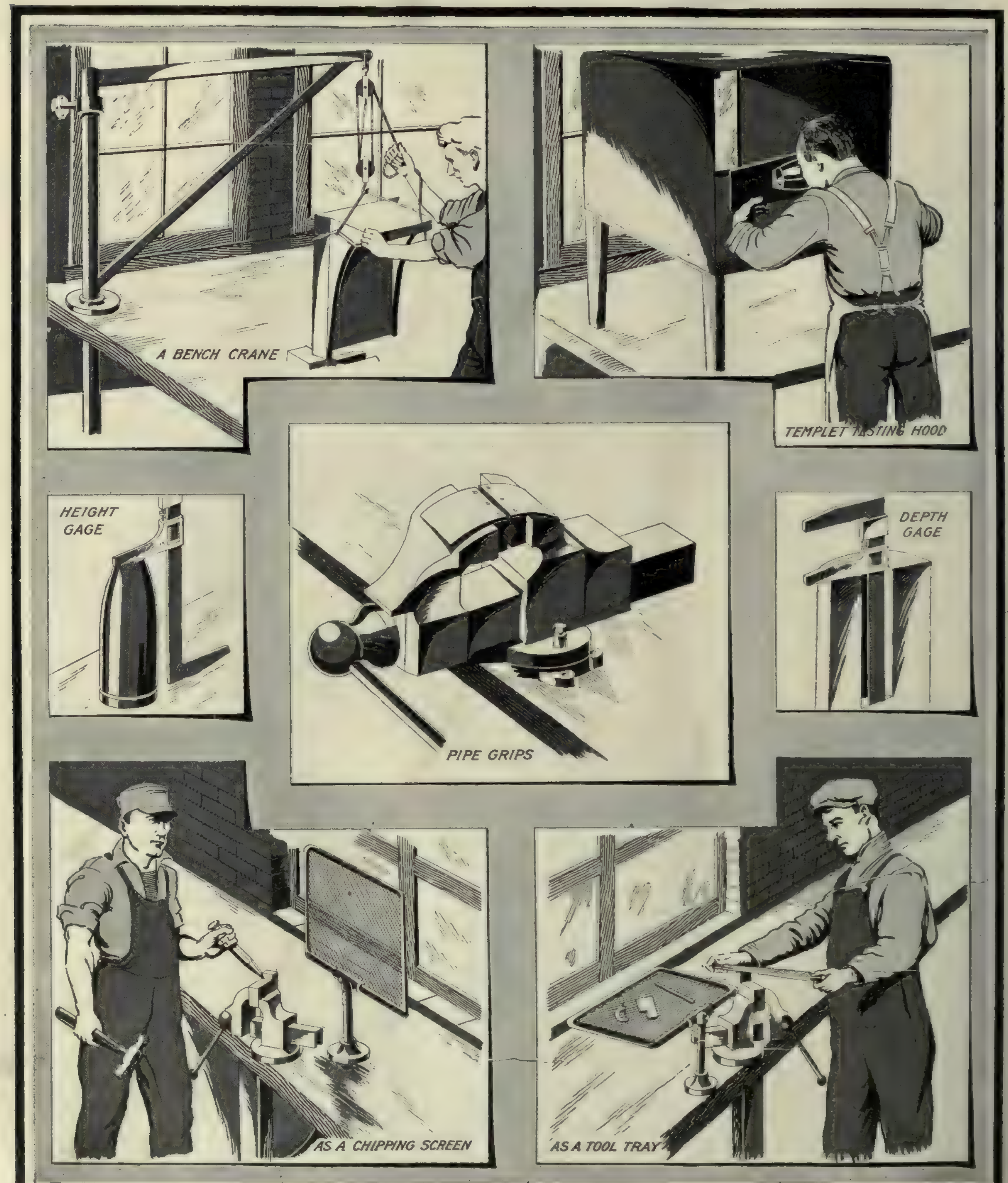


CLEANING RAILROAD RAILS

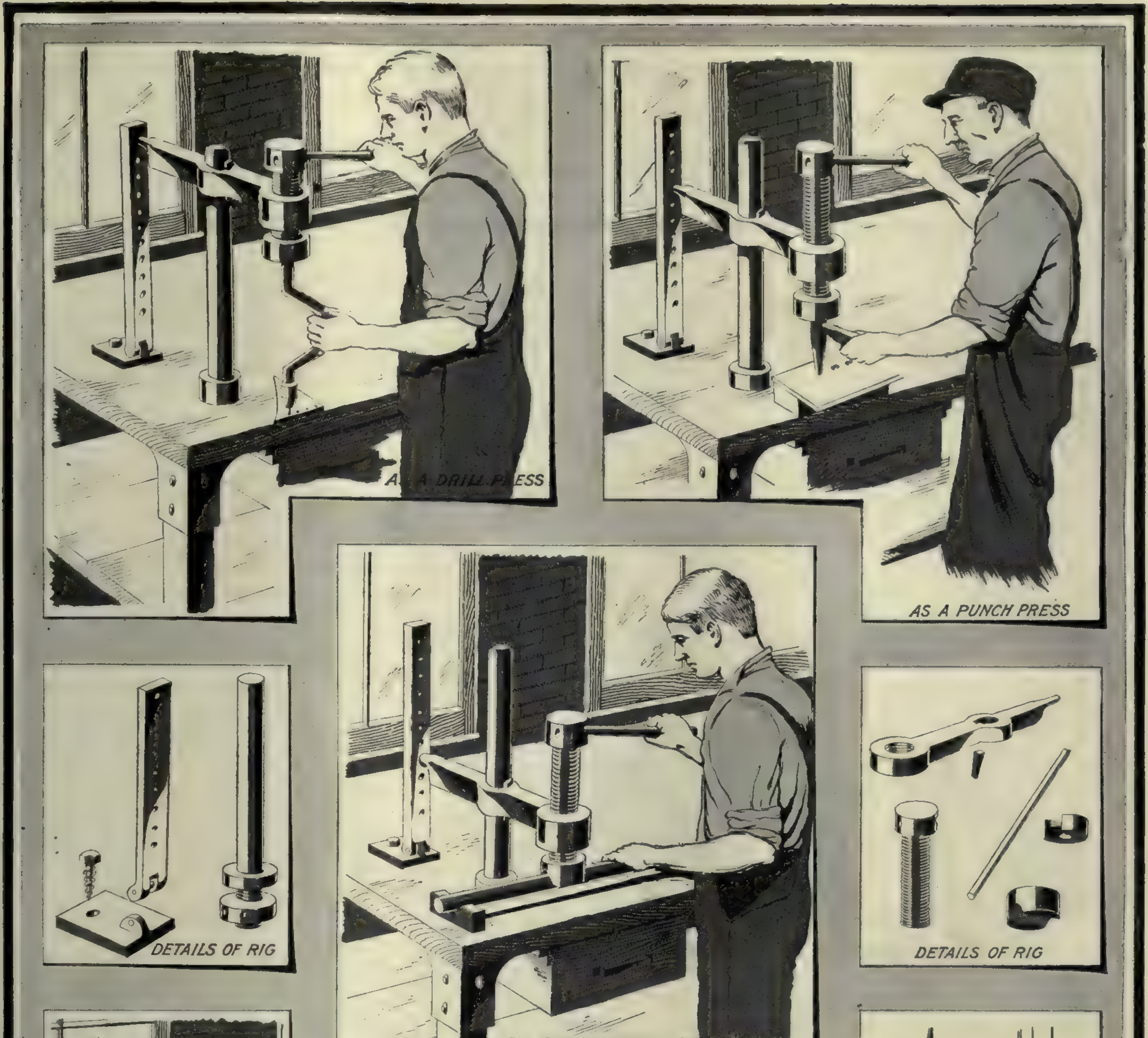
Various methods were tried, such as placing chemicals on the right-of-way, sprinkling sand on the tracks, and even brushing away the pests with brooms, but all these schemes were ineffective against the overwhelming number of caterpillars. Trenching the right-of-way was proposed, and only the prohibitive cost of digging miles of ditches stood in the way of this drastic measure. Finally Master Mechanic John Kennedy hit upon the solution of the problem. From the boilers of the locomotive he conducted a pair of tubes that extended in front of the cowcatcher and a couple of inches above the rails. From these a powerful jet of live steam was emitted, and the force was so great that the caterpillars were blown off the track The heat killed them, but without crushing the soft bodies. The tracks were left perfectly clean, while the bodies of the invading horde were piled up alongside in drifts.

From a Small-Shop Notebook

By J. A. LUCAS



A NUMBER OF HANDY SHOP KINKS



AS A DRILL PRESS

AS A PUNCH PRESS

DETAILS OF RIG

AS A STRAIGHTENING PRESS

DETAILS OF RIG

AS A VISE

DRIVING BUSHINGS

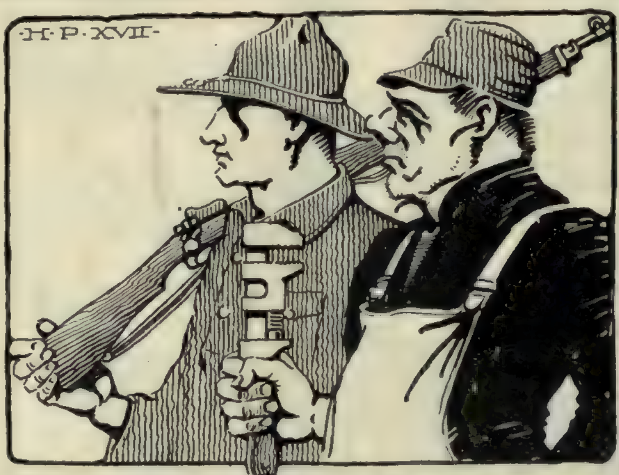
A HANDY RIG FOR THE WORK BENCH

Letter from Jack to Bill—Inheriting the Fighting Spirit

Deer Bill—What wood you advize me about inlistin for a soljer? Ile tell you why I ast you, you no Ime of fitein blood. One of my annsesters witch was of royl fammily was kild at the batl of the Boin and thats why weer so poore, because he was kild moast too yeers befoar his oldest son was borne witch was my annsister too and in them too yeers moast all the proppity was stoal off his wife she was my annsister too Bill. Do you beleve me?

Then my oan grandad he fot into the Sivl War and maid moast 15 hunderd $ in bowntis, and he had a penshun but wen he tryed to git too moar penshuns witch he'd well urned, him survin under three naims, the graspin plewtocrattic guvment maid a fuss and he moovd to Cannerdy, but Ive his fitein spirrit in me just the saim.

Well Bill in one of the big shops in this berg thay has what thay calls a sosherl survis department and the men beside havin to tell how mutch thay has in the bank and wether thay drinks beer is foarced to atend upp lift meatings and leckshers and I went to one with a guy I chums with and it was all about fitein to upphoald dimocrasy and you no I allwers voats that tikkit Bill. I gut all rort up and I fellt like I ort to inlist to hellp put down the hoe hen zollurns, I dont ritely no just what thay be but think by the naim a aggercultyurall implurmint trust or peraps poaltry and Ive no yuse for trust witch cut down the sallerys of hard wurkin men have you Bill?



"YOU NO BILL, IME OF FITEIN BLOOD."

But wen I gut hoam and thort it oaver I sez to myself what rite have I to deprive Uncle Sam of the survissis of a skild mecannik and aint mecanniks full as nessry as soljers? Then if I inlist mitent some man have to leev the seat of war to taik my job and he'd be a moar experunsed waryer than wat I be so the country woodent gane but mite loose by the chanje. So I think Bill Ide beter stik to my job till I go to that plaice you no Bill in Misshergun and then how long wil it taik me to saiv enuf of my 5$ a day (or moar) to by a librty bond and so hellp a lot beside gittin fare intrust, but if you think I ort to fite them hoe hen zollurns tel me so Bill and Ile think it oaver agen.

Well Bill my lurnin to be a plainur speshlist is allmoast dun and today the bos ast me to run a laith a little to hellp on a rush orrder. He sed to maik the strate part of all the peeces and then set the laith oaver and do all the tayper ends. Wen I come to the taypers I found the blaimd laith was fasnd to the flore with lagg scroos, and one of the laith speshlists told me to git a strugling bar from the toole crib and the crib guy laffed and sed what you need is tayper oil and youre lucky if you dont git find for not having a sqwurt can of it in your kitt, but peraps as youre not the reglar laithman the bos wunt fine you. Do you no Bill what that kind of oil is and how mutch it costs, for after Ime a plainur speshlist Ime thinkin of lurnin eether laiths or ottermattics. It must be fun to set and wotch the ottermattic do all the work. Ime tired Bill so no moar now from

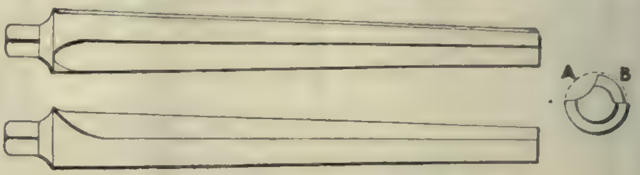
JACK.

P S—Bill a guy told me tayper oil is maid from eels hind leggs and I bashed him and we micksd it for a few minnits. Thats why Ime so tyred.

Improved Half-Round Taper Reamer

BY E. E. KEELER

Having a hurry job for a taper reamer and no fluted reamer of the size required, I concluded to try the old time-honored half-round, but before I started to cut it down to the center line I commenced to think and reason if there was not some better way than cutting the metal away to the center line, which renders this tool so easily breakable.



THE HALF-ROUND TAPER REAMER

Instead of reducing to the center line, after carefully drawing two center lines, I only cut slightly over one-quarter, as shown at *A*. I then carefully backed off the one-quarter portion *B* at the back of the reamer. I then hardened and ground it on a small wheel to give a slightly concaved cut, stoned it, and was surprised to see the result. It is a fast-cutting tool and the only requisite is to keep the concaved cutting edge sharp.

Concrete Mix for Foundry Floors

A correspondent writes: "We wish to put a gangway floor in our iron and brass foundries. It will get hard service in trucking castings to the storehouse. Wood blocks we believe to be out of the question on account of their inflammability. Concrete would dust and get rough on top, we are afraid. We are wondering whether concrete mixed with quite a large percentage of cast-iron chips would make a good hard floor that would stand. We put cast-iron chips out in our yard as an experiment last fall, and it is now as solid as iron. Of course, this path has no trucking of any kind on it, but it contains no cement, simply iron chips that have rusted into a solid mass. We will be glad to hear of any practical suggestions along this line."

Pattern Match Plates

BY J. V. HUNTER

SYNOPSIS—*Numerous examples of pattern match-plate work are shown and discussed from a practical standpoint, and this article will be interesting to all those who have to do with patterns or castings capable of being adapted to match plates.*

THERE has recently been considerable discussion in these columns, in short letters, about pattern match plates; but perhaps a little can be added, because no one who has written on the subject seems to be producing the plates in quite the same manner that we are, or else I cannot associate their descriptions with the particular points that I have in mind. I wish to call attention to the way of producing the most serviceable plates at the minimum cost.

The simplest match board is naturally one made of wood, to which the pattern is attached on one side only; but even this board must be made with due care, to be of the same thickness all over. Otherwise, the castings either will be distorted by being too thick on one side or will perhaps show fins at points where the thicker portions of the board have prevented the sand of the cope from joining the sand of the drag. So far as the board itself is concerned, it may be considered as ideal for mounting split-wood or metal patterns with straight partings. Wood patterns may be readily glued to its surface, and alterations, if necessary, can be readily made. Metal patterns can be fastened on with screws or bolted together through the wood board, when lined up properly as has been described in previous articles. Often, small alterations to these metal patterns can be made by attaching small wood pieces directly to the board itself, where otherwise much time would be consumed if metal pieces had to be soldered to all of the patterns.

Wood patterns and wood boards have the disadvantage of lack of permanence, because of the softness and lack of resistance to wear. They are easily damaged by much handling in the foundry, so are not economical where the production of a part will be long continued.

The majority of our manufacturing shops, however, send into their foundries hundreds of small wood patterns from which they will need a few hundred castings per month for their standard manufacturing operations. Such patterns frequently receive scant attention toward aiding productive efficiency, because at the most they are only considered the work of a day or two's run for a snap molder. If these patterns have crooked partings, a good oil sand match is often made up and preserved with the pattern; but more frequently the patterns are split with a straight parting and would be very suitable for mounting on a wood squeezer match board right from the start.

Those are the cases where the wood board is the greatest element for economy. To meet such demands, from time to time when the work in the pattern shop is a little slack, we have a workman make a stock of half a dozen of a few of our standard sizes of snap flask boards, so as to have them on hand for expediting the work when things are more rushed. Such boards, for material, labor and overhead, probably cost in the neighborhood of 60c. apiece. They are more simply made for work that will not demand the greatest accuracy than for work that is more particular. For the former a board with mitered ends is sufficient, while for the latter it is better practice to make up a three-ply veneer board to avoid the danger of warping, should the shellac wear thin and permit the board to soak up moisture.

MOUNTING THE PATTERNS

Care about many of the little things must be taken for properly mounting a pattern on a wooden board, or else it will be more of a bother to the molder than an aid. Notice in the diagram, Fig. 1, which shows a section through a pattern and match board, that at *A* there is apparently some glue lacking, or else the pattern was not pressed firmly to the board, while at *B* a small chip is broken off. Both of these defects were overlooked by the patternmaker when he mounted this pattern on the board. They should have been filled with wax and covered with a good coat of shellac at that time. Both defects will cause the sand to stick to the board at that point when the molder draws his pattern after squeezing, and they will give a rough or dirty mold. After mounting a pattern on a board, a much smoother job can be obtained by the foundry if the patternmaker will put a tiny fillet of wax all around the edge of the pattern at the joint with the board, similar to the one shown for the cast pattern plate in Fig. 2 at the points *A*. This fillet, which should not be of more than $\frac{1}{16}$-in. radius, will do much toward insuring a cleaner lift of the pattern and will help to avoid a crushing or breaking of the edge of the mold when closing, and so aid in producing cleaner castings.

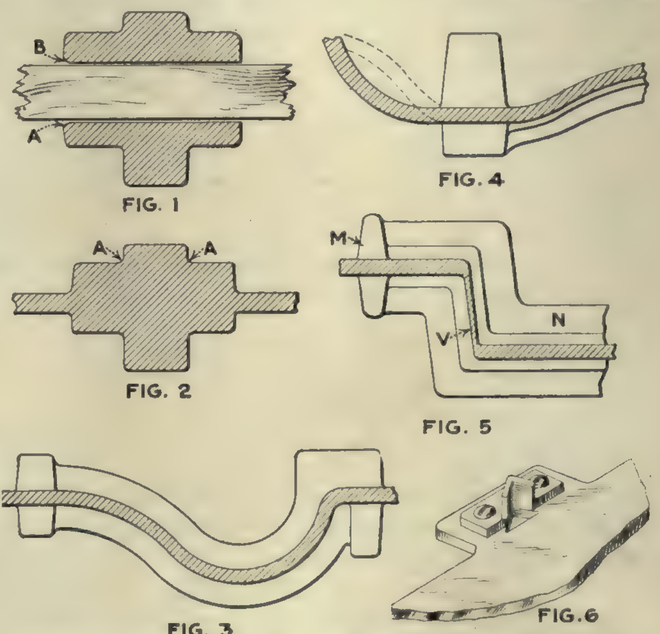


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6

FIGS. 1 TO 6. EXAMPLES OF MATCH-PLATE WORK

When wood patterns are simple and easily produced, enough should be made to fill the flask. If they are split patterns, they can be lined up on the two sides of the board in the manner described by previous writers on this subject. For these small patterns it is not the uncommon practice of many shops to make up gates of these right from the start, containing on each from two to ten or more of these small parts so joined together that the molder raps and draws all from the mold at one time. These gates are usually cast from brass or other soft metal. After being filed to a finish, they are attached to the patterns by small screws or similar fastenings. Observation will show that in the majority of cases it requires no more time for an experienced man to mount such a set of patterns to a board, if they are of a type that lends itself to this class of work. So doing will materially expedite the work in the foundry; and it has another advantage—these patterns are less subject to damage, particularly that very common form of breakage that separates one or more of the patterns from the gate, to the loss of everyone concerned.

Both types of pattern match plates, those made by mounting patterns on a suitable board, and the other type known as the cast match plate, should never be turned over to the foundry without providing them with a gate stick attached to the plate, so that the molder will not have the unnecessary work of cutting a gate after drawing his pattern. Such gates are doubly economical; yet often they are not provided, as they should be. Their economy lies, first, in the saving of the molder's time; secondly, they provide a uniform lightweight gate of just the proper size for running the casting, so there are no such occurrences as too light a gate and a spoiled casting, or too heavy gates and metal loss in the overweights of these gates.

METAL MOUNTINGS

Although in the previous paragraphs all reference has been made to mounting patterns on wooden boards, the work is very similar when metal plates are used to displace the wood for mounting split patterns. To a great extent the work is similarly conducted; but such a plated pattern must not be confused with a cast metal plate, which will be taken up later.

There are four common metal plates used for this pattern mounting—rolled brass sheet, cast aluminum plate with machined finish, black sheet steel and tinned or galvanized sheet steel. There are some advantages claimed for each, although for the aluminum plate very little can be advocated, except that it is light. This feature is offset by its softness and the fact that it is so easily bent that such plates must be used in much greater thicknesses.

Many platemakers prefer to use brass plates, which have the advantage of not rusting. After the metal patterns have been pinned to the two sides, carefully lined up in the manner that others have described, then they may be sweated or soldered to the plate and thus insure a tight smooth joint throughout.

The galvanized sheet-steel plates will prove nearly as suitable for mounting the metal patterns as the brass plate. They are rustproof and are quite readily soldered, while they are cheaper at the present time, due to the excessively high price of brass. Black sheet steel can be used for cheap mounts. It has the advantage over wood of being much thinner in proportion, so the two halves of the flask are closer together when molding, giving less opportunity for pin shifts. The mounting operations on black sheet should be conducted much the same as with wood boards. The joints of the pattern with the plate should be waxed to a small fillet, and before sending to the foundry the whole should be given a good coat of shellac.

THE CAST MATCH PLATE

As soon as the field of patterns requiring crooked partings is entered, then the cast match plate comes into its own and is the only type that can be successful. Please notice the parting shown in Fig. 3, which is a section through a plate, in which the plate itself is in section lines. Can you imagine building up a wooden match plate to obtain such a parting and have it the same thickness throughout, so that there will be no "crushes" or fins left when molding? By an expenditure of infinite time, care and patience, it might be possible, but it could not be done commercially. Still, I know of a high-priced patternmaker foreman, with no experience or knowledge of the cast plate, who actually started out on an order to produce a plate, by beginning to build it of wood, intending to make a casting of the wood plate and then finish it up in the shop like any metal pattern. Fortunately, he was shown how before much labor was lost.

The making of a successful cast plate depends largely upon the skill of the molder who is selected to do the work. The prime essential is to make the first sand match to hold the pattern in a manner to present the best and greatest possible straight vertical draft in both cope and drag.

The importance of a vertical draft in the drag is dwelt upon, because frequently a molder will so position his pattern to obtain a greater draft in the cope, which must be drawn vertically, because guided by the flask pins, but will at the same time have his pattern in such a position that it must be drawn from the drag at a slant from the vertical. So doing will show skill on the part of a molder working with single patterns, but is absolutely impossible with a plate, for the plate is likewise guided by the pins and must be drawn vertically.

A pattern that, from the start, one expects to plate should be made with double shrinkage, or in some cases with triple shrinkage allowance, in order that as many metal patterns can be cast from it as it is possible to place in the size of snap flask that is to be used.

POSITIONING THE PATTERNS

Careful positioning of the small patterns, or master patterns, required in making up a plate, to obtain the maximum number in the flask, may add from 10 to 20 per cent. to the output of the molder, when the plate goes into foundry service, without any additional effort on his part. The patterns should be kept as close together as possible without danger of the metal breaking through the mold, but should be sufficiently spaced to permit ready removal from the gate. A short gate will run more castings and give less loss to the foundry for remelting the gate scrap.

The writer has visited a malleable foundry where the costs and selling prices are figured so closely that the management counts on adding to its profits, over what another foundry would make, by putting the least possible metal into the gates. In this way, furnace and iron losses for remelting this metal are reduced.

For a plate to contain six patterns, starting from the original master wood pattern, six metal patterns are cast, not five, to insure that they shall all shrink to the same uniform size. These need not receive a high degree of finish. It is sufficient simply to polish off the rough spots and check for size. The molder will use great care in removing these from the sand the one time that they are used; and there is little danger of "tearing up" the mold, as would occur in daily molding practice.

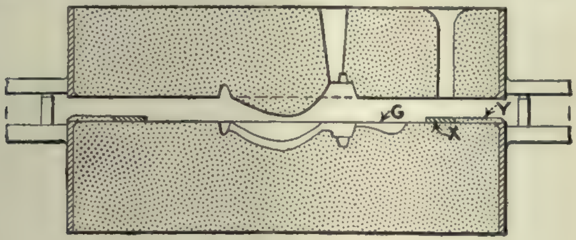


FIG. 7

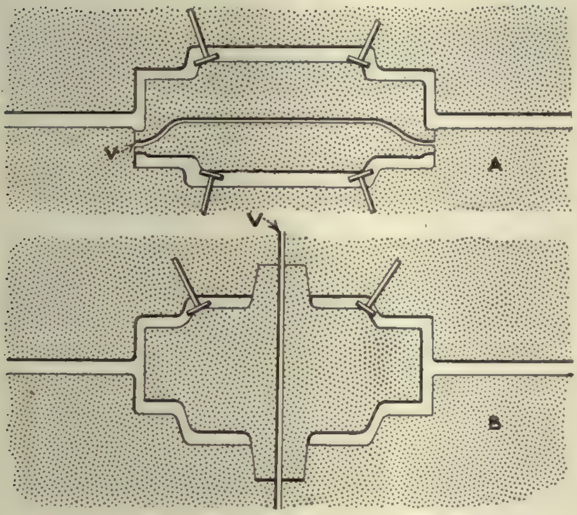


FIG. 8

FIGS. 7 AND 8. MATCH-PLATE WORK

When it can be obtained, use an iron flask for casting the pattern plates, one with smooth planed joints that fit together perfectly. Inside, it should measure not less than 4 in. longer and wider than the outside dimensions of the planned plate. This leaves 2 in. of sand all around the edge to prevent a "run-out" when pouring. Room to place the pouring gates and risers can usually be found where more room occurs at the corners not occupied by handles of the plate (mentioned later); and there is no harm in using a much larger flask, although it is just that much harder to handle.

A flask for this purpose must have long true pins; and it is very important that the bars of the cope be firm and stiff, and better still if there be some narrow bars in the drag, such as will not interfere with the placing of the patterns. The bars can either be cast integral with the flask or be bolted to it, but under no circumstances must they spring a particle.

The trouble with wood flasks for this purpose is in keeping them from springing, and particularly the bars, which if a trifle loose will give under the great pressure of the wide plate area when it is filled with molten metal. The result is a swollen or distorted plate of unequal thicknesses, which will give imperfect molds.

To fit standard snap flasks, a plate must be in a perfectly true plane in respect only to those edges which will come between the sides of the snap flask. Therefore, when working with split patterns, have a true smooth board for a parting board on which to place the patterns. For patterns with crooked partings, a molder usually makes up a temporary sand match in the cope, which is shaken out after the permanent drag has been rammed up and rolled over.

To insure that the drag so prepared shall have a true plane surface where the plate will come in contact with the sides of the snap flask, after the drag is prepared, as above, we always take a half of the "snap" and press it lightly upon the finished surface of the drag, before proceeding to ram up the cope. This serves two purposes: It gives an outline for the size of laying out the plate; also, it shows whether all of the crooked parting has been confined to the inside of the flask. Should this not be so, any hollow or raised portions of the parting surface, as shown by this light imprint, are filled in or built up, as the case may require, to a true plane on this outer edge; then the rest of the irregular parting is built up to as near a regular slope to this edge as can be.

The flask imprint shows the size of the plate. Now ram up a regular cope on top of the drag, providing for the necessary gates and risers for running the plate, outside of its outline, which has been indicated. The cope is then lifted off.

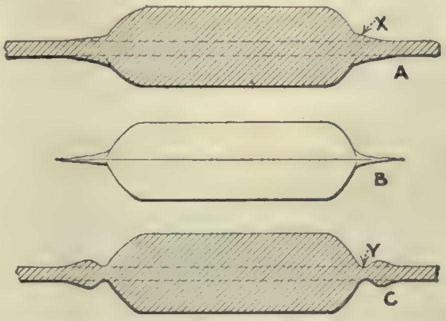


FIG. 9

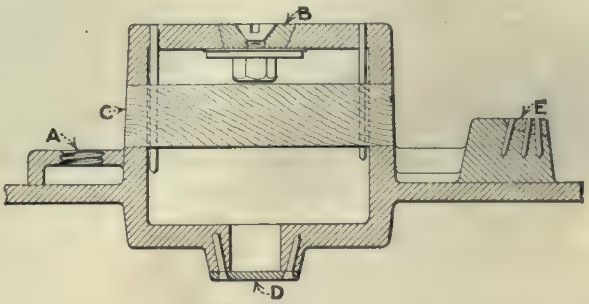


FIG. 10

FIGS. 9 AND 10. TWO PROBLEMS AND THEIR SOLUTION

Next, cut a main gate with side gates to each individual pattern, just as for a standard mold. This provides a gate cast right on the plate itself, so that in use it will never be necessary for the molder to cut one. For the main gate, it is often simpler to furnish a little wood pattern to be rammed into the drag at the start, since this will produce a smoother, straighter gate than can be cut by hand.

For the standard plate, which may be about ½ in. in thickness, provide several small straight strips of pine, ¼ x 1½ in., and the length and width on the plate respectively in length. These strips are placed on the drag parting with their outer edges in line with the slight imprint earlier made by the snap. In Fig. 7 is shown a section through the mold as it would be with the cope held above the drag to complete the view. The dark section *X* represents the small wood strips. These strips really act simply as a guide to give an accurate height, and outside of them, level, exactly with their tops, is built up the section of sand *Y*, completely following the outline of the future cast plate.

MOLD READY TO CLOSE

In Fig. 11 is reproduced a photograph of such a mold prepared for casting a plate. It shows how additional strips of wood of the same thickness are placed on the edges of the iron flask to aid in leveling the built-in sand strip, also to help prevent a run-out; and lastly, when left here when the mold is closed, they serve to carry the weight of the cope and prevent it from crushing down closer on any one corner. However, when ramming the cope has forced the parting below the level of the edge of the flask, these outer strips cannot be used.

In this illustration also may be seen in the outline of the plate impression, which has been formed, the extensions readily shown on the two ends. These form the little flat handles by which it is lifted from the mold when in service. These handles appear in more detail in Fig. 6, which shows that a triangular hole has been cut through to fit over a flask pin (these holes must be cut after the plate is cast). Also, to facilitate a straight lift, a small cast ear has been bolted to the plate, so that the pin itself will act as a guide and avoid twisting.

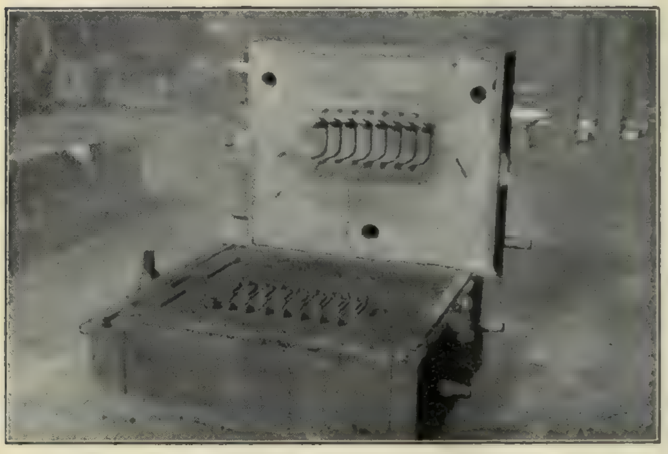


FIG. 11. THE FINISHED MOLD

The mold of Fig. 11, which is just ready to close, has been given a light surface drying by means of an oil-flame torch. The holes for the gates and risers, for feeding up the cast plate, show through the surface of the cope. After casting and removing the gates, the plate from this mold appears as in Fig. 12. This is before any finish work is done in the pattern shop, and shows what a clean smooth casting may be obtained by the use of a good sand and proper finishing of the mold surface. The pattern is for a passenger-car door handle, and the parting is a most irregular and raised one, to conform with the shape of the handle, as will be noticed. It will also be seen that the nature of the parting made it necessary to put the cast-on gate farther away from the patterns than is usually the case, to avoid the irregular depression at the end of each handle.

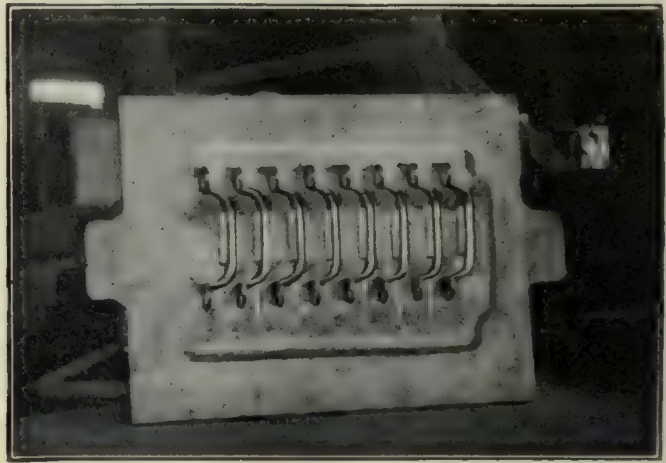


FIG. 12. PLATE CASTING TAKEN FROM THE MOLD

In earlier paragraphs mention has been made of cutting the gate and building up the sand strips on the outside of the mold. After these have been completed and all loose sand has been blown away, the patterns are swabbed and carefully drawn. Any damage is then repaired; and lastly, by a very light swabbing with water along the edges of the pattern impressions, or by slight pressure of the finger, these edges are made slightly rounded, which forms the fillet at *A*, Fig. 2. In addition to such service to the molder as previously mentioned, this tiny fillet aids in the prevention of slight back-drafts and shrinkage cracks, as might occur at this point when the metal shrinks.

The importance of using a stout flask with firm bars has been dwelt upon previously. When there has been any give in the cope or drag, at the time of casting the plate, the result is like that illustrated diagrammatically and exaggerated somewhat in detail in Fig. 9 at *A*. Here the pressure has swollen the plate thicker; and at *B* is shown the condition of the casting, which has wide fins at the parting line, because the increased, or swollen, thickness of the plate at this point, more than its thickness at the outer edges, prevents the sand from coming together at this point when the mold is closed. Sometimes, due to too soft ramming, such a condition is local on only part of the plate. Either case can be remedied as at *C*, where a shallow groove has been scraped around the pattern at the parting to bring the thickness of the plate at that point equal to, or the veriest trifle under, the thickness of the rest of the plate, so that the sand, when the mold is closed, will come together firmly and pinch off any tendency toward forming fins.

Success in getting a plate that will draw clean from the mold requires some thought and skill in the preparation of the parting, since some conditions that might work fairly well when molding with plain patterns are not so suitable for more expeditious work. Such a condition is illustrated in Fig. 4; it is a very prevalent source of complaint against some plates. In this illustration the dotted line indicates the manner in which the parting for the plate should not be made originally, although it is the one that the average molder will habitually form when cutting the sand surface down to the parting line. Its fault is that the sand extends down to a thin sharp corner, with a tendency to crowd itself in more tightly, and not sufficient body of sand down toward the point to make a bond of enough strength to always get a clean lift. In hand molding for such a sharp point, the molder will probably set in a nail or two for an aid to the lift, but such practice consumes too much time for rapid machine molding.

In this case the proper parting line is shown by the solid lines for the plate that have been section-lined. The parting has been brought down on a nicely rounding curve, which gives a broad point at the bottom. If such a "belly" is not too deep, no trouble should ever be experienced in getting a clean lift of the cope or pattern.

OTHER EXAMPLES

Other patterns may necessitate a parting that would make impossible the use of a cast plate. One that very closely approaches a condition of this kind is shown in Fig. 5, wherein it is seen that an offset of the pattern very nearly approaches the vertical with respect to the main parting. Although in casting the plate the mold halves were separated the regular distance, still at the point marked *V* this distance is measured on the vertical as well, while the thickness of the plate at this point is practically a horizontal measurement and in this case almost *nil*. A parting line of this kind, which approaches the vertical, will reach a limiting angle beyond which it will be impractical to go, because the plate will become so thin at that point as to be unserviceable. The only way to handle such a case would be to incline the patterns and part down to the ends so that the arms *M* and *N* would be respectively above or below the main horizontal plane.

If the patterns are bulky, in connection with the wide area of the thin cast plate they are bound to produce shrinkage variations that will cause trouble and imperfections, besides adding materially to the weight that must be handled many hundred times daily by the molder. To avoid having any heavy sections in a plate, it is advisable to insert some sort of core to remove all unnecessary metal; at the same time the core must be so placed that it may be vented and, after pouring the casting, removed from the plate.

SECURING CORES

In Fig. 8 are illustrated two very satisfactory methods of securing cores to serve this purpose. It is rarely necessary to call upon the patternmaker to construct a core box for such a core, because almost any foundry can find something among the stock cores that will be suitable after a little filing; or at least will have a box on hand that can be rammed up with a core for this service, placing the vents in the proper relation to the point where it will be possible to take them off. At *A* in this illustration all the core has been filed away except a very small piece at each end, through which the vent openings *V* extend to the outer sand. This core is supported and held in position by the chaplets.

A somewhat differently shaped core has been used at *B*. By this means the core can be more easily set in position before closing the mold; also, fewer chaplets are used, as the core helps to support itself, and the opening left by the core is more accessible for closing.

Cast pattern match plates are rarely made of other materials than white-metal and aluminum. When made of the former, there is never any difficulty in soldering to fill any little depressions or to plug up the holes. Solder itself closely approximates the composition of white-metal for patterns.

USE OF ALUMINUM PLATES

However, with aluminum the matter is entirely different. This metal is commonly used for many plates because of its lightness, but I have yet to find the solder and flux that will be really satisfactory for closing holes and depressions when applied to nothing but the aluminum.

The methods of taking care of this problem with an aluminum pattern are shown in Fig. 10. Here at the point *A* the simplest and best hole plug is obtained by drilling and tapping, then screwing in a short aluminum plug and filing the top smooth. An oblong hole at *B* has had a plug filed to fit, which is held in place by the flathead bolt and large washer inside, as shown.

Sometimes a hole can be more quickly plugged by driving through a small wood block, as at *C*. This can be secured in place by drilling small holes in from the side and driving through a few nails. When the hole occurs in the center of a small lug or boss, as at *D*, the simplest method will be to dress down the top a little, then file a thin brass plate to fit for a cap, drill through both and drive in some small brads for pins. These brads should be driven at different angles from one another; so placed, they will act as a dovetailed joint.

As previously mentioned, aluminum cannot be soldered successfully for plate service, because the intense jarring action of the modern foundry vibrator will quickly shake it loose. When we have a lug, as at *E*, that has shrunk down on top and left a small depression that must be filled, we again drill a lot of small holes at this point at different angles, to obtain an anchorage. Into these holes brass pins are driven; and as brass can be readily soldered with half and half solder, a secure joint can be obtained by building up about the small stub ends of the brass pins that project from the aluminum.

Often it is desirable to make up plates from standard patterns which are already in service and upon which no extra allowance for another shrinkage has been provided. Frequently, a small degree of shrinkage will not matter in such a case. Then the following white-metal alloy mixture will be satisfactory: Tin, 65 per cent.; antimony, 10 per cent.; zinc, 20 per cent.; lead, 5 per cent.

In cases where it is desired to eliminate every degree of shrinkage possible, 5 per cent. of bismuth can be added to this alloy, displacing an equal amount of antimony. Bismuth has the peculiar property of expanding when it solidifies, so that it will to a great extent make up for the shrinkage of the other component parts of this alloy.

When a plate is to be cast from aluminum, almost any one of its common commercial alloys will be satisfactory, although a stiff one should be selected, as pure aluminum makes a soft casting that is rather subject to damage from bending or bruising. Where pure aluminum has been furnished the foundry, it can be alloyed with from 4 to 8 per cent. of copper or with a rich alloy mixture in which copper and zinc are mixed in such proportions that when added to the aluminum the final alloy will contain about 2 per cent. of copper and 10 per cent. of zinc.

One great factor in properly finishing a cast metal plate is to keep the patternmaker from doing any unnecessary polishing or filing on the plate itself. The sand will not naturally stick to a plate, because that parting is a flat one and will not ordinarily have any draft to necessitate a clean draw from the sand. Consequently, time spent upon it is wasted and, moreover, is apt to make the plate thin in spots, so that there will be sand crushes when the mold is closed. Sufficient finish can usually be put upon the plate by rubbing it somewhat with sand or emery cloth.

The finish of the patterns that have been cast upon the plate is a different matter. Like all good metal patterns, they should be filed or polished to a good finish, due care being observed that more metal is not removed from one side of the plate than from the other, or it will show in a badly matched parting when the casting comes from the sand. The true measure of the skill of a metal-plate maker will be indicated by the condition of the plate he sends to the foundry and its degree of freedom from back-drafts.

Power Device for "Spotting-In" Parts

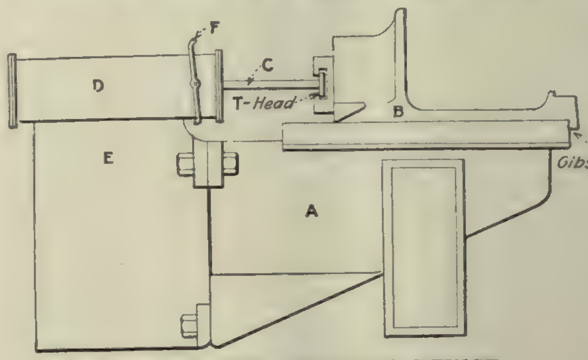
By H. B. McDermid

When scraping in heavy parts of machine tools or bearings, it is often unhandy to keep a gang of helpers to aid a skilled mechanic to move the parts while "spotting" the work for scraping. In many places conditions are such that no special devices can be used for doing this work, but in shops producing large quantities of similar pieces such apparatus can sometimes readily be designed, or some stock device be placed upon this special job, with the result that only the skilled mechanic is needed upon the work, leaving the helpers free for other duties.

Such a device was recently seen by the writer in the shops of the Blanchard Machine Co., Cambridge, Mass. The head of this company's heavy, high-powered vertical surface grinder carries an electric motor built upon the shaft that drives the grinding wheel, making a compact and neat design, but requiring close, accurate, scraped fits upon its guides. While the motor is capable of exerting over 30 hp., still the movements of the head must be accurately controlled, as the limits of accuracy in the output are often less than 0.0002 inch.

The gibs for these guides are scraped in the following manner: The column *A* upon which the vertical head *B* has its sliding fit is laid down horizontally, with the head in place. To the head is attached the piston rod *C* of an ordinary stock air hoist *D*, the cylinder being attached to the frame *E* of the machine. When the parts to be fitted are properly coated with red lead and the gibs fastened in their proper positions, the scraper hand merely operates the air-control lever *F* of the hoist. When the head slides forward to the predetermined point the operator reverses the hoist, bringing the head back to the initial point. As many strokes as may be required having been completed, the hoist is stopped, the gibs removed and examined and, if necessary, scraped and again marked as before.

It is simply a case of a standard device being put to a new use with good results. There is no pulling and hauling of heavy parts by a high-priced mechanic, nor any need to keep a gang of helpers within call. The work is done rapidly and better than by hand, the gibs can be set tighter, and as the power permits steady positive movement of the fitted parts, it is likely that more precise and positive spotting is secured, thus permitting work to be scraped with fewer trials.



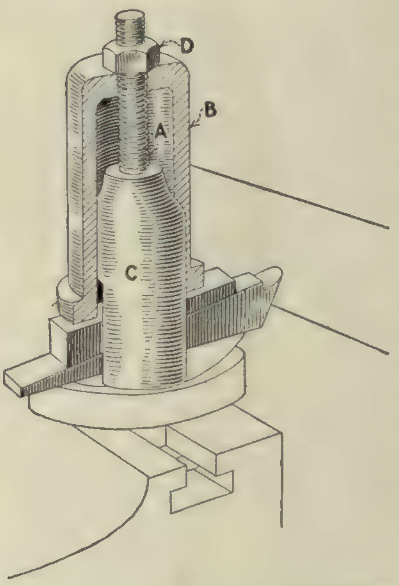
THE POWER SPOTTING DEVICE

The apparatus was devised and placed in operation by W. W. Blakeman, superintendent of the shop.

Toolpost Repair and Improvement

By W. B. Robe

Having had considerable trouble with toolpost screws in our manufacturing lathes, I developed the toolpost attachment illustrated, which has proved satisfactory. The stud *A* is made to fit the toolpost. The sleeve *B* fits over the outside of the toolpost *C* and has a hole in the top to fit the stud *A*. With the addition of a nut *D* to pull down the sleeve, the toolpost is complete, and stud and nut can be renewed without trouble. The tool is held at two points over a solid ring and not at one point over a hole in the ring. This attachment has been used for the past three months on all our lathes, 24 hours a day, and as yet has needed no repairs. Tool breakage has been greatly reduced, and the device has been successful with "efficiency"-type self-clamping toolholders.



IMPROVED REPAIR OF TOOLPOST

The Panoramic Sight

By

W. L. Olmstead

IV. Special Gear Operations

The cutting of the worms and gears on the panoramic sight is a difficult machine operation. Extreme accuracy is required in the milling operation on the teeth. The standard dividing head of a high-grade miller, however, is not sufficiently accurate.

The double pinion, shown in Fig. 37, is made in two parts forced together. The smaller, or 12-tooth, pinion is completely finished first. The large pinion is then finished to size except turning the outside diameter and cutting the teeth. The two pinions are then forced together, the large pinion finish is turned, and the teeth are milled. The double pinion must be milled very accurately, as it operates the mechanism that measures the

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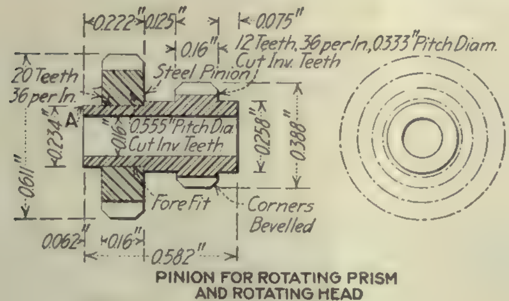


PINION FOR ROTATING PRISM AND ROTATING HEAD
FORGED STEEL, Finish

FIG. 37

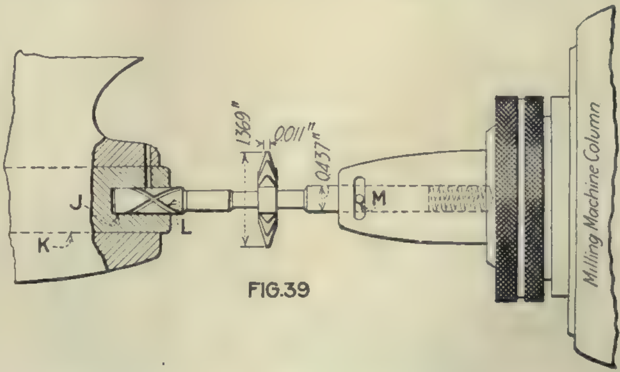
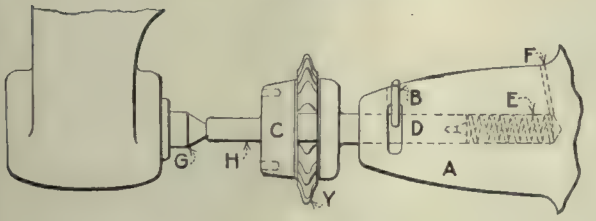
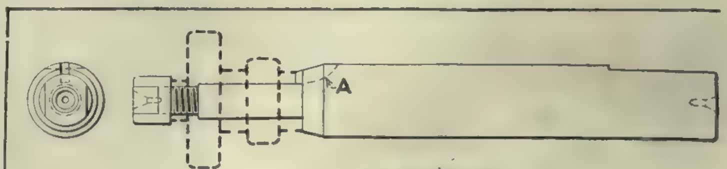


FIG. 39





MACHINE STEEL
Finish f±0.002"

FIG. 40

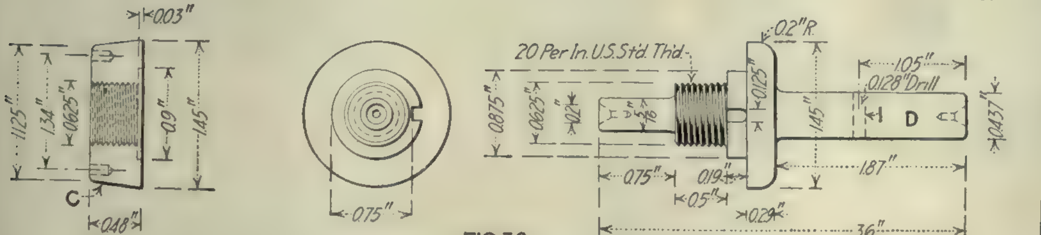
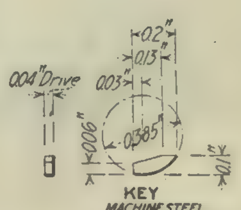


FIG. 38



KEY
MACHINE STEEL
Finish f±0.002"

FIGS. 37 TO 40. THE DOUBLE PINION AND THE SPECIAL MILLING FIXTURE movements of the rotating head and rotating prism, the results of which must be accurately recorded if correct results are to be secured.

A device for holding the milling cutter is illustrated in Fig. 38. It is used to correct the variation caused by the expansion or contraction of the metal parts of the miller and reduces the chance for error.

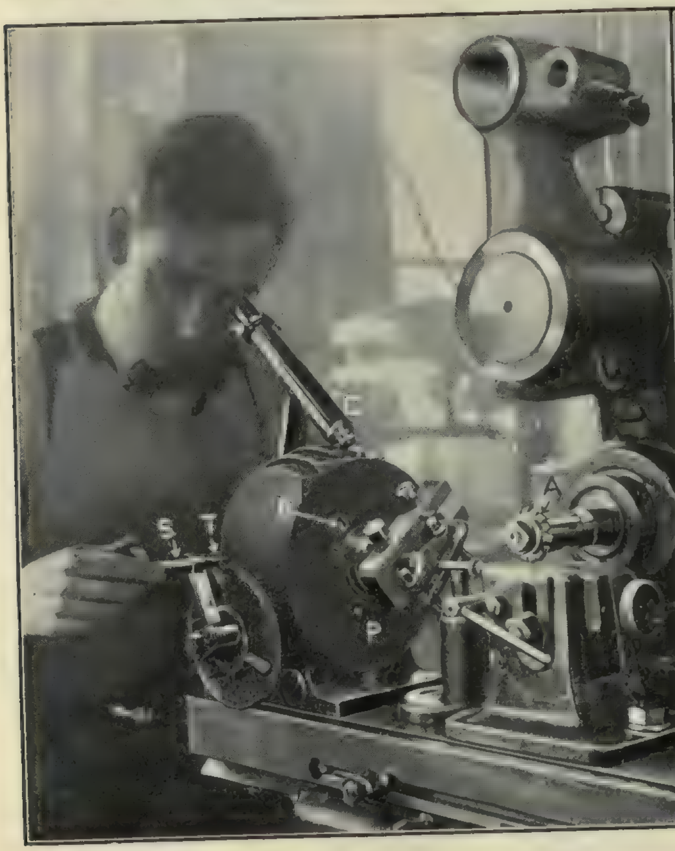


FIG. 41. MILLING THE DOUBLE PINION

In Fig. 38 is given a detailed view of the cutting arbor. The material is machinery steel. The shank is turned to fit the special collet *A* and is drilled for the driving pin *B*. The arbor is turned and keyed to fit the Brown & Sharpe gear-tooth cutter *Y*, and is threaded for the clamping nut *C*. Two spanner holes are drilled.

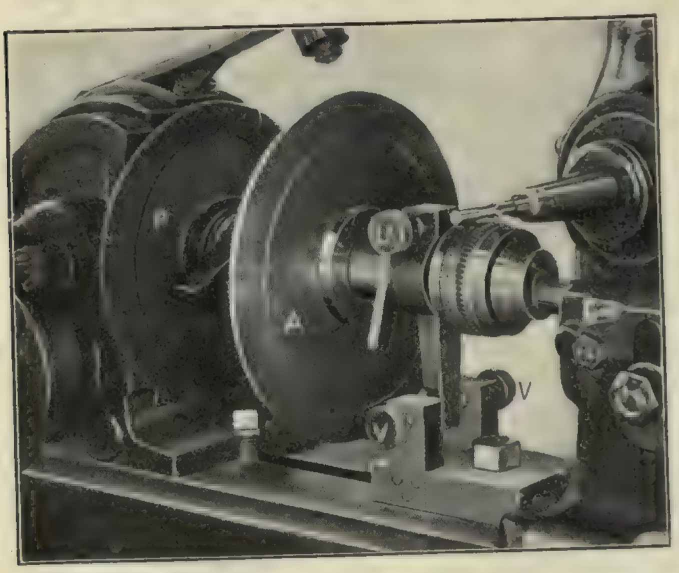


FIG. 43. NOTCHING OPERATION

The collet *A* is bored and reamed to fit the arbor shank *D*. The hole is of sufficient depth to receive the tension spring *E*. An air hole should be drilled in the collet at *F*. In making the arbor the shank *D* should fit the collet hole so that there is no perceptible shake.

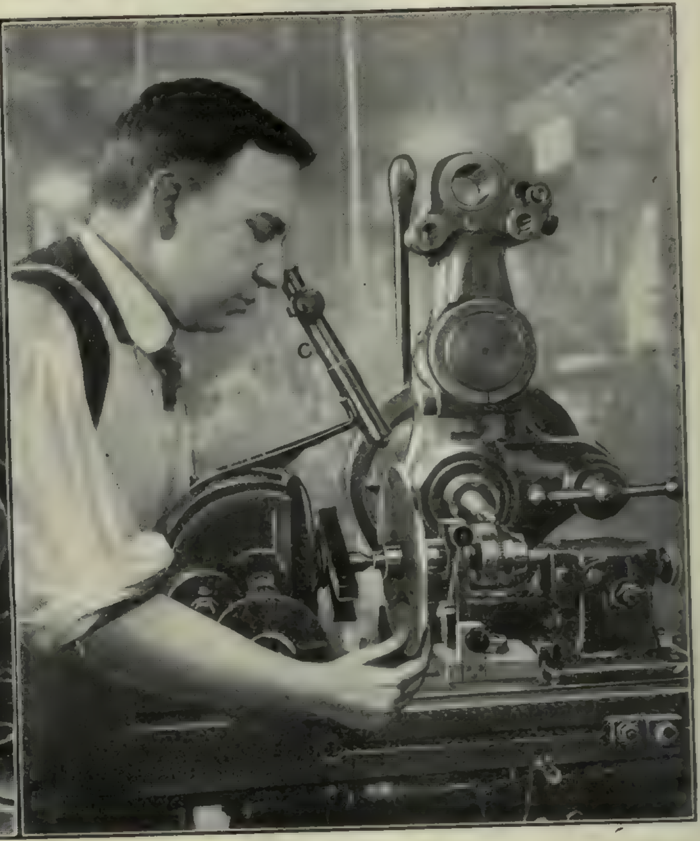


FIG. 42. METHOD OF INDEXING ON DEAD CENTERS

The outer shank *H*, after the arbor has been rough-turned, is finished to size and case-hardened. The other dimensions are then machined to size.

Pressure against the overhanging arm is applied, causing the spring *E* to contract. The degree of spring tension desired is governed by the size of the wire and the length of the spring. It should be at the right tension when the pin hole *I* in the arbor shank *D* is opposite the slot cut in the collet *A*. The driving pin *B* is then pressed lightly into the shank.

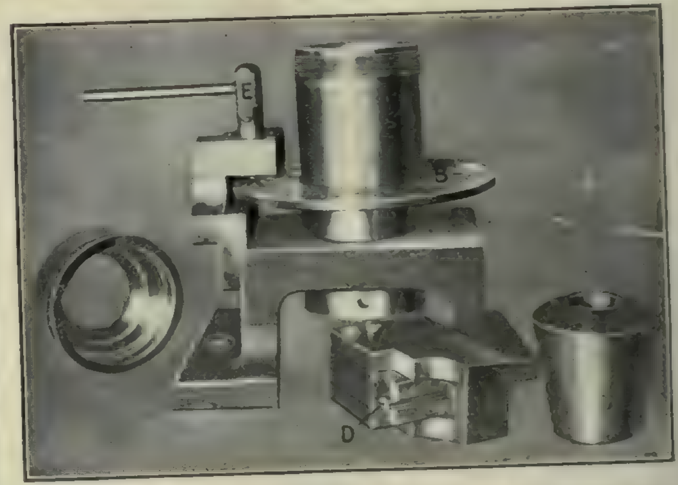


FIG. 43A. INDEXING AND WORK HOLDING FIXTURE FOR GEAR SHAPING OPERATION

By this arrangement the arbor is held firmly against the center *G* by the spring. The reason for using special means for holding the cutter is because it reduces to a minimum the loss of position of the cutter under certain conditions. If, for example, a cutter arbor is used which drives solidly into the machine spindle, the lateral position of the cutter is affected by expansion or contraction unless the job is carried to completion without stopping the machine. This applies of course to the degree of accuracy demanded. In cutting accurate gear teeth on a miller it is good practice not to start the cut unless all the teeth can be milled without more than a temporary stop of the machine. When the special apparatus described is used, the trouble is practically eliminated, as the changes in temperature affect only the part of the arbor between the center *G* and the cutter. In Fig. 39 is shown the special cutter for the scoring operation on the azimuth wormwheel. The method of holding the cutter is the same as that shown in Fig. 38, with the exception of the support for the outer end. In this case the cutter and arbor are made in one piece. The outer end is turned to fit into the hole *J*, bored into the sleeve *K*. The bottom of the hole *J* is machined square to take the thrust of the outer end of the arbor. The sleeve *K* fits the hole in the overhanging arm. The oil grooves *L* provide the lubrication.

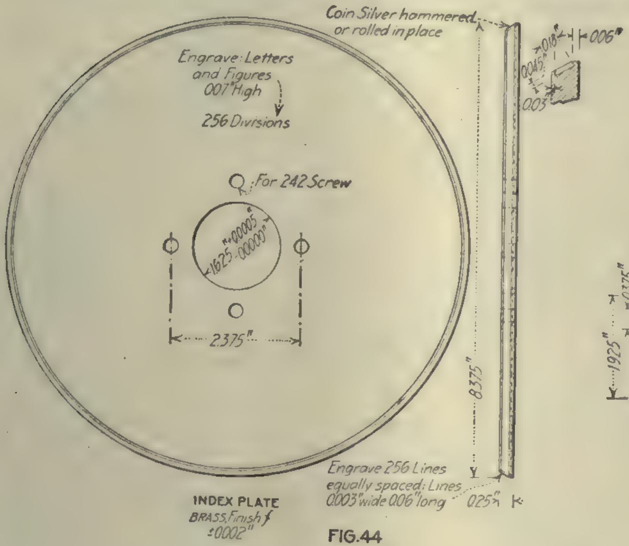

Coin Silver hammered or rolled in place
Engrave: Letters and Figures 007" High
256 Divisions
For 242 Screw
+.00005 1.625 -.00000"
2.375"
8.375"
.018"
.006"
.0045"
.003"
Engrave 256 Lines equally spaced: Lines 0.003" wide 0.06" long
.025"
INDEX PLATE
BRASS, Finish ƒ ±.0002"

FIG.44

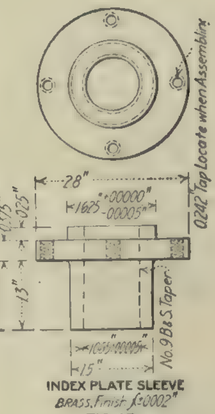


FIG.45

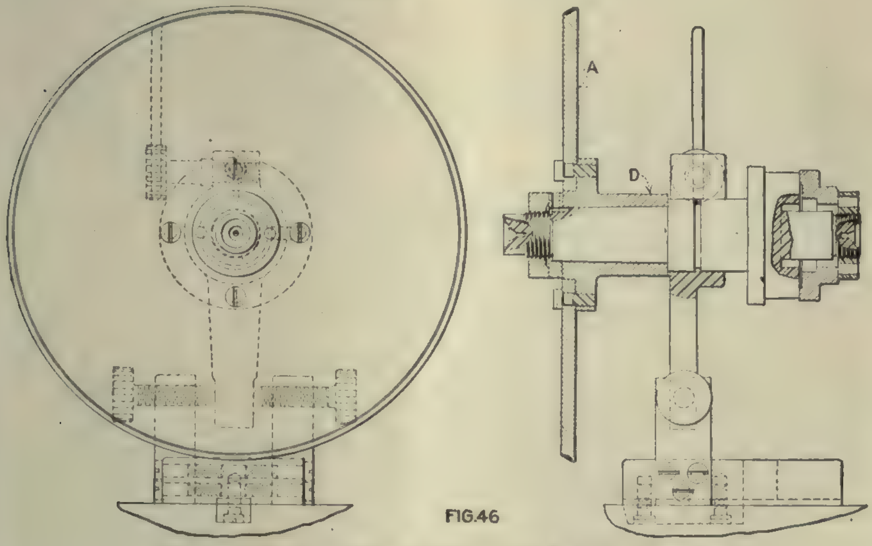


FIG.46

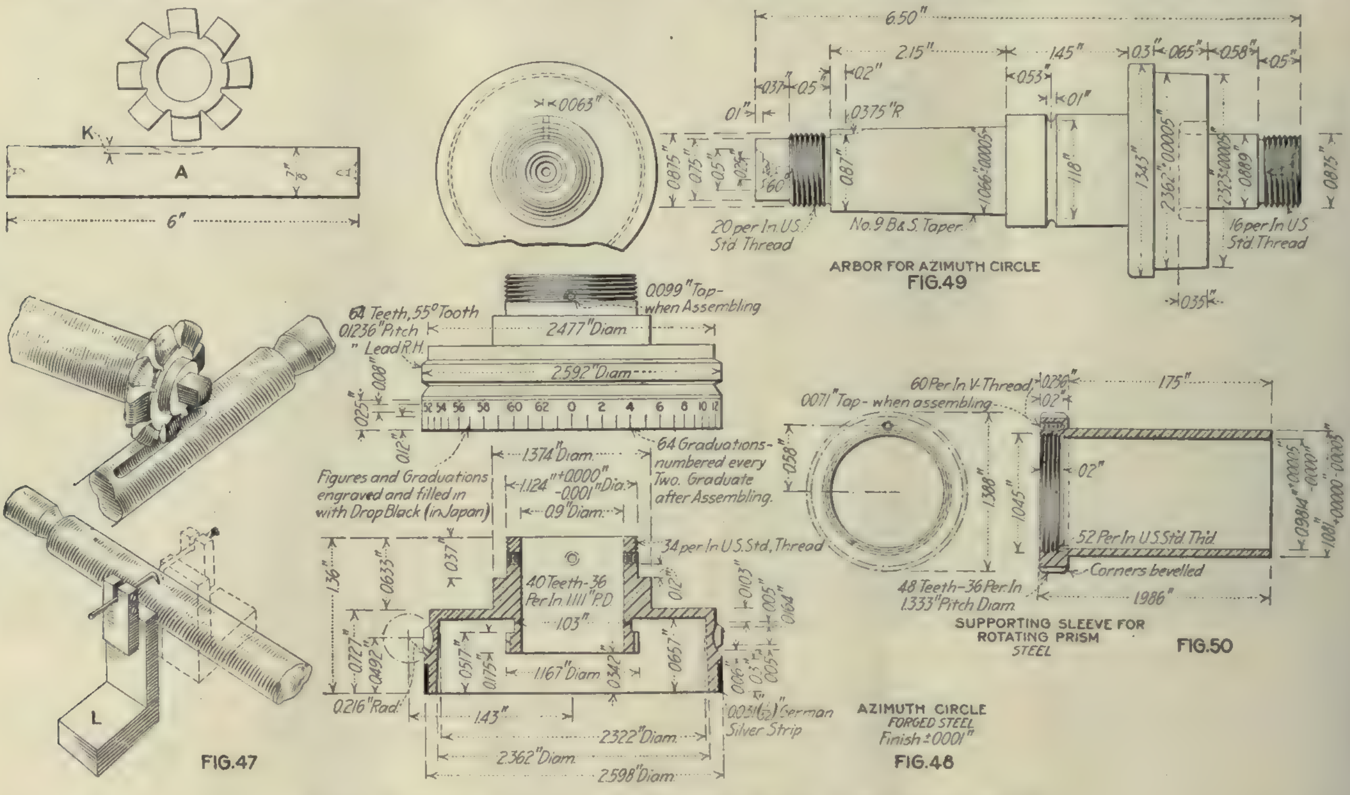
FIGS. 44 TO 46. THE INDEX PLATE AND SLEEVE

The driving pin *M*, in Fig. 39, is shown in its central position. If desired, the pin can be made to screw into the arbor instead of using a straight plug.

The holding arbor for the double pinion is shown in Fig. 40. It is fitted with the holding key *A*. The corresponding slot in the pinion into which the key fits is not shown on the pinion drawing, but is cut at the end marked *A* in Fig. 37. It is used for holding the pinion from turning on the arbor during the operation of milling the teeth, and is used for that purpose only. The arbor is held between centers, as shown in Fig. 41. In this illustration the method of holding the cutter arbor *A* differs slightly from the method described for Fig. 38. The principle is the same, however, the difference being that the tension spring is held in a slightly different way. In Figs. 41, 42 and 43, the overhanging arm that supports the outer center during the milling operation is temporarily withdrawn so that a clear view of the operation is obtained. Three index plates are used for the work on the panoramic sight. It will be observed that the index plate *P*, Fig. 41, is attached to the dividing-head spindle. The hole in the index plate is made a trifle larger than the diameter of the hub of the spindle, so that the adjusting screws *R*, of which there are three, can be used to adjust the plate so that it will run true to an indicator. The support for the microscope *C* is slotted, so that adjustments for focusing can be made when setting up. The microscope contains two vertical crosshairs that are used to determine the position of the engraved lines on the beveled edge of the plate, which are brought into the central position between the crosshairs by turning the index finger *S*. For the purpose of making close adjustment easily, the shaft of the finger at *S* is fitted with the small pinion *T*, which engages with the circular rack cut upon the index dial. As the pinion will run freely around the dial, the finger can be revolved rapidly for the number of turns required to bring the desired line under observation through the microscope, and the finer adjustment is then made.

The cutter for cutting the teeth in the work should be very carefully inspected before using, especially in regard to the shape of the tooth. Standard gear-tooth cutters for involute teeth are satisfactory, provided the shape is correct. Both sides of the tooth must be exactly the same shape. A correctly made gage, by reversing the gage on the tooth, will show whether the shape is the same on both sides of the tooth. Keep the cutter sharp! To get the best results where great accuracy of the gear parts is demanded and standard machine tools are used, it is advisable to watch carefully the seemingly unimportant details during the various operations.

For the purpose of setting the cutter central, a small bar of brass *A*, Fig. 47, is helpful. Any other metal can be substituted, if preferred. In the same figure is shown the method of using the scriber for laying out the centralizing lines on the brass bar. The bar is held between the miller centers, and the face of the angle plate *L*, with scriber and holder attached, is pressed firmly against it. The angle plate is alternately placed on each side of the bar, and parallel lines are scribed at a width to suit the cutter used. The cutter is then brought into an approximately central position and milled into the bar to its pitch line, or about half of its full cutting depth. By the guiding lines previously scribed on the bar, it can be determined what amount of lateral movement is necessary to bring the cutter to its true central position.


K
A
6"
L
FIG.47
0.063"
6.50"
2.15"
.145"
.0375"R
20 per In. U.S. Std. Thread
No. 9 B&S Taper
16 per In. U.S. Std. Thread
ARBOR FOR AZIMUTH CIRCLE
FIG.49
64 Teeth, 55° Tooth
0.1236" Pitch
" Lead R.H.
0.099" Tap-when Assembling
2.477" Diam.
2.592" Diam.
64 Graduations-numbered every Two. Graduate after Assembling.
Figures and Graduations engraved and filled in with Drop Black (in Japan)
1.374" Diam.
1.124" +0.000" -0.001" Dia.
0.9" Diam.
34 per In. U.S. Std. Thread
40 Teeth-36 Per In. 1.111" P.D.
.103"
1.167" Diam.
0.216" Rad.
.143"
2.322" Diam.
2.362" Diam.
2.598" Diam.
0.031(62) German Silver Strip
AZIMUTH CIRCLE
FORGED STEEL
Finish ±0.001"
FIG.48
60 Per In. V-Thread
0.071" Tap - when assembling
.175"
.02"
52 Per In. U.S. Std. Thd.
Corners bevelled
48 Teeth-36 Per In. 1.333" Pitch Diam.
.1986"
SUPPORTING SLEEVE FOR ROTATING PRISM
STEEL
FIG.50

FIGS. 47 TO 50. VARIOUS PARTS, FIXTURES AND OPERATIONS

The index plate, Fig. 42, differs from the plate shown in Fig. 41 only in the way in which it is used. In Fig. 41 the plate is held so that it is turned with the spindle of the dividing head. The work on its arbor also turns with the spindle to which it is attached by the dog. In Fig. 42, however, the plate has no connection whatever with the spindle, except that it is supported by the headstock center. The work in this case is milled on dead centers. The indexing is performed independently from the dividing head.

The index plate *A*, Fig. 42, is used for the scoring operation for the azimuth-circle worm. It is graduated so that the operator, with the aid of the microscope *C*, can obtain the setting for each tooth with great accuracy. In Fig. 44 the details of the index plate are shown. It is bored and faced to fit the hub of the index plate sleeve *D*, Fig. 45. The outside diameter is turned bevel and recessed to receive the german silver or coin silver, which is hammered or rolled into place and given a high finish. Graduated lines are then engraved upon its surface.

It is necessary to have the graduated lines cut with a graduating machine. The lines so cut are barely visible to the naked eye, but when seen through the microscope are clear cut and sharply defined. The outside diameter of the index plate should be concentric with the hole. The operator of a graduating machine generally trues the work with an indicator, using the surface that is to be engraved. Two sets of graduations can be engraved if desired, one of 256 equal divisions on the outer edge and one set of 360 divisions on the inner edge of the beveled surface.

In Fig. 46 the index plate is shown attached to the taper-end of the arbor. The opposite end of the arbor is turned to receive the work, which in this case is the azimuth circle, Fig. 48. Details of the arbor are given in Fig. 49.

In Fig. 43, the set-up for the scoring operation is shown. In this photograph the overhanging arm is disengaged temporarily. The plate *P*, attached to the spindle, is used when cutting the double pinion. When not in use, the graduated rim is covered with a protecting felt cover, as shown. In this figure the work is held on dead centers and is not dependent upon the dividing head for the indexing.

At the completion of each cut, the indexing is performed by loosening the screw *U*, which allows the index plate *A* to be revolved freely. The operator turns the plate by hand until the graduated line for the next division appears under the microscope. The binding screw *U* is then tightened, and finer adjustments are made with the adjusting screws *V* secured in a block fastened to the table.

The supporting sleeve for the revolving prism is shown in Fig. 50. In the first operation the sleeve is roughed out all over. The second operation is annealing. The third operation is finish-boring, face and thread one end. In the fourth operation the outside is finish-turned. The teeth are then milled with the special milling appliances previously described.

The operations on the azimuth circle are as follows:

Operation 1—The forged-steel blank is chucked. The taper recess is roughed out, the clearance cut and inside gear blank roughed, and a $\frac{13}{16}$-in. hole is drilled and reamed.

Operation 2—A $\frac{13}{16}$-in. arbor is used, and all other dimensions are rough-turned to $\frac{1}{32}$ in. of finished size.

Operation 3—Anneal.

Operation 4—The $\frac{13}{16}$-in. arbor is used and a second roughing cut taken all over, allowing 0.005 to 0.010 for finish-turning. In this operation the seat for the german-silver band is turned to the finished size.

Operation 5—Solder on the german-silver band.

Operation 6—Use $\frac{13}{16}$-in. arbor and turn edge of german-silver band flush with the end.

Operation 7—The work is held with its tapered recess side fitted to a special holder, and the finished thread is cut upon the hub. The diameter, 1.374 in., is turned to size, and the faces are finished. Holding by the same taper recess, the hole is bored and reamed to size.

Operation 8—Finish-turn all over except taper. The taper cut is finished last, holding the work by the threaded hub and its face.

Operation 9—Lap to gage.

Operation 10—The gear teeth are shaped upon the inside hub. For this operation the vertical slotting head for the miller and a special gear-tooth shaping tool *D*, Fig. 43A, are used. For the indexing, a special index plate *B* of large diameter is attached in a horizontal position to the work-holding fixture, Fig. 43A. Index holes are located near the rim and are spaced to correspond to the number of teeth on the work. An indexing plunger *E* permanently doweled to the fixture is entered into each successive hole as the plate is revolved for the indexing. The use of an index plate of large diameter reduces the slight errors in the position of the holes. A slight error in the holes of the large index plate would be negligible when reduced to the diameter of the work. The plate should not be less than 12 in. in diameter.

Operation 11—The work is held as shown in Fig. 43 and notched for the worm-hob cut. The notching tool, Fig. 39, is used. Particular attention must be given to seating the work properly on the arbor. The taper hole must be firmly and snugly seated. After the notching operation on each piece, a worm hob is used and the work hobbed to the finished size. In using the vertical feed during the hobbing operation, do not feed up at the same place at each revolution of the work. For gaging the depth of the cut, a master worm is placed in the work and the over-all measurement taken with a micrometer. The distance between the centers of the worm-wheel and worm can then be figured.

Operation 12—Graduate and engrave. If a graduating machine is not available, the graduating can be performed with excellent results with the same arbor and index plate shown in Fig. 43. The figures are then engraved with an engraving machine.

The Anti-Metric Case

By F. A. Halsey

Referring to the article, "The Anti-Metric Case," by Robert B. Sosman, on page 740, Vol. 46, Mr. Sosman's attitude is one of sympathy with English measures, but he seems to be disturbed over our fractional railway gage and the sizes of pipe and shafting. The origin of our railway gage was due to the accident of circumstance. It was, at the start, 5 ft., measured between the flanges, which were on the outside of the *rails*. When the flanges were placed on the wheels in order to save existing cars, the gage was reduced to 4 ft. 8½ in., where it now stands. Unfortunate as this is, there is no better illustration in the entire range of industry of a dimension that it is impossible to change.

As regards drawn pipe, the bore was originally of the true size within the tolerances permissible in such work. Those sizes, however, involved an excessive and unnecessary thickness of material for ordinary pressures and, as methods of manufacture improved, it became feasible to reduce the thickness of the pipe wall. In the meantime, the Briggs system of pipe threads and fittings had come into use. To reduce the thickness of the wall by reducing the outside diameter involved a complete upsetting of the system of threads and fittings, whereas, by enlarging the bore, these standards were unchanged.

Our shafting sizes form a parallel case with lumber measurements. As sawed, a 1-in. board measures 1 in. in thickness—again within the tolerance required for such work. When we put a 1-in. board through a planing mill and plane off one side, its thickness is reduced, but, in the trade, it is still called a 1-in. board. When we put it through the mill again and plane off the second side, its thickness is again reduced, but it remains, in the trade, a 1-in. board.

Precisely so with shafting. In the nature of the case, a turned shaft is smaller than the rough bar from which it was turned. The first operation being that of rolling the rough bar, it is naturally made to the neat size, again within the tolerances required. When we turn the bar, we take off $\frac{1}{16}$ in.; but if the rough bar was 2 in. in diameter, we still call it a 2-in. shaft.

These things are merely matters of trade custom. I do not see that they have any bearing on our system.

Carbonized Machine-Steel Bushings

By H. A. Schauer

I have had experience with carbonized machine-steel bushings similar to those Mr. Johnson wrote about on page 712, Vol. 46, but in my case it was mostly with large ones. They were used as drill and reamer bushings, also as guide bushings for boring bars in crank-case jigs.

A number of the tool-steel bushings had been lost through cracking just under the head, and as some of them were made as much as 4¾ x 5¼ x 4½ in. long, the loss was considerable and so this method was tried and adopted. To the best of my recollection no bushing made in this way was ever lost. Another thing, these bushings required less stock for grinding than those made of tool steel, owing to the fact that they distorted less, 0.030 in. being sufficient to clean them up internally.

Perspective Sketching from Orthographic Views

By ARTHUR B. BABBITT

SYNOPSIS — *This article is especially prepared for the draftsman who may have occasion to make perspective sketches from working drawings. The accompanying diagram, if properly employed, will enable one to make a perspective drawing in good proportion, even though he may not have had previous training in free-hand drawing.*

TO OBTAIN the true convergence of lines, to secure the proper spacing and relation of these lines to each other and to make them the proper length require a training of hand and eye which most of us engaged in mechanical work have not acquired; in fact, a training which requires also natural ability that many of us do not possess. To use the diagram, Fig. 1, to the best advantage, it should be stretched upon a drawing board in order that the free-hand sketch to be made may be drawn upon tracing cloth or thin paper tacked over the diagram.

The heavy, full lines form the perspectives of squares and may be used as guide lines for the edges of rectilinear objects. The numbers on these lines measure off equal units of length. The finer full lines show the half-unit dimensions, and the dashes across the full lines give quarter-unit values. The vertical lines are parallel, as is the case with all vertical lines of a perspective drawing. The lines at right and left of the vertical line upon which the numerals are given converge to vanishing points that are located at some distance to the right and left of the diagram. On the vertical line that is numbered, the measurements are equal, while on the oblique lines as we get farther away from this vertical line, the units of measurements decrease in length as they do on a perspective drawing. These units of measurement are in the proper proportion to the units of measurement given on the vertical line.

The portion of the diagram thus far described is all included in and represents two planes at right angles to each other. The line where these two planes meet is the vertical line upon which the numerals are placed.

The fine dash-line extensions of the heavy full lines must be imagined as projecting out from the planes just referred to and extending to the right and left of the observer. If those using the diagram will get a clear conception of the relation of these planes and the projecting lines, it will be a material help in using the diagram.

Perspectives of a Square Prism

In Figs. 2, 3 and 4 are shown perspective drawings of a square prism, having a base 1¾ in. square and an altitude of 3 in. These drawings are made with the prism in three different positions and using three different parts of the diagram. These same perspectives, with the portions of the diagram by which they were drawn, are shown respectively in Figs. 2-a, 3-a and 4-a. In Fig. 2-a the base of the prism, which is 1¾ in. square, is shown at the left. To obtain this base, we first draw the vertical line from *O* to the point representing the 1¾-in. dimension. From this point a line is drawn for 1¾ in. on the oblique line to the left, indicated by the dashes. From *O* on the lower oblique line to the left we trace a line 1¾ in. long, and from the extremity of this line a vertical line is drawn completing the square of the base of the prism. Only one of these lines, the vertical one from *O*, is in its true length, and all the others are the perspective lengths of the lines with the object in that particular position.

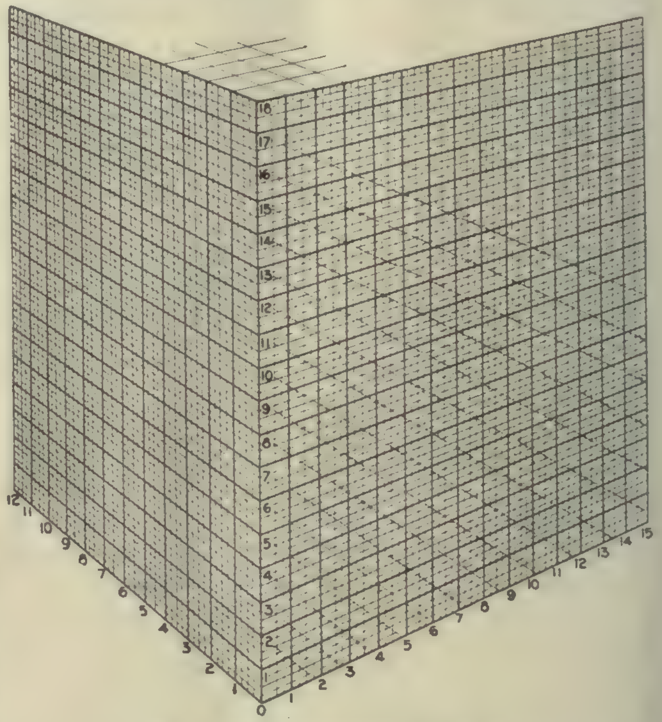


FIG. 1. PERSPECTIVE DIAGRAM

The altitude of the prism may be laid off on the oblique line at the right by drawing a line 3 in. long on the lower line of the diagram. A vertical line 1¾ in. long at the end of this line determines the height of the right-hand edge of the prism. The upper line of this right-hand large rectangular surface of the prism follows the line of the diagram 1¾ in. above the lower line. The top surface is completed by drawing the upper lines of the figure with the same general taper as the lines of extension in front of the planes of the diagram.

The same prism shown in Fig. 3-a is drawn with the square surface at the right, using the section of the diagram near the 9- and 13-in. dimensions on the vertical line. One of the 1¾-in. dimensions is laid off from the 9½- to the 11¼-in. line, giving one edge of the square base. The square is completed by drawing lines *A*, *B* and *C*, each being 1¾ in. on the perspective scale of the diagram. The line *D* is made 3 in. on the scale, which gives the altitude of the prism. The lines *E* and

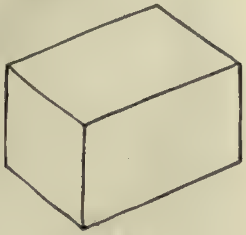


FIG. 2

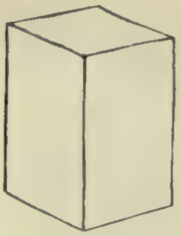


FIG. 4

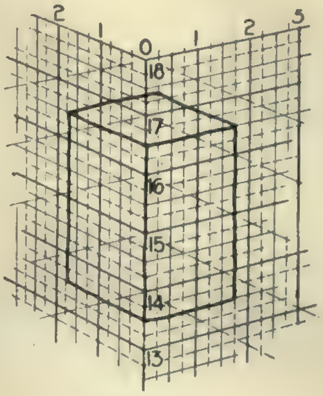


FIG. 4a

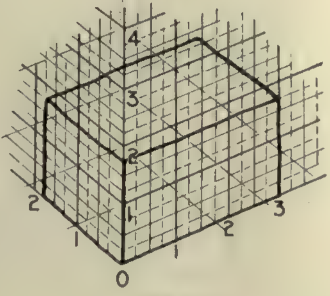


FIG. 2a

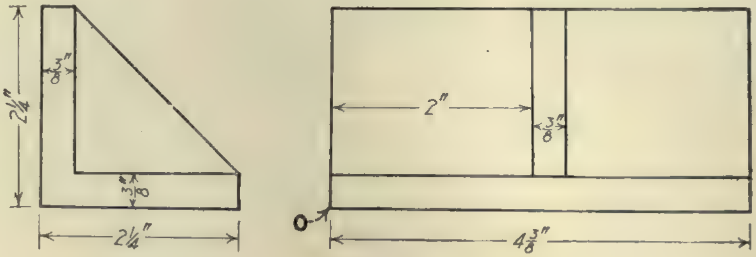


FIG. 5

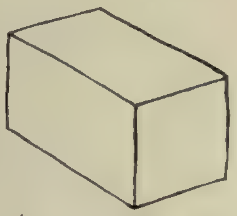


FIG. 3

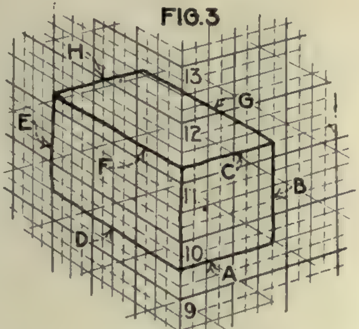


FIG. 3a

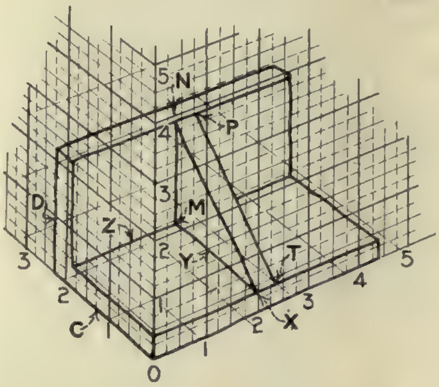


FIG. 6

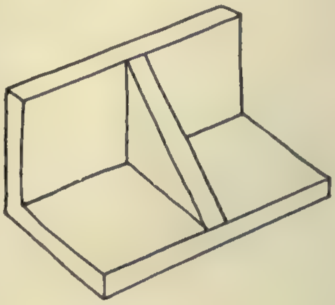


FIG. 7

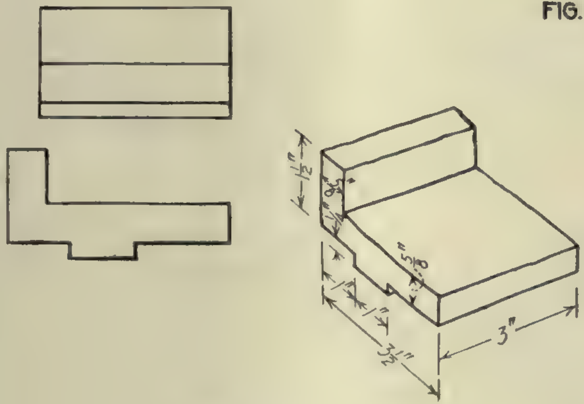


FIG. 8

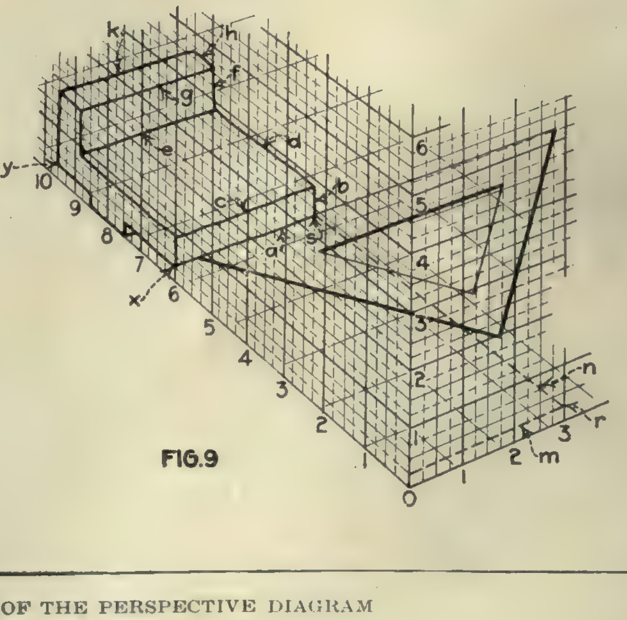


FIG. 9

FIGS. 2 TO 9. A NUMBER OF USES OF THE PERSPECTIVE DIAGRAM

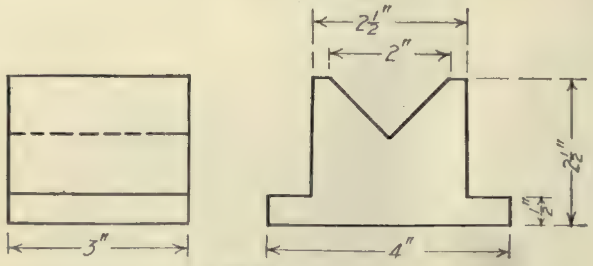


FIG.10

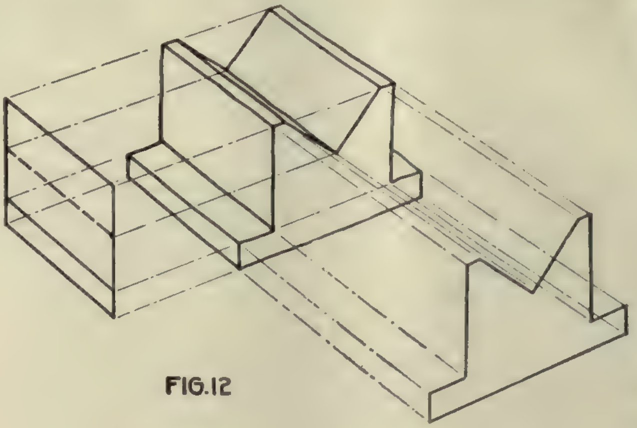


FIG.12

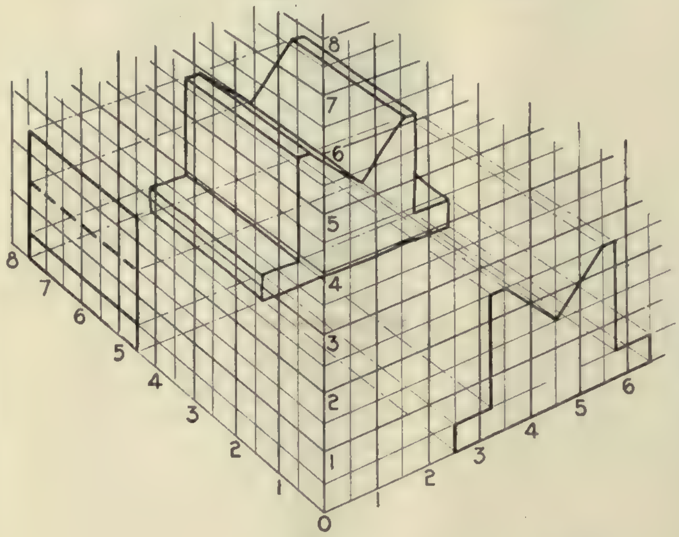


FIG.11

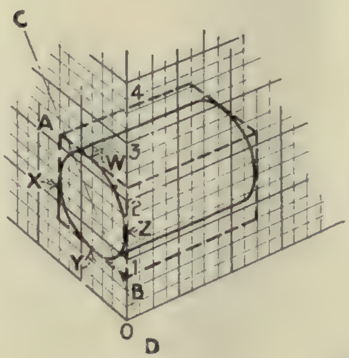


FIG.13

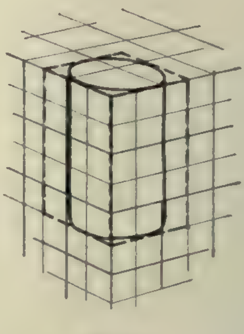


FIG.14

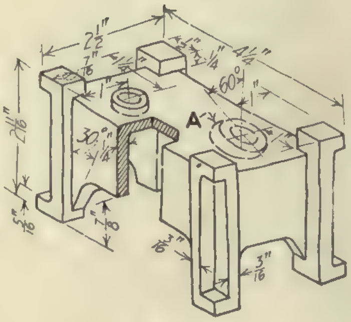


FIG.15

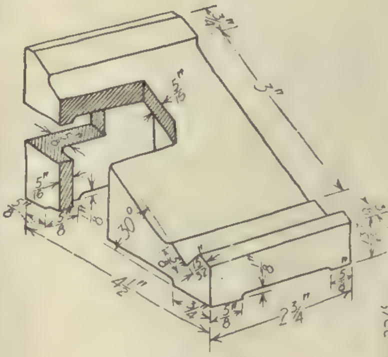


FIG.16

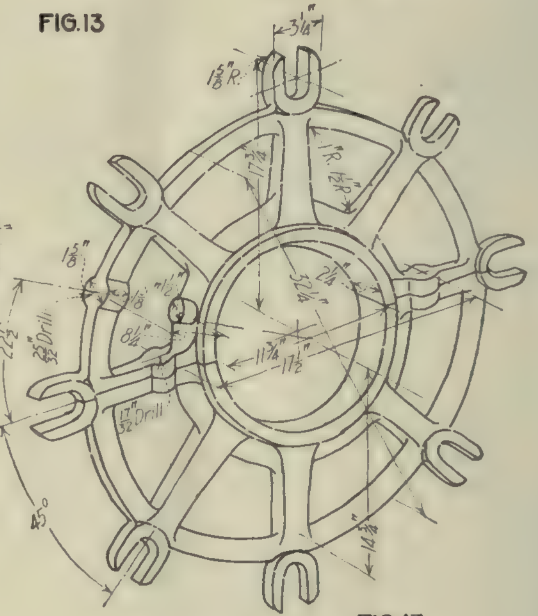
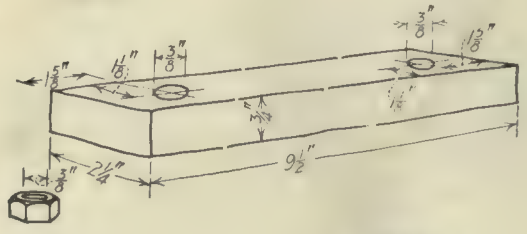


FIG.17



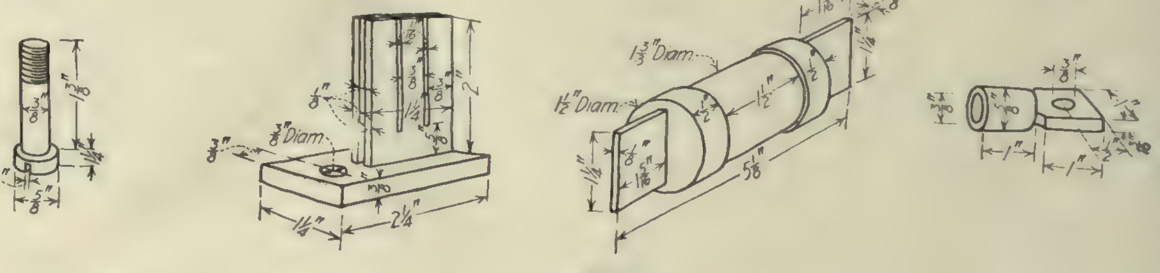


FIG.18

FIGS. 10 TO 18. APPLICATION OF THE PERSPECTIVE DIAGRAM

F complete the large left-hand rectangle. The general direction of the lines *G* and *H* is determined by the long dash lines extending in front of the perspective planes from point 13. The lines *G* and *H* are not drawn parallel to these extension lines, but converge to the same point that all lines drawn in these directions do, the angle being determined by the eye.

THE PRISM RESTING ON ITS SQUARE BASE

The third position of the prism is shown in Fig. 4-a. This sketch is begun at the 13½-in. graduation on the vertical line, and the height of the front edge is obtained by drawing the line up to the 16½-in. graduation. Notice that the lines for the edges of the bases are 1¾ in. long and are measured on the oblique lines at right and left of the vertical. A further description of the manner in which the figure is completed is hardly necessary.

Let us next apply the diagram to the drawing of an object in which two orthographic views are given. Take, for example, the angle plate given in Fig. 5. This is a simple problem, as it has all straight lines. It will be readily seen that the object may be drawn in several positions. It may be shown resting upon one of the broad surfaces with the angle either at right or left, or it could be shown resting upon the end with the long edges in a vertical position.

Let us assume the position in which we would most naturally find the angle plate when it is in use. This would be in the position shown in the orthographic view, Fig. 5, resting upon one of its 2¼ x 4⅜-in. surfaces. The corner *O* in the orthographic placed at *O* in the sketch shown in Fig. 6 gives us a starting point for one perspective drawing. A line drawn to the right 4⅜ in. long following along the lower edge of the diagram, is the lower edge of the rectangle which is shown in Fig. 5. Vertical lines ⅜ in. long, at the ends of this line, give points which, when connected by an oblique line 4⅜ in. long, will complete the rectangle. A line 2¼ in. long drawn along the lower line of the diagram to the left from *O*, Fig. 6, gives one line of the right angle, and the left end of the line is the vertex of the angle. Another line drawn 2¼ in. long in a vertical direction completes the right angle. The surfaces *C* and *D* may be obtained by drawing lines parallel to and ⅜ in. from the right-angle lines just drawn and making connections at *O* and at the upper end of the surface *D*. The remaining lines of the figure, with the exception of the lines showing the rib or brace, may be drawn by using as guides the lines of the diagram.

To draw the brace between the angles, observe that the left edge of the brace is 2 in. from the left edge of the casting. On the upper line of the rectangular surface, Fig. 6, determine the point *X*, which is a point of the left edge of the brace, by taking a point on the perspective scale 2 in. from the vertical line through *O*. Through this point draw the line *Y*, using the line of the diagram from point 3 as a guide. The intersection of this line with the line *Z* will be the vertex of the right angle of the side of the brace, and the line *M N* will complete this angle. The line *X N* forms the oblique line of the brace. The line *P T* gives the thickness of the brace. The points *P* and *T* are obtained by making *N P* and *X T* equal to ⅜ in. on the perspective scale. In Fig. 7 is shown the perspective drawing of the angle plate with the lines of the diagram by which it was obtained removed.

The planer angle plate shown in Fig. 8 was drawn at the left of the diagram as shown in Fig. 9. How the perspective may be applied to a working drawing by the addition of dimension lines and dimensions is also illustrated in Fig. 8. Every dimension required in making the object is clearly indicated. In Fig. 9 is shown how this view was obtained.

The perspective of the angle and the projecting key are easily obtained by following the vertical and oblique lines and laying off the proper distances by the perspective scale. The 3-in. lines follow the general direction of the extension lines which are drawn on the diagram in front of the perspective planes. In the diagram these extension lines are drawn from the inch graduations only, which may perhaps make it difficult to determine the proper angle of intermediate lines. When there is a question with regard to the direction of these lines and where the draftsman's eye may not be sufficiently trained to sense the exact angle, a straight-edge placed on the point through which the line is to be drawn and made to coincide with a line of the other plane, will give the exact direction of the oblique line. The triangle shown in Fig. 9 illustrates the point in question.

Another principle of value to the user of this diagram is also shown. The length and height of the angle plate may be readily determined on the perspective by using the scale as indicated on the portion of the diagram where the sketch is made, but the width, or 3-in. dimension, has to be determined as indicated by the heavy dash lines.

The line *a* upon which the 3-in. dimension is to be measured is ¼ in. above the plane upon which the object is resting and also ¼ in. above the horizontal plane that contains the two lines to the right and left of the vertical through *O*. This being the case, we make the measurement from the point where the line *x y*, if continued, would meet the vertical line through *O*. This point could also have been obtained by measuring up ¼ in. from *O*. To get the width after obtaining this point, measure 3 in. to the right along an oblique line. This measurement is indicated by the dash line *m*. To transfer this measurement back to the object, draw the line *n* from the point *r* to the point *s*. This line *x s* is then 3 in. long in perspective. The vertical line *b* intersecting *c* completes the end rectangle of the object. The line *d* follows the oblique line of the diagram to its intersection with *e*. The vertical line *f* and the line *g* form the face of the projecting angle, and the lines *h* and *k* complete the figure.

ANOTHER METHOD

Another method of using the orthographic views is illustrated in Figs. 10, 11 and 12. Having given the orthographic views, the perspective may be obtained by reproducing these views upon the perspective planes of the diagram and projecting to produce the picture. The V-block shown in Fig. 10 is reproduced on the projection planes and projected to obtain the picture. This is shown in Fig. 11 without the lines of the diagram. Notice that the view at the left in Figs. 11 and 12 is a perspective of the view at the left in Fig. 10.

The same statement is equally true of the views at the right in the three figures.

The projection lines to produce the sketch follow the converging lines of the two planes, and the intersection of the projection lines makes the perspective. The figures themselves speak so clearly that further explanation seems unnecessary. This method takes considerably more time than the other methods described, and would not be used in preference to any of them. It has been explained because the principle involved may be used in the solution of many intricate and awkward pieces that otherwise would be hard to handle.

A cylindrical piece may best be drawn by first outlining a square prism the faces of which are tangent to the cylinder. The circles of the bases of the cylinder form ellipses in the perspective and may be determined by the square base of a prism of an equal diameter, or at least by the points of tangency of the square and the circle. A cylinder 1½ in. in diameter and 2½ in. in altitude with the axis horizontal is shown in Fig. 13.

The heavy dash lines show a square prism drawn with the base at the left and the long edges at the right. The points *W*, *X*, *Y* and *Z*, which are points of tangency, between the circle of the base of the cylinder and the square of the base of the prism, are four points through which the ellipse of the base of the cylinder may be drawn. Here it is that some "feeling" on the part of the draftsman is necessary in order to make the curve of the ellipse such that the major axis is not on a line connecting the corners *A* and *B* of the square, but nearly upon the line which is lettered *C D* in the drawing. A cylinder in perspective with the axis vertical is illustrated in Fig. 14. This cylinder is of the same dimensions as the one shown in Fig. 13 and is drawn at the extreme upper part of the diagram.

In Fig. 15 is shown a drill jig in perspective made by the use of the diagram. This illustrates how portions of the piece may be broken out to show the interior detail. The cradle or stand for this jig to be used for drilling the oblique hole at *A* is given in Fig. 16. A number of oblique lines enter into this problem, yet it is a comparatively simple matter to obtain the true perspective, through the aid of the diagram.

The brush holder yoke shown in Fig. 17 is an example in which circles, arcs, curved surfaces and straight lines are in combination. This would be a very difficult problem without the aid of a diagram. With the diagram the problem is simplified materially. The several sketches contained in Fig. 18 were made from a number of different diagrams, as will be clearly seen by a careful study of the several sketches.

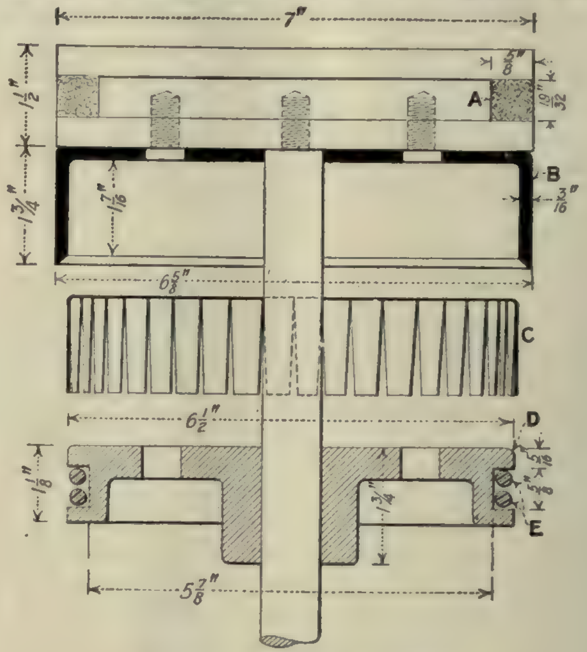
The writer does not advocate this type of drawing to supplant the orthographic type, but presents the scheme for making perspective drawings, as he has had occasion to use perspective illustrations in demonstrating the proportion and relation of many things mechanical.

Air-Hoist Piston Packing

By George W. Bershee

The accompanying illustration shows a method of making an air-hoist piston and cup leather that will give good service. I have made many such for use in an iron foundry where the hoists are used to handle ladles of iron while "pouring off" machine floors. This service requires them to hold steadily at any height needed and subjects the hoist to considerable heat. The ring of square hemp packing *A* serves as a swab and distributes any heavy oil used to lubricate the piston and cylinder.

To assemble, slide the cup leather *B* into place, then the slashed sheet-iron disk *C*, and then the follow plate *D*, and tighten all with the cap screws. The ¼-in. spring rings *E* should stand open ¾ in. when spread and the ends butt when closed. Slip these into the follow-plate groove behind the sheet-iron disk and they will keep the edge of the cup leather tight against the cylinder wall all around, and the air pressure will finish the job. The piston should then slip in easily.

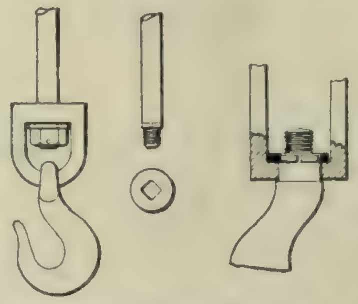


AIR-HOIST PISTON PACKING

Securing Crane Hooks

By W. B. George

Trouble is often experienced in the foundry by the loosening and unscrewing of the nuts that support the hooks of cranes and air hoists. Owing to the heat, dust and damp sand, the bearing surfaces become dry and rusty in spite of frequent oiling. I have known nuts to unscrew and come off entirely under the ordinary swiveling back and forth of the hook with its load, even though the nut had a ⅛-in. pin passing entirely through it and the hook stem. A washer of annealed tool steel, faced true on both sides and with a square hole to fit snugly on the squared end of the piston rod or hook stem, as shown, will stop the difficulty. Press the washer to its place with the nut, and pin the latter with a small pin, as shown, to prevent loosening by jarring.



SECURING CRANE HOOKS

The Submarine and Kindred Problems

By Courtesy of THOMAS ROBINS

Secretary of Naval Consulting Board

THE thousands of suggestions and plans presented to the Naval Consulting Board for assisting the Government in the present emergency indicate the patriotic fervor of the mass of our citizens.

The board makes a careful examination of every proposal presented. To facilitate this work, by suggesting the elimination of impractical ideas, the board calls to the attention of those who desire to assist it some of the popular misconceptions as to certain fundamental principles which are most frequently misunderstood by the layman.

A careful consideration of the following statements will greatly simplify the work of the Naval Consulting Board.

Electromagnets and Magnetism

The electromagnet, the magnetic needle, permanent magnets and magnetism have been carefully studied for many years, and the laws governing their application may be found in any book on the subject.

Although these laws are generally known, and applied in a practical manner in a multitude of devices in common use, even the man of wide experience will be astonished at the limited range of practical effect of electromagnets of large size. For instance, the magnets used in our manufacturing plants for lifting heavy masses of iron or steel are designed to exercise maximum magnetic effect, and for operation require a very considerable amount of electrical energy; yet a magnet which can lift 20 tons, when placed in contact with an iron plate of that weight, will not lift a 2-in. cube of iron or steel if separated from it a distance of 2 ft. Therefore, proposed devices which depend on the attractive power of magnets for their operation in deflecting or arresting torpedoes, mines or submarines, must be governed by the simple laws of magnetism. A torpedo weighing approximately 2500 lb. and traveling at a speed of 25 to 45 miles an hour will not be deflected to any practical degree by any known application of magnetism; and it is not believed that an enemy torpedo, mine or submarine will ever be found in a position to be interfered with effectively by any electromagnetic means, however powerful.

Electrical Effects in General

There is a general misconception regarding the "electrification" of water and the atmosphere. There is no known method of "charging the sea with electricity," or "shooting a bomb of electricity" or of "charging the atmosphere with electrocuting current." Suggestions along these lines should show that the writer has made research in the laws governing the application of electrical energy and should contain sufficient proof of their feasibility to insure serious consideration.

On the other hand, applications of the transmission of electrical energy by means of alternating or pulsating currents—as used in wireless systems, for example—belong to a different class of electrical development. Inventive genius is rapidly improving apparatus of this type for the sending and receiving of signals and messages, and the possibility of valuable results in this field is unlimited.

Protection against submarine attack, the subject of which is occupying the public mind as is no other, divides itself into a number of problems, the most important being the following: (a) Means of discovering the approach of a hostile submarine and locating it so as to permit prompt action for combating its attack; (b) protection of cargo-carrying ships by nets, guards and screens; (c) protection through decreasing the visibility of vessels; (d) methods of destroying or blinding a hostile submarine.

Submarines, to operate most effectively, must approach within close range of the vessel which is intended to be torpedoed. The installation of offensive weapons on the merchant marine has increased the necessity for the utmost care being exercised by the submarine commander in remaining unseen by the officers on the vessel to be attacked.

Reports from abroad indicate that in many cases submarines must have remained along certain lanes of travel for periods extending into weeks of waiting with the expectation of torpedoing certain vessels. Under certain favorable conditions, where the waters are less than 200 ft. in depth, a submarine might lie at rest on the bottom and if equipped with sensitive listening devices attempt to detect the approach of a vessel. As soon as this evidence was secured, the submarine might come to the surface for a quick observation by means of the periscope and in this manner obtain the proper aim that would be required in order to register an effective hit.

Motion Necessary in Deep Water

In case the water is more than 200 ft. in depth a submarine must be kept in motion to obtain steerage way in order to hold its proper depth of submergence. This speed may not exceed 4 or 5 miles per hour, but to remain submerged, and at the same time unobserved, the water must be at least 60 ft. deep.

The latest type of submarine which is being used abroad has a surface speed of at least 17 knots per hour and a submerged speed of probably less than 10 knots. The superior gunfire from the merchantman which has been properly equipped would make it necessary for the submarine commander to obtain his observations, such as would permit accurate aiming of the torpedo, during the very brief interval of time required to come to the surface for observation through the periscope and to again submerge.

If running near the surface, the periscope might be raised, a quick observation taken, and lowered again within 30 sec. If, however, the submarine is on the surface and hatches uncovered, from one to four minutes will be required to completely submerge, depending upon circumstances.

A submarine of recent type probably has a total radius of action of as much as 8000 miles when traveling at a moderate cruising speed of from 10 to 11 knots, and may remain away from its home base for as much as one month, without requiring either fuel or other supplies during this period.

This type of submarine may have as many as three periscopes, two conning towers and two rapid-fire guns attached to the upper portion of its hull. The vessel is steered by very efficient gyroscopic compasses, which are unaffected by extraneous magnetic or electrical influences.

A general understanding of the capabilities of the modern submarine for offensive operations will make it easier to appreciate the importance of the three problems which follow:

1. Means for Discovery—When the condition of sea and air are favorable, a submarine is readily discernible from an airplane flying at a sufficient height, even though the submarine be submerged to a considerable depth.

While airplanes have thus been used successfully in the English Channel, they are unable to fly far out to sea, where the submarines are now most active. Mother ships for carrying and launching airplanes might be used in this connection; but there are only a small number of such ships in operation, and the construction of others under present conditions is necessarily a slow process.

Sound-Recording Devices

Various sound-recording devices, intended to locate surface vessels, submarines and even moving torpedoes are now being carefully tested. Water is an excellent conductor of sound, and the development and improvement of such apparatus offer a promising field for inventive endeavor to those who possess adequate scientific training and laboratory facilities.

Many devices are suggested which depend upon optical means of detection, such as special forms of telescopes and field glasses to be mounted on ships or on scouting vessels. Many special forms of searchlights and projectors have been suggested. The fact that a moving torpedo leaves in its wake a stream of air bubbles caused by the exhaust air from its propelling engines offers, under favorable conditions, one means for discovering the approach of a torpedo. This evidence is, however, difficult to detect in a rough sea or at night, and furthermore, the bubbles do not reach the surface of the water until after the torpedo has traveled onward a distance of from 50 to 200 ft. toward its target.

The dragging of trawls or nets by special guard boats, not only with the view of locating submerged submarines, but also to sweep up floating and stationary mines, is frequently suggested. Under certain conditions this operation is practicable and effective.

It will be seen that each of the above methods, however useful, has its limitations, and scientists and inventors should apply themselves not only to the task of improving these, but also of finding supplementary methods and devices.

2. Protection of Cargo-Carrying Ships by Nets or Screens—Many designs of such devices are suggested, and most of them are intended to be attached to the hull of the vessel to be protected. Many other suggestions along these lines and differing only in some of their minor characteristics from the foregoing have been received by the board. Up to the present time not one of these proposals involving screens of any kind has received the approval of the Navy Department or of the merchant marine. The principal objections offered to these devices are that they are heavy, difficult to hold in position, unmanageable in a heavy sea and that they interfere with the speed and with the ability of the vessel to maneuver. The undeniable evidence which has been accumulated during the past few months of submarine activity has demonstrated that the immunity of a vessel to submarine attack is dependent very largely on its speed and also its maneuvering ability. The percentage of vessels having speeds of 15 knots or more which have suffered from submarine attack is very small, while the losses of slow vessels, whose speed is less than that of a submerged submarine, is practically 100 per cent. of those attacked. Many of the suggested devices would prevent the launching of lifeboats or rafts from the vessel to be protected. It is barely possible, however, that there may be developed some form of this general plan which will be found practicable. In no other field have so many suggestions or so many duplicate inventions been presented to the board.

3. Protection Through Invisibility—The point of lookout on a submarine being close to the water, the position of a vessel at a distance can only be determined by observing its smoke, which floats high in the air. Improved smokeless combustion is therefore desirable. Relative invisibility may also be afforded by methods of painting. Suggestions as to any other methods of reducing the range of visibility will be of interest.

4. Destruction and Blinding of the Submarines—A rapid-fire gun is effective when the sumbarine is seen within accurate range of the gun, but the target is so small that it is difficult to hit.

Effect of Submarine Explosions

The powerful effect of any submarine explosion on all neighboring bodies provides a simple means of destroying or crippling an undersea boat. Once it has been even approximately located, the setting off of a heavy charge of high explosive, well submerged in the vicinity of the submarine, will bring about this result.

In certain areas, a quantity of heavy, black petroleum or similar substance which will float on the surface of the water has proved an effective means of clouding the optical glass in the periscope's exposed end.

Under favorable conditions of wind and position, many vessels have saved themselves from torpedo attack by the production of a smoke screen. This may be formed either by incomplete combustion of the oil used for fuel by most naval vessels, or it may be created by burning chemicals, such as phosphorus and coal tar, or mixtures in which both of these and other materials are used.

After hiding itself from the submarine in a cloud of dense smoke, the vessel, if possessed of sufficient speed, may be able by a quick maneuver to change her position and escape before the submarine is able to discharge a torpedo.

5. Mines and Torpedoes for Naval Operations—Ever since the first use of gunpowder in the prosecution of war, mines and torpedoes have received great attention both from the warrior and the inventor. Mines are either fixed or floating. The fixed or stationary submarine mine is fired by contact, electricity, timing

device or fuse. Such mines, which are extensively used by all navies, are rugged in design and may contain large charges of explosives. They are placed in position by especially equipped mine-laying vessels. Such a mine is provided with an anchoring device.

Floating mines differ from fixed mines in that they are unanchored; and unless guard boats are at hand to warn friendly vessels of their proximity, may be as dangerous to friend as to foe. Such mines must be, according to laws of war, designed to become inoperative within a few hours after being set adrift.

The modern submarine torpedo is about 20 in. in diameter and 20 ft. in length, is self-propelled, is not steered by magnetic means, and keeps a fairly accurate course for several thousand yards at an average speed of more than 30 miles an hour. Its weight is approximately a ton and a quarter and, when traveling at normal speed, possesses great momentum—in fact, in one case when the high-explosive charge in the "warhead" failed properly to detonate, the body of the torpedo penetrated the steel hull of the ship attacked. Torpedoes are also provided with means to more or less effectively cut through screens, nets or guards placed in their path.

A torpedo is projected from a submarine or other vessel by means of a special form of tube or gun. A small charge of gunpowder or compressed air is employed to start the torpedo, after which—if of the usual self-propelling type—it is driven through the water by its own compressed-air motor, the air being supplied from a strongly built reservoir within the body of the torpedo itself. The torpedo is kept upon its course by a gyroscope steering mechanism, which is immune to outside magnetic disturbances.

The detonation of the torpedo is accomplished through a mechanism placed within its warhead; and if the torpedo is either abruptly diverted from its course or is checked in its forward motion, the firing device, which is operated by arrested momentum rather than by any form of a projecting firing pin, instantly ignites the heavy charge of explosive contained within the warhead. The explosion, if it takes place within 20 ft. of the vessel, will usually rupture the ship's plating, because of the terrific blow transmitted through the water from the point of the explosion to the ship's side. The depth at which a torpedo travels may be regulated and is usually between 12 and 15 ft. below the surface.

CONFINING THE SUBMARINES

The question as to why submarines are not destroyed before they reach the open sea is a most natural one, and the best answer which it is possible to give, according to the officers of our navy and those of the foreign commissions who have visited this country, is as follows:

The submarine bases are very strongly protected by land batteries, airplane observers and large areas of thickly mined waters extending to such distances that the largest naval gun cannot get within range of the bases. In spite of these protections, there is now going on a continuous attempt on the part of the Allied navies to entrap or otherwise defeat the submarines as they emerge from the protected areas. Nets are laid and as promptly removed by the enemy, whose trawlers are in turn attacked by our destroyers. The design of these nets and the detailed arrangement of their fastenings and attachments offer a broad field for invention, but it should be remembered that they must be capable of being used in waters in which there is a tidal current running from two to five miles per hour. Many suggestions for "bottling up" these bases have been offered; but as will be realized, it is not desirable to publish information which would indicate even in the smallest degree this country's plans.

SHIPS AND SHIPBUILDING

Many suggestions are made for ships of unusual form to provide for safety in case of a torpedo or mine exploding near or against the hull. Most of these plans are an elaboration of the usual water-tight bulkhead construction now required as structural design for all modern ships.

The multiplicity of water-tight compartments in any hull design tends to add to the vessel's safety. The modern tank steamer used to carry fluid cargoes, such as petroleum products or molasses, is a good example of this design, which has been in general use for many years.

The explosion of a near-by submarine mine or torpedo frequently tears great rents in the ship's plating, in some cases opening a jagged hole 10 ft. or more across, but the destructive effect on the hull of a ship caused by the explosion of a mine or torpedo may be greatly diminished by special hull construction.

From recent experiments and experience, it has been demonstrated that the average merchant steamer may be seriously damaged by the explosion of a torpedo 35 ft. away from its hull, but the destructive effect at any given distance from the point of explosion depends to a large extent upon the design and condition of steel framing and plating. A vessel with a strongly built hull can withstand an explosion that would destroy a weaker vessel.

INSTRUCTIONS TO THOSE OFFERING SUGGESTIONS TO THE NAVAL CONSULTING BOARD

A very large proportion of the letters and plans that are received describe devices or schemes which are obviously impracticable or which show no novelty or improvement as compared with existing methods. After the elimination of these, the more meritorious inventions are submitted to the various standing committees of the board for examination. If an invention receives the approval of a standing committee, it is presented to the board with a favorable report; and if then again approved, it is forwarded to the Navy Department with the indorsement of the board.

The fact that inventions, plans and devices must be forwarded to the various departments of the board for examination makes it essential that everything be presented in writing. Communications should be addressed to Thomas Robins, Secretary, Naval Consulting Board, 13 Park Row, New York, N. Y.

By means of the condensed information contained in bulletins, it is hoped that inventors and others who wish to present matters for examination will coöperate with the board by analyzing their own inventions. The board will thus be enabled by this help to spend a larger part of its time in the development of inventions, plans or devices which are believed to be promising of assistance to the Government in prosecuting the war.

Presumably, the Government intends to pay for inventions which it adopts, but as yet no specific provision has been made by law for this purpose.

Inventions and suggestions received by the Naval Consulting Board are examined in a preliminary way by the secretary, who is aided by the following committee of engineers: Lieut. Charles Messick, G. Herbert Condict, Howard W. Starr, Carl K. MacFadden, Percy Adams Hutchison and Lieut. Alfred Addison Thresher.

The members of the Naval Consulting Board of the United States are: Lawrence Addicks, Bion J. Arnold, Dr. L. H. Baekeland, Howard E. Coffin, Alfred Craven, Thomas A. Edison, William Le Roy Emmet, Dr. Peter Cooper Hewitt, Andrew Murray Hunt, Dr. M. R. Hutchison, B. G. Lamme, Hudson Maxim, Spencer Miller, Prof. Joseph W. Richards, Andrew L. Riker, Thomas Robins, W. L. Saunders, Matthew Bacon Sellers, Elmer A. Sperry, Frank J. Sprague, Benjamin B. Thayer, Dr. A. Gordon Webster, Dr. W. R. Whitney, Dr. Robert S. Woodward. The officers are: President, Thomas A. Edison; vice president, Dr. Peter Cooper Hewitt; chairman, W. L. Saunders; secretary, Thomas Robins.

What Will We Do with the Money?

By Entropy

Within a few weeks previous to the declaration of war there was passed in Congress a bill known as the Smith-Hughes bill, offering some millions of dollars for Federal aid to industrial education. It is necessary for each state that proposes to share in this money to set aside an equal sum, and it is within their province again to make it necessary for each city that shares it to add another similar sum. Altogether it makes possible the expenditure of something like fifty millions each year for industrial education, beginning just at a time when the country needs mechanics as it has never needed them before.

The question before us is this, Shall these millions go the way of countless other millions into the hands of professional educators who, up till yesterday, were decrying all form of industrial education as sinful in lack of culture, or shall it go into the hands of men and women who know first hand the needs of industry, even though they may be slightly lame in their methods of appealing to youth?

At first thought it might seem that the natural and proper place to look for school administrators is in schools, but this is a time which calls for virility and prompt action. No long-drawn-out courses of instruction, beginning with the history of the industry and taking the pupils through each step in its past development, can be allowed if any advantage is to be had from the expenditure of this money during the war. If advantage is not to be gained during that time, no money should be spent for this purpose.

This money should be spent to give the most direct and immediate instruction in something that will help to solve the problems now before us. We shall need a million or more men, and women, in overalls standing before lathes and millers and planers. There is not time to make a machinist of one of them before they must begin to produce. They must each, however, be able to make something, operation by operation. They must all learn how to measure, to read a micrometer, to use a gage, to realize when a tool is cutting freely and when it is not.

This is not a matter of months, but of weeks, provided the necessary machinery can be had and provided the men who can best show another how are spared both from enlistment and from actual production long enough to do it. It is not always, nor often, the most highly skilled mechanic who can transmit the maximum of knowledge. In fact, that quality is rather intangible and not easily discovered, so it will take some time in a trial by error process to discover the right men; but when they are found, they must be left untrammeled by tradition, to teach just as rapidly as possible and to teach only the things that are of immediate need. All thought of any classroom work that does not apply directly to the thing which the apprentice is to do in the next few weeks will have to be stripped from the course, regardless of whether what is left is good pedagogy or not.

Women are likely to be just as necessary in the machine industries as men; and they are probably quite as easily trained for these individual operations, even though we may be quite sure that few of them are essentially mechanically inclined. They have the advantage of approaching each job with an open mind unconfined by any preconceived ideas as to how the job should be done, and they are excellent at following another's lead.

Saving Time and Abrasive Wheels

By H. L. Kohr

Mr. Murphy's article, "Toolroom Grinding," page 755, Vol. 46, brought to mind a grinding kink that I use. It is a time and money saver, and may be of interest.

We have in use a great many special-form abrasive wheels for grinding and regrinding a certain class of tools. These forms require extreme precision and necessarily consumed a great deal of time in dressing the wheels. In removing these wheels from the spindle of the grinder and replacing them at a future time for regrinding the same job, it was always necessary to redress the wheel, owing to the fact that it was impossible to replace them on the spindle again so that they would run true. We bought a lot of abrasive-wheel centers (or bushings on which the wheels are mounted on this particular grinding machine), and instead of removing only the wheel we remove the entire abrasive-wheel center, leaving the wheel mounted on it while not in use. These abrasive-wheel centers are interchangeable on the No. 13 B. & S. universal grinder and the No. 2 B. & S. surface grinder. In this way they may be used on either machine, and when they are replaced they run perfectly true without redressing, only requiring redressing when they wear out of shape or become glazed. The cost of the abrasive-wheel centers is very small, in fact less than the cost of dressing some of our abrasive wheels.

We have at the present time at least fifty wheels of different shapes stored away that will not be removed from the emery-wheel centers until they are worn out.

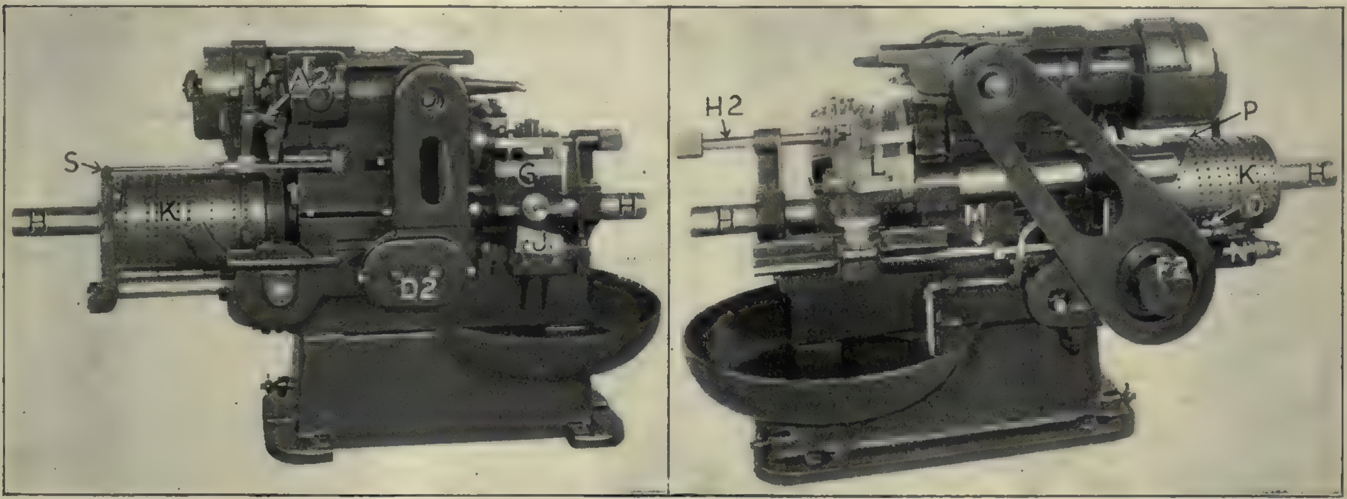
The Fay Automatic Ring-Gear Machine

SPECIAL CORRESPONDENCE

SYNOPSIS — *The Jones & Lamson Machine Co. has developed a highly specialized modification of its Fay automatic lathe for the work of machining the large ring bevel gears in the rear-axle drive of automobiles and trucks.*

A FRONT view of the Fay automatic ring-gear machine is given in Fig. 1, and a rear view in Fig. 2. Fig. 3 shows the gear-drive headstock with cover removed, and Fig. 4 is a typical tool set-up. Reference should first be made to Fig. 4 in order to get an idea of the operations for which the machine is designed. The front toolholder moves on an angle, as shown by the arrow, for finishing the bevel on the outer and inner ends. The tool *A* roughs the outside diameter; the tool *B*, immediately following in one continuous motion, finishes it, while the tool *C* machines the inside end. The rear toolholder, moving in the direction of the arrow as shown, carries the tool *D*, which roughs the bevel face of the blank. The tool *E*, which follows immediately after, finishes it, and the tool *F*, in the same continuous motion, rounds the corner at the back side of the blank. It will be noticed that the front and back faces, and the bore by which the blank is held, have been machined by previous operations on the turret lathe.

Going back again to the description of the machine on which this work is done, at *G* in Fig. 1 is shown the front tool carriage. This carries the tools *A*, *B* and *C* of Fig. 4. It is mounted on bar *H*, Fig. 1, which has an endwise motion, and the bar and toolholder together are rocked in the journals of the bar by means of the follower on the under side of the toolpost, which rests on the bevel former *J*. This former may be adjusted to any angle required to meet the desired angle for the bevel on the ends of the teeth. The longitudinal movement of the bar *H*, by means of which the toolholder *G* and the tools mounted thereon are fed along the work, is given by cams on the inside of the drum *K* operating on a cam roll fastened to a carrier clamped to the bar *H* on the inside of the drum.



FIGS. 1 AND 2. FRONT AND REAR VIEWS OF SPECIAL AUTOMATIC RING-GEAR MACHINE

On the rear side of the machine, shown in Fig. 2, is seen the rear toolholder *L*, which carries the tools *D*, *E* and *F* of Fig. 4. This is a compound rest operated by a strongly constructed rack, gear and pinion device, the pinion shaft extending up through the center of the angular adjustment of the rest. It carries at its lower end a gear meshing with the rack *M*, Fig. 2, which is connected with the cam slide *N* and the cam roll *O*, operated by outside cams, of which one is shown at *P* on the drum. The compound rest carrying the tool block *L* can be adjusted to any angle to turn anything from a cylinder to a straight face or even an internal bevel.

The movements of both front and rear cross-slide are thus seen to be controlled by cams on the drum *K*. This drum has a slow motion for feed and fast motion for idle movements, driven as will be later described and automatically shifted by adjustable dogs placed on the drum in the usual way.

The drive of the machine is best shown in Fig. 3, where the headstock is illustrated with the cover removed. The drive is either from a motor mounted on the headstock or through the main lineshaft direct to tight and loose pulleys at *Q*. The driveshaft for the driving pulleys *Q* carries a triple sliding gear *R* shifted by a fork controlled by the handle *S*. In the three positions it meshes with the three corresponding gears on the intermediate shaft *T;* the gears on this shaft in turn drive the third shaft *U* either through the slow-speed ratchet gear *V* or the intermediate clutch gear *X* or the fast speed *W*. This speed change is under automatic control of the machine by means of the clutch collar *Y* and a speed-change lever.

This speed-change lever is operated by dogs on the drum which throw the clutch collar *Y* either to its intermediate or extreme right or left position, as may be required at any point in the machining of work. In the intermediate position the drive is through the silent ratchet gear *V*. This gives a very slow speed used when the cutting tools are below the scale on hard forgings. The clutch collar *Y* is next thrown to the right, giving the intermediate speed through the clutch gear *X* used for roughing. When the finishing tools come into play, the clutch collar is thrown to the extreme left, bringing the drive through the gear *W* and giving a high speed for finishing. The spring release mechanism, shown at *A*2 in Fig. 1, is used in snapping the gears through the neutral position in getting from the intermediate to high speed when changing from roughing speed to finishing speed.

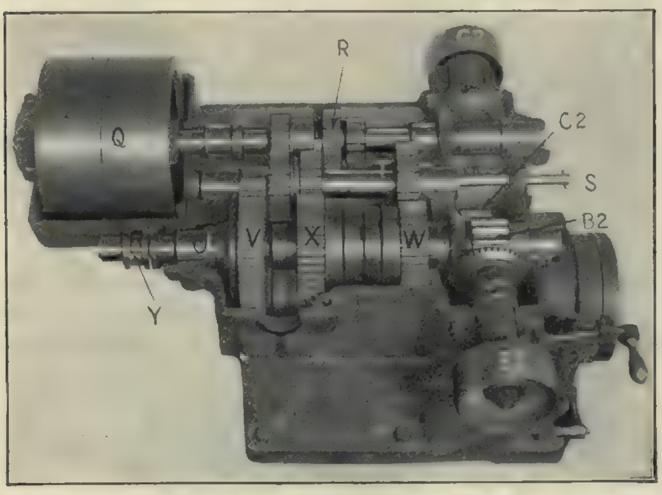


FIG. 3. GEAR-DRIVE HEADSTOCK WITH COVER REMOVED

All the gears of this drive are of hardened steel and run in oil. Pinion *B*2, Fig. 3, on the third shaft meshes with the spindle gear *C*2. This spindle gear runs in a bath of oil, which it carries up to a scraper, feeding it into the upper reservoir in which the transmission gears revolve. This reservoir in turn drains back through the main bearings of the spindle into the lower reservoir where the spindle gear *C*2 again picks it up and returns it over its course, thus giving continuous lubrication.

This geared headstock will thus be seen to give nine spindle speeds without change of drive-pulley speed, and these speeds are so arranged that there are three groups of three each in the headstock operated by hand for any one of the three groups; and they automatically by the mechanism have any one of the three speeds in that group required at any point in the operation.

The cam drum *K* is driven by a wormshaft connected through change mechanism at *D*2 in Fig. 1 and a belt with a slow-speed driving pulley *E*2 in Fig. 3. This, it will be noticed, is connected with the third shaft, which receives all the speed variations of the geared head drive. The change gears may thus be set for any feed in revolutions per inch irrespective of the spindle speed. The fast motion is through a clutch pulley *F*2, shown at the back of the machine in Fig. 2. This is belted to the fast-motion drive pulley *G*2 in Fig. 3. This driving pulley, being geared for a main driving shaft, runs at constant speed, so that fast motions of the cam drum are always at high speed irrespective of whether the spindle is running slow or fast.

This arrangement, together with the fact that no time is required for turning of turrets or other similar idle operations, reduces the idle moments of a machine to practically nothing.

Finishing tools, as shown in Fig. 4, follow immediately after the roughing tools, so that no time is lost in bringing them into action.

Another interesting provision possible with some designs of ring gears is shown clearly in Fig. 2. It consists of the wrench shaft *H*2, carrying on its inner end the flange plate by means of which the ring gear is held to the fixture on the end of the spindle. By this means the flange is always in place on the machine, and it is not necessary to pick it off and set it on a bench with other outside pieces. It only remains to clamp it and unclamp it as the work is put in and removed, leaving the hands of the operator free for handling work.

With other designs of ring gear it is better to use the arrangement shown in Fig. 4, where the flange *J*2 is clamped up against the work by the nut with interrupted holding lugs, which are such that when the nut is released the flange may be drawn off past the lugs through its clearance slots without requiring the nuts to be entirely screwed off and on. Either one of these clamps gives great rapidity in loading and unloading.

The advantages claimed for this machine are:

1. Continuous production at exactly the right feeds and speeds required for the most efficient cutting without any lost time required for idle movements.
2. Compactness of mechanism for the amount of output per machine, reducing the factory space required for a given production.
3. Extreme simplicity of mechanism and the confining of the machine to single spindle units, so that in event of any slight disarrangement in the mechanism but a small part of the production is held up.

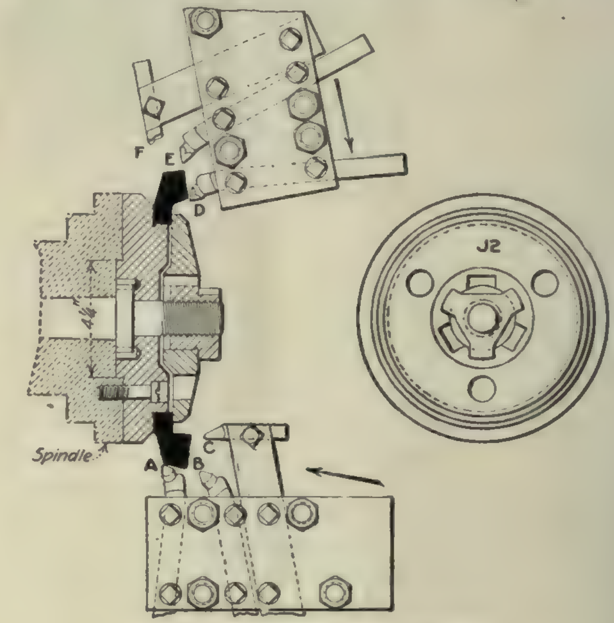


FIG. 4. TYPICAL TOOL SET-UP

4. The low capital cost for a given output, made possible first by high productivity and the low cost of each unit.
5. Low labor cost, owing to quick change of work possible; high speeds and feeds; and quick change from one job to another, camming being permanent.

IDEAS FROM PRACTICAL MEN

Chart for Pulley Sizes*

By Henry J. Fuller

The pulley user will find this chart a great time saver. When you have a lineshaft, the speed of which you know, and buy a machine that should run at a speed given by the maker, the question arises as to what pulleys you need to order.

There are a great many things that affect your choice besides the diameters that will give the speed ratio: The drop of the shaft hangers on the lineshaft or countershaft; the nearness of some pipe or beam; on the machine itself some parts limit the size of the driven pulley; or if the drive is close, the arc of contact may prohibit a smaller pulley.

Surely it is worth something to be able to tell at a glance all the pulley combinations that will produce the speed changes you need. The right-hand figures in the accompanying chart are for shaft speeds in revolutions per minute, as are the lower set at the bottom. The other two sets are pulley diameters in inches.

For example, you have a driving shaft running at 150 r.p.m. and a machine or countershaft running at 250 r.p.m. Find 150 at the right. Follow the cross-section horizontal line until it meets the cross-section vertical line that starts from 250 at the bottom of the page. The diagonal line or curve that crosses this intersection is the key to all the pulley combinations that will give these speeds.

Notice that the vertical from 33 and the horizontal from 20 meet on this line; also, 40 and 24, 50 and 30, 67 and 40, 80 and 48, 90 and 54, 5 and 3, 15 and 9, etc. It works both ways. If you have in stock a number of pulleys, you can soon tell how near any two of them will come to giving you the speeds you wish.

If the speed horizontal and vertical do not meet on any of the diagonals that are drawn to give the usual speed changes, you can easily place a ruler so that

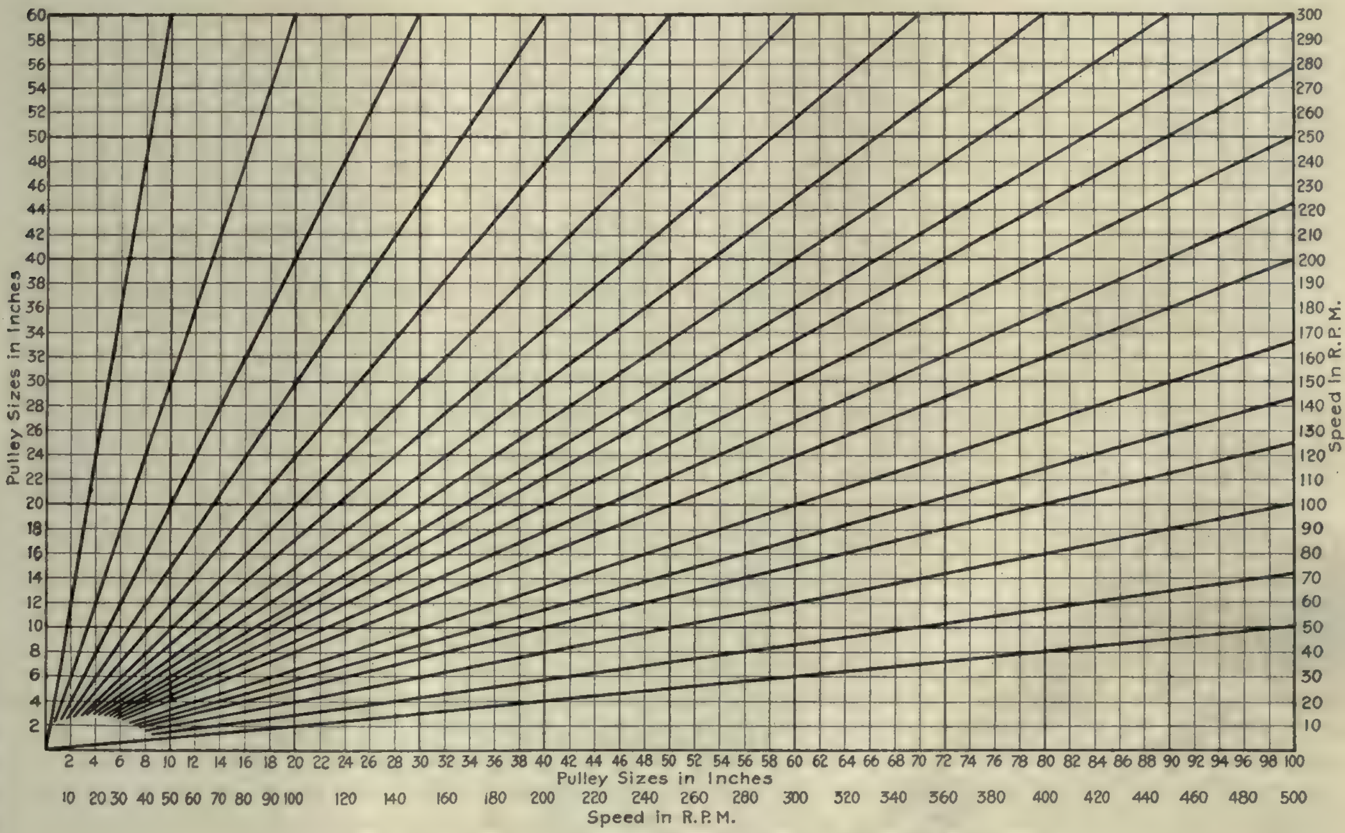


CHART FOR QUICKLY DETERMINING THE SIZES FOR PULLEYS the edge passes through the intersection and also through the lower left-hand corner of the page and draw your own key line.

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Then also, if you are limited to pulleys where horizontal and vertical do not quite meet at the diagonal of your chosen speed, a glance will show you how much your speed will be affected; for instance, pulleys 49 and 30 in. would make the speed 245 instead of 250.

In reading such a curve or chart, a celluloid rule or right triangle is an aid; and when the lines are close together, it is sometimes better to read a multiple, as in the last example 50 to 30 is the same as 5 to 3. Likewise, for numbers larger than those shown, a smaller can be used, as 15 for 150 on the left-hand side; only it must be remembered to add the zero or point off in the answer, as the case may need.

Efficiency in the Foundry

By M. E. Duggan

Frequently machine parts are designed with pockets, projections or undercut portions that make the work of molding very difficult. In many cases the design of certain parts can be simplified, thereby modifying the pattern, increasing production and decreasing the expense in the foundry without detriment to the utility of the part or the machine.

The sewer cap ring shown is a very fair example of a job of this kind. The pattern for this ring as it was made and received at the foundry is shown in Fig. 1. To aid my description I have shown the ring inverted with the cover face down; in other words, in the pouring position of the mold. The pattern maker constructed his pattern to mold the inside down to the projecting ring *X* in the cope. This required a special cope flask to take care of the heavy body of hanging sand. The sides of the pattern being almost straight, it was a difficult job for the molder to make a clean lift when removing the cope, and considerable labor and care were required to secure the mold in order to prevent a drop when closing. A slight change in the design—a taper of, say, ½ in.—would in no way affect the design and would be an aid in the lifting of the cope. With the design shown in Fig. 1, four castings was a day's output.

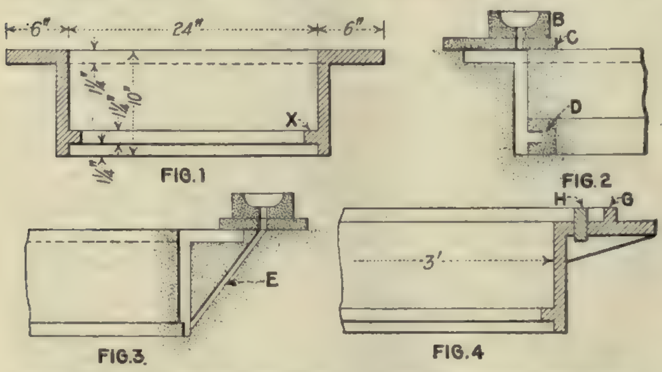


FIG. 1 FIG. 2 FIG. 3 FIG. 4

FIGS. 1 TO 4. THE ORIGINAL AND ALTERED DESIGNS

In order to simplify the molding, lessen the labor, increase the daily production and decrease the expense in the foundry, the foundryman made a change in the pattern. Notice how this simple change affected the whole job of molding without changing the original design of the casting. The decreased production was due to the projecting cover ring *X* shown in Fig. 1. This the foundryman had removed or cut away from the body of the pattern. A ring core made up of six segment cores and having a recess that formed the ring was placed and rammed up in the mold as shown in *D*, Fig. 2. The whole pattern was molded in the drag. After the mold was completed, the pattern was withdrawn.

No cope was used, as the casting was made in an open mold. While this method does not produce a smooth cope face on the casting, it is satisfactory for the purpose for which it is intended. The pouring basin *B* is mounted on the slab core *C*. The hole or sprue is so located that the metal runs to the bottom of the mold. In Fig. 2 the mold is shown ready to be poured. Nine castings were produced in a day.

In Fig. 3 a change is made in the design. Instead of a projecting ring the pattern is made with a recess to receive the cover. This simplifies the molding, as no core is required. Notice the change in the location of the pouring basin. The metal, if run straight down, as in Fig. 2, would land on and wash away the green sand forming the recess for the cover, thus creating a lump in the recess that would destroy the usefulness of the casting. To overcome this trouble the metal is directed into the mold at the bottom corner, as shown at *E*.

Another very good example of efficiency in the foundry is shown in Fig. 4. This shows the type of manhole cover in general use in the construction of underground wiring systems. In design it is different from the sewer cover shown in Fig. 1. It is made with the projecting ring *G* on the bottom face (inverted in the sketch). When the casting is in place on the concrete wall, this ring anchors and prevents a shift. With this simple ring made on the casting the molding is more difficult and production is decreased, because a cope flask is necessary to complete the mold. Notice how the molder got around this trouble. The anchor ring *G* was cut away from the pattern, thus making it possible to produce the casting in an open mold. Pins *H* were used to take the place of the ring. These were sheared from wrought bar iron 1 in. square. Four pins were employed in each casting. After the pattern was withdrawn, the four pins were inserted in the mold equally spaced on the circle as shown at *H*. With the original design, three castings was a day's output. The altered design made it possible to produce seven castings in the same time.

An incident that happened on a certain job where a number of the manholes shown in Fig. 4 were being put in, is deserving of notice. The masonry work was far in advance of the casting supply. When the castings were delivered on the job it was discovered that they were produced from the original design with the ring *G* cast on them. No provision was made in the concrete for the anchor ring. The result was that the manhole cover, when placed in position on the concrete wall, was 1½ in. above the prescribed street level. This trouble was corrected in the following way. Castings from the altered model were made and kept on hand in the foundry, and the anchor pins were driven out of these castings. By so doing they were made the required height and became available for immediate use.

Editorials

Rational Interchangeability

JUST as it has been a human tendency to attempt to regulate prices without finding out first what constitutes cost, so has the effort been to establish limits without defining interchangeability.

Actual interchangeability is something that is so rare (on fine work) that it would be difficult to cite one real example of it among all the fine products manufactured in this country.

The nearest approach to true interchangeability comes on mechanical products where nicety of workmanship is not of primary importance—where a hole may be, say, a sixteenth of an inch larger than the spindle that it is to receive.

* * *

There is no great difficulty in obtaining a "fit," as the word is interpreted in *such* cases. However, apply this to the case where half- and quarter-thousandths represent the difference between a fit and no fit, and you find a different story.

One large machinery-manufacturing concern producing a machine that requires very close fitting for proper operation spent in the neighborhood of $100,000 attempting to secure real interchangeability, and was forced finally to abandon the idea.

Typewriter and cash-register work may be cited as examples of "near interchangeability," but the parts in these cases, although small, are not worked to really fine limits.

When it comes to a piece of mechanism where the tolerances run to tenths of thousandths and where some of the dimensions are held without limit, true interchangeability becomes so difficult as to be almost impossible.

* * *

Take, for example, the Springfield rifle. General Crozier testified a few days ago before the Senate Committee that the reason for delaying the start on the new modified Enfield rifles was to secure the same degree of interchangeability in them that the Ordnance Department has maintained on the Springfield rifle.

We would like to see this interchangeability put to the test and believe that it would be well worth the expense in clarifying opinion as to what interchangeability really is and how much of it is essential on rifle work.

* * *

We would suggest as a very practical test of this interchangeability of which General Crozier speaks that a civilian committee of engineers select two rifles made at the Springfield arsenal, one being a rifle, let us say, that has just been completed, and the other a rifle that was completed a month ago. Let them, then, with the aid simply of wrenches and screwdrivers and without files or emery cloth, dismantle these two rifles and interchange their parts.

This would make an interesting test of the real interchangeability of the Springfield rifle and incidentally, we believe, give certain of our ordnance officials useful food for thought on the necessity of splitting hairs.

Censoring Technical Articles

THE problem of censorship has many angles, and it is no easy task to impose on anyone. This is especially true in the case of technical articles, particularly when the censor is not trained both in mechanics and the proper discrimination as to the value of such articles in assisting production.

The Bureau of Public Information has taken the broad stand that the public is entitled to any and all information that will not be of service to the enemy. The people of the country must pay the cost of the war, both in blood and treasure, and they are entitled to know all that can be safely told them. Then, too, it is policy to keep them informed and interested, because they are the customers for all bond issues that it may be necessary to float.

* * *

In the matter of technical information the proper publicity becomes a vital factor in securing the desired production of all sorts of mechanical devices and parts.

The publication of data concerning shell manufacture in the *American Machinist* in the earlier days of the war was credited by the Canadian Shell Committee and others with having greatly aided the production of shells at a time when they were most needed. Yet data of this kind might easily have been prohibited by any but a broadminded censor on the ground of giving information of value to the enemy.

There are very few cases where the publication of data regarding the manufacture of munitions that are needed in large quantities can fail to be of help in aiding production. And this is usually of far greater importance than the possibilities of the enemy knowing how the munitions are made—he can usually find out without much difficulty and can seldom utilize the knowledge in any case.

* * *

The new airplane program, including the aviation engine, is a case in point. We are constantly receiving requests from shops in various parts of the country desiring specifications and asking how they can be of service. Many of these shops have capacity that could be utilized to advantage in making engines or propellers or parts of engines or planes, but it is going to be impossible to utilize these shops unless there is some way of acquainting them with what is needed and perhaps showing them how the work is done in other plants. The only practical method of accomplishing this is to publish all necessary details in such a paper as the *American Machinist*, which reaches thousands of shops.

There seems to be a general impression in some quarters that the industrial inventory covered all this, but a little consideration will show this belief to be erroneous. Take your own case, and see if the answers you gave to the questions asked would enable anyone to tell exactly what you could make that would fit into the airplane program, about which you knew nothing at that time. Not knowing the work, you could not answer so as to let anyone know how nearly your experience fitted that line of work. Consequently, those who must place orders are left about where they were before the inventory was taken. They must depend on personal knowledge of plants in placing orders and in so doing unavoidably lay themselves open to the charge of favoritism, even when none is intended.

* * *

If, on the other hand, some general idea of the work desired, together with a few leading specifications, can be placed in the hands of several thousand shop managers, a goodly number of them will see that certain parts of the work are within their capacity, and the sources of production will be greatly increased.

There can be much profitable publicity by a careful coöperation with the engineering periodicals that can be of service in this matter.

Mechanics for Repair Work Behind the Lines

ONE of the very interesting features of the present preparation is the development of a large machine-shop capacity for repairing artillery, motor trucks, automobiles, motorcycles, etc., directly behind the lines on the other side. These shops have been organized on a very extensive scale, larger than we are apt to realize, and it is gratifying to know that the equipment is rapidly nearing completion.

The personnel of these shops, which will require several thousand mechanics, is now being organized by the Quartermaster Corps in Washington with the view to early service in France.

* * *

These shops are laid out to care for a very wide range of repairs, in fact, being general shops. Applications for enlistment will be gladly received of men who are competent blacksmiths; carpenters; welding repairmen; gasoline-engine repairmen; harnessmakers and saddlers; laundrymen; motor-truck and pleasure-car repairmen; machinists; toolmakers; die sinkers; magneto repairmen and electricians; motorcycle repairmen; oxyacetylene welders; painters; plumbers; steamfitters; gasfitters; automobile-radiator repairmen; sheet-metal workers; rear-axle and transmission repairmen; shoe repairmen; storage-battery repairmen; tentage repairmen; automobile-tire repairmen; automobile upholsterers and trimmers; and wheelwrights.

Applicants must be within the ages of 21 and 45 years and, if drafted, cannot be enlisted in this organization, but may be transferred to it from the draft. In case applications are made for enlistment in this organization, letters of recommendation stating fully the qualifications by some competent authority should be inclosed.

Applications should be addressed to Quartermaster General, United States Army, attention of Maj. H. A. Hegeman, 1421 I St., N. W., Washington, D. C.

Obtaining Transportation Priorities

By Waddill Catchings

Chairman of Committee on Coöperation with Council of National Defense, of the Chamber of Commerce, U. S. A.

"DURING the continuance of the war in which the United States is now engaged the President is authorized, if he finds it necessary for the national defense and security, to direct that such traffic or such shipments of commodities as, in his judgment, may be essential to the national defense and security shall have preference or priority in transportation by any common carrier by railroad, water or otherwise."

* * *

These are important words for business men. They are in the recent amendment to the Interstate Commerce act and create the power which the President has delegated to Robert S. Lovett.

The meaning and effect of this new statutory provision are illustrated by Judge Lovett's order in connection with the shipment of coal to the Northwest. On Aug. 20, a number of railroads serving Lake Erie ports in the transportation of bituminous coal for transshipment by vessel to ports on Lake Superior and Lake Michigan were directed until further order daily to give preference and priority in the distribution of cars to coal mines served by them and transport the same so that bituminous coal for transshipment by lake shall have preference and priority in transportation.

Business men who may at some time apply for preferential shipment under the terms of this act should bear in mind that preference can be granted only when essential to the national defense and security. When such applications come to be considered, it is not unlikely that attention will be given to the manner and extent to which such business men are contributing to the national defense and security.

* * *

Thus, when a manufacturer recently applied for preferential shipment of a material of which he was in need, inquiry was made of those branches of the Government served by this manufacturer to develop how the manufacturer stood on contract deliveries and what his attitude was toward supplying the Government at fair prices.

Business men should not forget the maxim of equity that those asking relief and assistance should come with clean hands.

War Convention of the United States Chamber of Commerce

SPECIAL CORRESPONDENCE

SYNOPSIS—*The War Convention of the United States Chamber of Commerce, at Atlantic City, Sept. 17 to 21, developed an expression of the attitude of American business toward the conduct of the industrial side of the war.*

MACHINERY manufacturers will follow with interest the findings and recommendations of the War Convention of the United States Chamber of Commerce held last week at Atlantic City. The object of this convention was twofold: First, to secure from the representatives of our Government inspiration and suggestions as to how industry collective and individual can become more efficiently applied to the end in view; and second, to secure from the collective membership of the convention suggestions and resolutions leading to the same purpose. While the subject is too large to be covered by any convention assembled for a short period of time, it was a promising beginning for a more widespread and detailed consideration of the great question of the coöperation not only between Government and business, but between individual industries at this time.

Representing the Government at the convention, Secretary Baker and Secretary Lane outlined the task confronting industry and commended the unselfish way in which industry has voluntarily put its shoulder to the wheel in an unselfish and whole-hearted desire to contribute its full effectiveness.

Following this, Waddill Catchings, chairman of the Committee of the National Chamber on Coöperation with the Council of National Defense, pointed out the necessity of altering or perfecting the existing organization at Washington to do away with cross purposes and confusion in the Government's contact with industry.

"The Government," Mr. Catchings said, "we are informed, intends to spend $19,000,000,000 for itself and its allies during the next year. When we consider that the entire gross turnover of the United States Steel Corporation and its subsidiaries is $853,000,000 each year, it will be seen that the Government will place upon business a demand 20 times as great as the entire annual turnover of all those great corporations."

Mr. Catchings pointed out that as the result of the competitive bidding between the Government and private industry since the war began, high prices have been produced and that there has been much discontent. Taking up the work of the War Industries Board, he said there is a question whether this board can go beyond the purposes for which it was intended and meet the industrial problems arising from the Government's purchases.

"Our committee advocates the creation of a War Board similar to the Ministry of Munitions in England," Mr. Catchings said. He said that the civilian advisory commission to the Council of National Defense should be actually in the service of the Government with the Government officials, and not merely advisers, that they should be doing the actual purchasing for the Government, determining prices and controlling priority as well as distribution.

"Chaos exists in business today," Mr. Catchings said, "and order must be brought out of this chaos if we are to win the war. The Price Control Committee—Wall St. man, farmer, distributor and merchant—is unanimously of this opinion."

President Rhett then explained that the Committee on Coöperation with the Council of National Defense is probably the most important committee of the chamber, and said that the statements made by Mr. Catchings represented the result of the daily experiences of the committee sitting in Washington.

The Wednesday morning session was devoted largely to distribution and priority. A. C. Bedford, president of the Standard Oil Co., described the uses of petroleum and its products during the war.

PINCH IN SHIPPING WILL COME IN FEW MONTHS

Raymond B. Stevens, of the United States Shipping Board, said, "The pinch in shipping is likely to come in the next six or eight months." He urged that the Chamber of Commerce of the United States support the request of the Shipping Board that Congress allow the President to suspend during the war only the laws that prevent foreign ships from engaging in coastwise trade.

Harry A. Wheeler, of Chicago, former president of the Chamber of Commerce of the United States, spoke on the relation between business and transportation.

"Federal control of railroads," Mr. Wheeler said, "will be brought 10 years closer by reason of the war." He said that the next step in regulation would be Federal incorporation, and Federal regulation of the issuance of securities. The functions of the state railroad commissions, he believes, will gradually be absorbed by the United States Government.

"The Government," Mr. Wheeler said, "must render assistance to the railroads in obtaining capital, as it goes on tightening and increasing its regulations."

After Mr. Wheeler's address a discussion was opened by Walter Parker, representative of the Department of Commerce in Inland Water Transportation, and others. The subjects under discussion were as follows: (a) Priority of transportation and distribution of materials and finished products for the Government, the Allies and the public at large; (b) what steps business may take by planning bulk shipments and more efficient storage to secure greater use of existing railroad facilities; (c) the increased use of our inland waterways and coastwise transportation; (d) what the business men of the country may do to accelerate the shipbuilding program.

Mr. Parker pointed out that the normal volume of commerce requiring movement in the United States is greater than is the provision for moving it as required.

"In other words," he said, "the day of railroad monopoly of transportation is now at an end, just as the day of boat monopoly was forced to an end some years ago. The Federal Government realizes the necessity of a readjustment, and ports are now building river-rail-ocean terminal and warehouse facilities. River towns, too, are building or preparing to build river-rail terminals and water-side storage facilities. The State of New York is preparing to revive inland transportation in a large way."

During the discussion, Samuel M. Hastings, president of the Illinois Manufacturers Association, pleaded for coöperation among business, ocean transportation, rail transportation and river transportation.

The Wednesday afternoon session brought out some live discussion on the subject of how industry can organize for better coöperation. Walter S. Gifford, director of the Council of National Defense, held out as an ideal, not only during, but after the war, the nation-wide organization of each industry. He suggested that each industry thus organizing should select a board of directors and a chairman in a democratic way that will give true representation to the industry.

George D. McIlvaine, secretary of the National Trade Organization Secretaries, brought out the fact that practically every important industry is today represented by its national trade association. William Butterworth, president of the John Deere Plow Co., cited as an example of the trade association as a point of contact with the Government the facility with which the Wagon Manufacturers Association had arranged with the Government in the placing of a contract for 34,000 army wagons. A committee from this organization, also including those not in the organization, completed in Washington in one week the matter of standardization for practical manufacture, the form of contract and the matter of price, and in addition placed the order for 34,000 wagons with various members of the association and other wagon builders. Mr. Butterworth spoke strongly in favor of eliminating individualism in these matters and handling them collectively through trade associations.

GOVERNMENT MUST GIVE DEFINITE ANSWERS

The president of the Emerson Brantingham Co., C. S. Brantingham, spoke of the necessity of an organization on the part of the Government which would permit industry to receive definite and decisive answers to important questions. He stated the well-known fact that under the present arrangement it is necessary for an inquirer on industrial subjects to spend most of his time finding the man who can give a definite answer, and that often this is impossible. He said that the Government should do two things: Establish definite priority, and provide an organization capable of answering questions asked by industry and business.

S. M. Hastings, president of the Illinois Manufacturers Association, commented on the loss to industry through local labor competition whereby one factory will attempt to replenish its supply of trained labor at the expense of its neighbors, to the ultimate loss of efficiency of all concerned.

S. A. Osborne, vice president of the Westinghouse Manufacturing Co., expressed the belief that preferential treatment in priority should be accorded in ratio to the necessity of the industry to war. He also believes that industry should name its own committees in connection with handling Government matters, and that wage fixing is a duty in connection with price fixing.

At the Wednesday evening session, Herbert Hoover and Lord Northcliffe spoke to an audience numbering several thousand. Lord Northcliffe stated that he had recently visited one of the large war-industry plants in England and that this plant (with its ramifications) covered an area of 3 x 9 miles. He said that England has been forced to establish in France, for the quick repair of cannon and war material, industrial centers rivaling in size the City of Bridgeport, and stated that we of the United States would also find it necessary to establish in France workshops of like magnitude for the care of our equipment.

Edward A. Filene, of the Filene Co., Boston, said in part:

"The problem of American business after the war will be complicated by two obvious facts. Every nation will be under an equally heavy pressure to find profitable markets for its products. And war has stimulated the production of Europe as it is stimulating the production of America. These facts will make the nations of Europe our severe competitors in the race for markets. Nor will the nations of Europe buy from us more than urgent necessity demands, when once the imperative needs of reconstruction have been met. This will be true because after the war the nations of Europe will have learned that a nation that contains within its own borders all the elements needed to sustain its life and supply its army will stand the best chance of survival in the event of another war.

"American business, when the war is over, will find itself in a world of fierce competitors and reluctant customers, neither of which will be the result of the ill will of nations toward us, but the inevitable development growing out of the urgent need of the nations."

At the Thursday morning session, Lewis E. Pearson, chairman of the board of the Irving National Bank of New York, spoke on trade acceptances, strongly advocating this means of encouraging better business and simplifying business relations with the producer, the manufacturer, the wholesaler, the retailer and the final consumer.

SECRETARY WILSON DISCUSSES LABOR PROBLEMS

Of interest to all manufacturers are the views of Secretary of Labor Wilson, regarding industrial relations, as expressed at the convention Thursday morning. Secretary Wilson said in part:

"There is a limit to which employers can go, no matter how generous they may be toward their employees, and that limit is the extent to which they are forced by their less generous competitors. Material things are not the only things for which we stand, and when I say 'we,' I mean both employer and employee. So far as the employee is concerned, while he may appreciate your generosity, admire your charity in the housing conditions and other fine surroundings in which you place him, he would rather live in a log cabin, a home of his own, and on hominy of his own production than live in a palace and feel that it came from charity.

"The employee wants the right and privilege of doing something for himself. Now, you employers have the advantage of experience. Your contact with the world gives you a broader view than the employee can possibly have. It is only when he has the opportunity of selecting skilled men to speak for him that he comes anywhere near you in advantages."

The secretary spoke of problems which have come before the Department of Labor. "In the department," he said, "we have not sought to impose any views on either side, employer or employee. In these labor difficulties we have tried to find some ground acceptable to both sides, but it occurs to us that employers and employees should both be willing to yield something for peace, that both should make sacrifices, in order to keep our industries moving smoothly. I have said to employees that this is no time to insist on the recognition of the union, no time to insist on the changes of standards in work. I have said to employees that if they have been unable to gain recognition of unions in normal times, they should not endanger their country's future by insisting on these changes in these abnormal times.

"But," the secretary continued, "I also want to say to you employers that this is no time to stand upon your prejudices, no time to insist upon 'profiteering.' If you have been unable to gain big profits in normal times, you should not take advantage of your country's necessities by insisting on abnormal profits at this time."

After describing in considerable detail some labor troubles which the Department of Labor has recently adjusted, the secretary said:

"Many of you are wondering why there is a spirit of unrest among the workers of the country. Many of the troubles which have come from this unrest we have been able to adjust before they reached the strike stage, by negotiation along the lines I have outlined to you. Did it ever occur to you that the greatest reason for the unrest that exists among the workingmen of this country is that the story has gone forth that corporations engaged in the iron and steel industries, for instance, are making a profit of from 200 to 400 per cent.? that corporations engaged in the shipbuilding industry are making enormous profits? that corporations engaged in the mining and lumbering industries are making enormous profits?

THERE SHOULD BE NO "SWAG"

"In other words, did it ever occur to you that the story has gone forth that business men are not patriotic? that they have been 'profiteering'? And did it ever occur to you that the workingman has said to himself that he will insist on getting his share of the 'swag'? Now, my position is that there should be no 'swag' to share between you!"

Mr. Wilson spoke of what he believes to be the value of price fixing. He said that price fixing will stabilize industry and, above all, eventually stabilize the price of labor, so that wages will in the end be fixed not by an arbitrary government, but by industry itself.

A combined session on banking, finance and foreign trade was held Thursday afternoon. James A. Farrell, president of the United States Steel Corporation, spoke on the subject of "Helping To Win the War Through Foreign Trade," pointing out not only the necessity of supplying our allies with material through ships that must be built, but also of keeping ourselves supplied with important imported raw materials which we do not produce, but which are, nevertheless, absolutely essential to industry.

RESOLUTIONS ADOPTED BY THE UNITED STATES CHAMBER OF COMMERCE

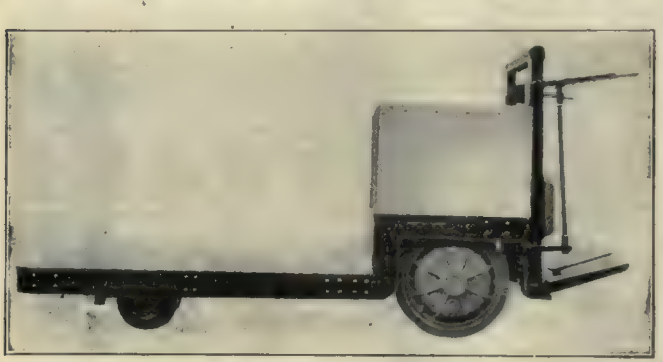
Resolutions to the following effect were adopted by the United States Chamber of Commerce as voicing the sentiment of the American business and industry at this time:

1. A declaration of unanimous support of the Government in every step necessary to the advancement of the cause of liberty and democracy.
2. A recommendation that all war buying be assembled under the control of one board, this board being given full powers as to priority and the fixing of prices, not only with respect to Government purchases, but to the public, when necessary.
3. The extension of sympathy and support to the new Russian republic.
4. A recommendation to all business to coöperate in the forthcoming Liberty Loan.
5. A recommendation that steps be taken by the Government to maintain the parity of the American dollar in all countries.
6. A reiteration of the principles enunciated by the Council of National Defense that neither employers nor employees should endeavor to change at this time the pre-war standards then established.
7. That the Calder Daylight Saving bill, which has already passed the House, receive the favorable attention of the Senate before adjournment.
8. That there be no profiteering by producers, manufacturers, distributors or labor.
9. That American roads and highways be improved as a military necessity for efficient transportation.
10. That war-service committees should be speedily appointed by all industries, the committees consisting of representative men from the industries; that those industries not already nationally organized should take steps to become so at once; that these committees should be truly representative, not only of members of the organizations, but also of those not in these organizations; that these committees be appointed by each industry independent of Government appointment, and given full power to deal with the representatives of the Government in all matters pertaining to the undertaking of Government orders by each industry so represented.
11. That an arbitration board be established consisting of representatives of the Government, of employers and employees, to pass upon all disputes relating to employment and labor matters, and that the decisions of this board be binding, making it illegal to interrupt production either by lockouts or strikes.
12. That universal military training be adopted at once.
13. That the Webb bill permitting coöperation in export trade be favorably considered by the Senate before adjournment.
14. That resident aliens be encouraged to secure naturalization.
15. That an international congress of chambers of commerce be convened at the earliest practical moment.
16. That retail merchants be urged to coöperate with the Commercial Economy Board to reduce waste in distribution.
17. That the United States employment service maintained by the Department of Labor be given further powers for effective work.
18. That a foreign commission be speedily appointed to proceed abroad to study present and after-the-war problems.
19. That in connection with price fixing by the Government, the various industries be permitted from time to time to submit evidence of changing costs of manufacture so that the prices may be changed in accordance where necessary.
20. That it be urged as a recommendation to Congress that war taxes exceeding a certain amount be payable quarterly instead of annually.
21. That the president of the Shipping Board be empowered to employ foreign-built vessels in coastwise shipping, where necessary, as a war measure.
22. That land and water transportation be strengthened as a measure of defense.

SHOP EQUIPMENT NEWS

Hunt Storage-Battery Truck

The illustration shows the latest storage-battery truck, known as type DF-60, which has been placed on the market by C. W. Hunt Co., Inc., West New Brighton, N. Y. In each front driving wheel of the machine is a motor having a rated horsepower of 1¼. The armature is provided with a shaft at each end, two bevel pinions being used, one meshing with the gear on one side of the wheel while the other meshes at the other side of the wheel. This method of construction gives a balanced form of drive and eliminates chains, worms, sprockets, jackshafts and differential.



HUNT STORAGE-BATTERY TRUCK

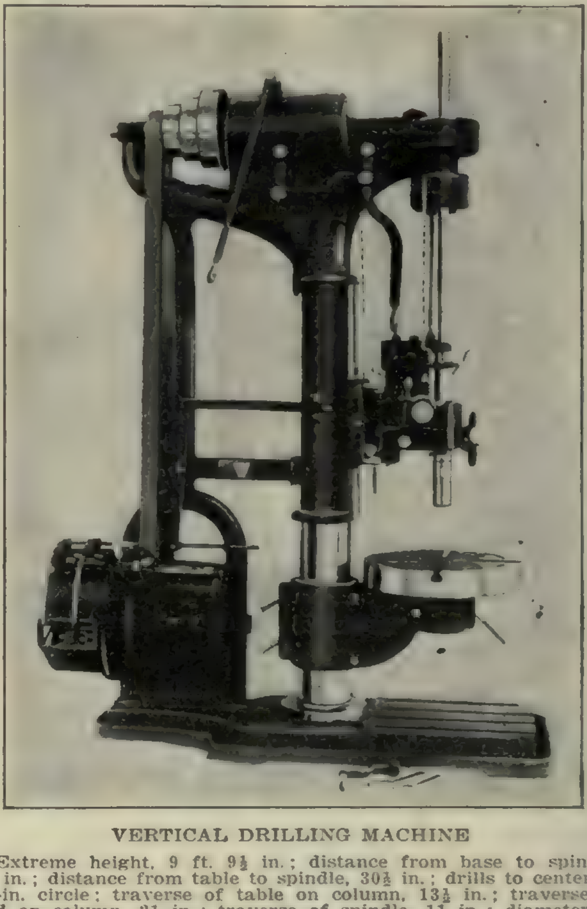
Front wheels, cast steel with ball bearings; rear wheels, cast steel with roller bearings; tires, front, 20 x 3½ in., rear, 10½ x 5 in., pressed-on type; height of platform, 11 in.; dimensions of platform, 60 x 37 in.; four-wheel steer; turning radius of outside wheels, 5 ft. 8 in.; brakes, external contracting; drive, motors in wheels; wheelbase, 52⅜ in.; front-wheel tread, 26⅜ in.; rear-wheel tread, 24⅜ in.; length over all, 106 in.; width over all, 37¾ in.; maximum speed, 7 miles per hour; capacity, 4000 lb.; grade negotiated with full load, 15 per cent.; controller, drum type; speeds, two forward and two reverse with multivoltage control; safety cutout, drum type

A separate compartment in front of the truck is used for the batteries, while the load is carried on the low platform at the rear. Both the loading platform and the battery box are covered with checkered steel plate. Four-wheel steering has been adopted, which gives a turning radius to the outside wheel of 5 ft. 8 in. The controller is entirely inclosed in a dustproof box, and a hinged cover is provided so that all parts may be reached without disassembling.

The machine is equipped with a lever for steering, a lever for control, two speeds forward, two speeds reversed, a movable operator's platform that completes the electrical circuit when stepped upon and a brake pedal that has to be depressed to release the brake. Two tons is the capacity of the machine, and a battery of sufficient size is supplied so that it will run for a working day of 10 hours without being recharged.

Weigel 25-Inch Drilling Machine

The Weigel Machine Tool Co., Peru, Ind., is now marketing a new 25-in. vertical drilling machine. The base is ribbed on the under side and is equipped with an oil groove extending entirely around the outer edge. Four T-slots are formed in the base for clamping work in place. The column is of the usual tubular section, and the table and table arm are raised and lowered by means of a rack and pinion actuated by a crank through a worm and worm gear. The bore for the table hub is made of such size that a compound table may be used without making any changes. Back gears are inclosed in an oil-tight box and submerged in oil.



VERTICAL DRILLING MACHINE

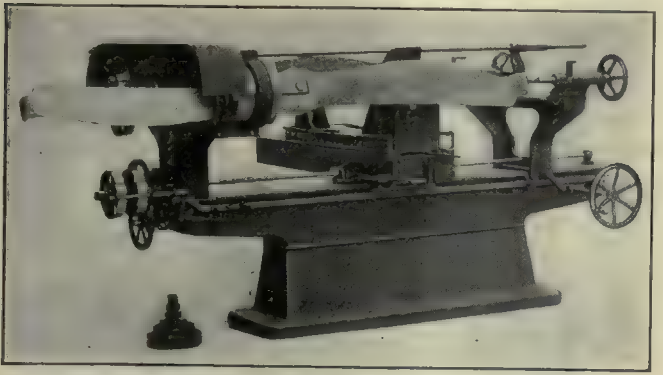
Extreme height, 9 ft. 9½ in.; distance from base to spindle, 47½ in.; distance from table to spindle, 30½ in.; drills to center of 25⅝-in. circle; traverse of table on column, 13½ in.; traverse of head on column, 21 in.; traverse of spindle, 11 in.; diameter of table, 22 in.; diameter of column, 7½ in.; diameter of spindle sleeve, 2⅝ in.; diameter of spindle in sleeve, 1$\frac{11}{16}$ in.; taper in spindle, Morse No. 4; bevel-gear ratio, 2½ to 1; feeds, eight, 0.004 to 0.0432 in. per revolution; speeds, eight, 15 to 400 r.p.m.

Eight feeds are provided, which are obtained by means of sliding gears. There is a friction quick-return movement, an automatic stop serving to throw out the feed at any predetermined point. A tapping attachment can be furnished if desired. It is mounted on the spindle and has a reverse speed double that of the forward motion. Motor drive may be had if ordered. All gears are covered by housings, which is also true of the lower cone pulley, the tight and loose pulleys being protected by an adjustable cast guard. A shifter takes care of changing the position of the cone-pulley belt.

Defiance Airplane-Propeller Lathe

A machine that should be of use to a large number of manufacturers on account of the increased number of airplanes being built is shown in the illustration. It is known as the No. 613 airplane-propeller turning lathe and is the product of the Defiance Machine Works, Defiance, Ohio. It may also be used for turning struts and other irregular-shaped articles up to 12 in. in diameter and 10 ft. 4 in. in length, and will produce both right- and left-hand work from the same model.

By a simple adjustment of the tailstock either end of the work or the entire piece can be made larger or smaller than the model. The cutter head is fitted with either six right-hand or six left-hand knives to feed both ways and will handle either hard or soft wood. It is mounted upon a sliding frame and supported by a carriage that travels across the path of the material to be turned, by means of a feed screw driven by double friction pulleys. These pulleys are operated by a hand lever in starting the feed and are automatically disengaged when the end of the cut is reached. The frame supporting the cutter head and guide roller is gibbed to the carriage, moves in a path to correspond with the shape of the model placed in the machine and is connected with a hand lever to bring the cutter head up to the work or throw it out of the way, either of which operations may be performed while the machine is in motion.



PROPELLER AND STRUT-TURNING LATHE

Horsepower required, 6; floor space, 68 x 120 in.; domestic shipping weight, 4925 lb.; capacity, work up to 12 in. in diameter and 10 ft. 4 in. long

In turning propellers a hollow chuck is used, the propeller being clamped in the chuck by means of a pin inserted through the hub. The chuck is also used in turning other pieces over 5 ft. in length. The machine is regularly furnished with one cutter head complete with knives, one model, countershaft and wrenches. A centering device for quickly locating the centers is supplied as an extra.

Slocum Sine Bar and Indicating Square

In Fig. 1 is shown an improved sine bar that has recently made its appearance on the market. It has but one point of adjustment, one button being constant and acting as a fulcrum so that the bar can be set at any predetermined angle by moving it to the proper location as determined by the second button and locking it with the screw that slides in the curved slot. After the bar is set, the work may be clamped directly to the angle plate and machined in this position. The bar, buttons and studs are of tool steel, hardened, ground and lapped to size. Fig. 2 shows the indicating square with which it is possible to read angles from 80 to 100 deg. Where it is desired to use the device as an ordinary square, the engaging pin that holds the blade firmly in position may be slipped into place. A setscrew is also provided for locking the blade at any desired angle within the limits of its travel. The entire mechanism is concealed to protect it from dirt, all parts being made of steel, hardened and ground to size. These devices are produced by the Slocum, Avram & Slocum Laboratories, Inc., 531-537 West 21st St., New York City.

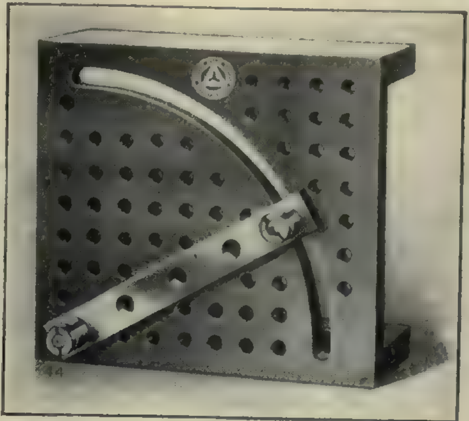


FIG. 1. IMPROVED SINE BAR

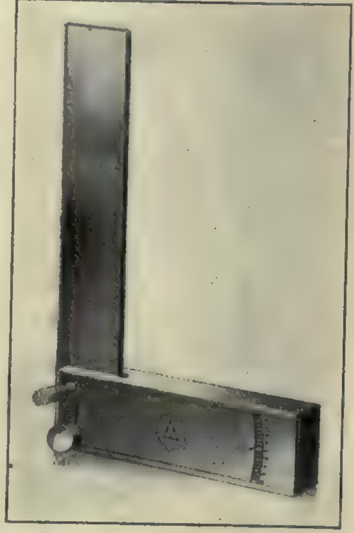
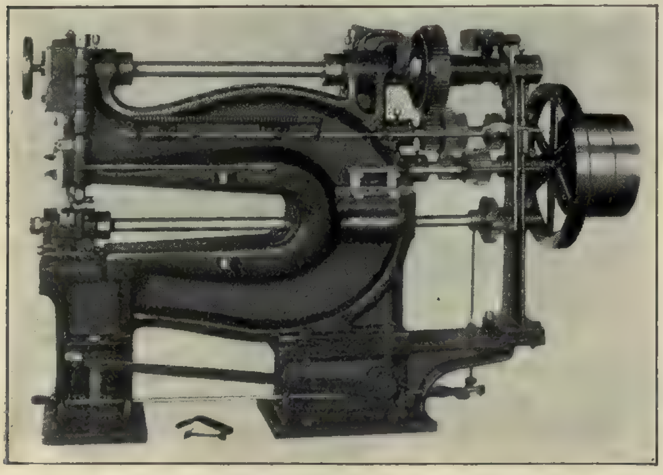


FIG. 2. INDICATING SQUARE

Savage Sheet- and Plate-Metal Cutter

The illustration shows a machine known as Gray's universal sheet- and plate-metal cutter No. 3, which is being manufactured by the W. J. Savage Co., Inc., Knoxville, Tenn. The machine is especially adapted for cutting shapes usually done with a hammer and cold chisel, by drilling, punching or the use of an acetylene torch. The great advantage claimed is that the cutting is accomplished without springing or buckling any portion of the sheet, all edges being left square and true.

The feed and direction of cut are under control of the operator and may be stopped, started or changed in direction at will. On stock up to and including ¼ in. in thickness it is possible to start an inside cut without an opening. Heavier stock requires that a hole be drilled or punched for this operation. The cutting speed varies from 10 to 80 in. per min., depending upon the thickness of the plate. A change gear gives speeds of 80, 110 or 160 strokes of the knife per minute and makes a cut at each stroke according to the length of feed being used, which may be varied from ⅛ to ½ in.

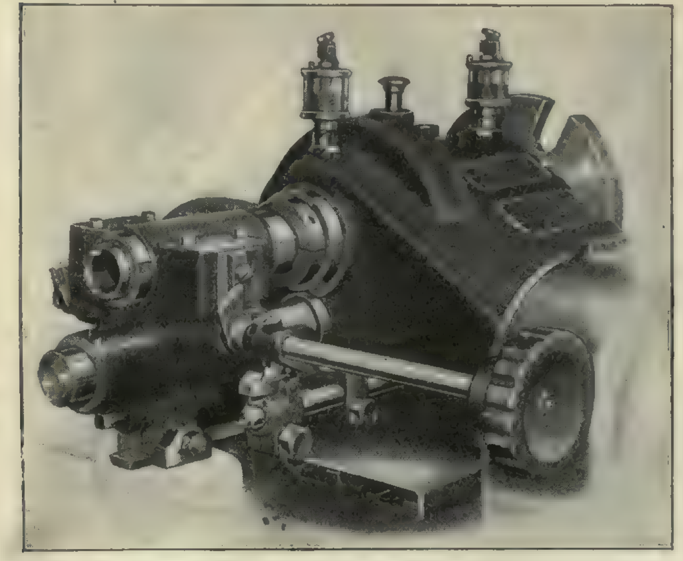


UNIVERSAL SHEET AND PLATE CUTTER

Height, 70½ in.; length, 103 in.; width, 28½ in.; weight, 6000 lb.; strokes per minute, 80, 110, or 160; feed per stroke, ⅛ to ½ in.; length cut per minute, 10 to 80 in.; thickness of plate handled, up to ⅝ in.

Porter-Cable Rapid Screw-Cutting Device

The Porter-Cable Machine Co., Syracuse, N. Y., has added a rapid screw-cutting device to the list of special attachments for its manufacturing lathe. The device will handle threading jobs up to 2½ in. in length. All gearing is eliminated between the spindle and carriage, the carriage being actuated directly by the lead screw through a traveler connected to the carriage by a dovetail pull rod. The lead screw is made in the form of an externally threaded sleeve and is mounted on an extension at the rear end of the lathe spindle; this extension is screwed on the threaded end of the spindle.



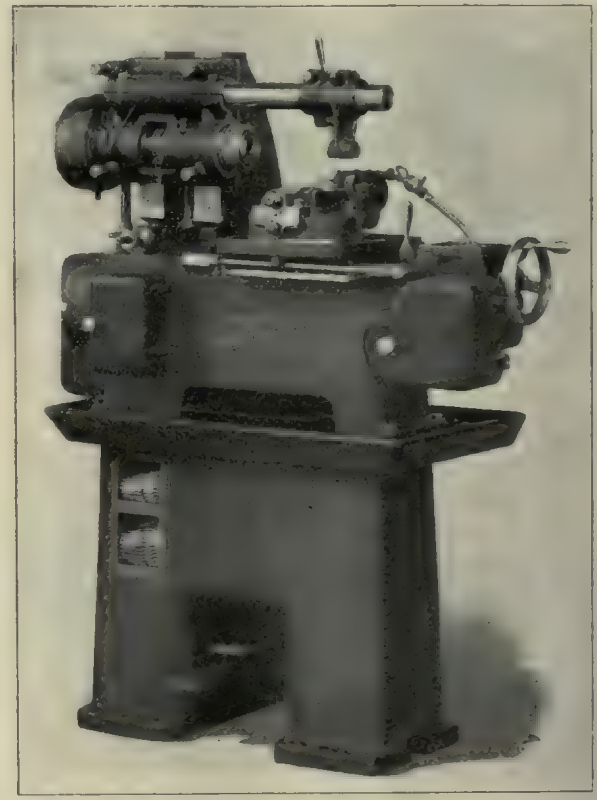
RAPID SCREW-CUTTING ATTACHMENT

The company is prepared to furnish lead screws and nuts of standard pitches that will cover U.S.S. threads from ¼ to 1 in., also A.L.A.M. and pipe threads, as it will be necessary to use a lead screw and nuts of the same pitch as the thread to be cut. These parts are readily interchangeable.

It is claimed that the device is so simple and positive in action that, with a suitable stop on the cross-slide of the lathe which would limit the total depth of cut, the operator could cut a thread with his eyes shut. The accuracy of work done depends only on the accuracy of the lead screw, as the pitch of the screw cut will be an exact duplicate of the pitch of the lead screw.

Barber-Colman Gear-Hobbing Machine

The Barber-Colman Co., Rockford, Ill., is the manufacturer of the gear-hobbing machine shown in the illustration. It is called the No. 3 machine. The bed and upright are of box section reinforced by ribs, cast integral. The sub-base is also of box section and contains a tank for oil or cutting compound.



GEAR-HOBBING MACHINE

Capacity, work up to 5 in. in diameter, 7-in. face and No. 12 diametral pitch; diameter of hob spindle, ¾ in.; maximum diameter of hob, 2$\frac{1}{16}$ in.; taper hole in spindle, No. 9 B. & S.; driving pulley, 8 x 1⅞ in.; hob speeds, six, 100 to 500 r.p.m.; hob feeds, 0.015 to 0.150 in. per revolution; floor space, 28 x 40 in.; net weight, 1700 lb.

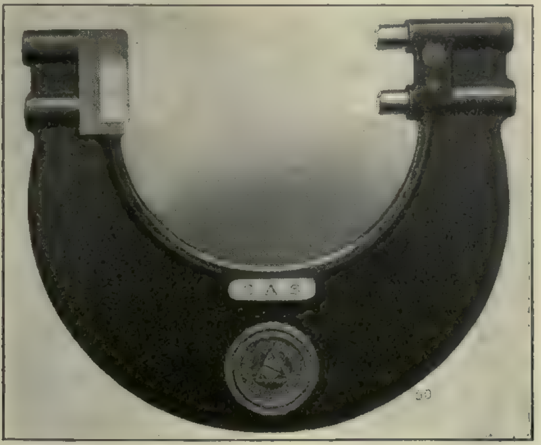
The work spindle is horizontal, and it is claimed that this construction makes for more convenient handling of the work. Forged crucible steel is used for the spindle, which is ground to size, the front bearing being conical while the back is of the straight type. Adjustment for wear is provided by a bronze and a hardened and ground steel thrust washer in the front, and a pair of hardened and ground locknuts back of the front taper bushing. The work-spindle slide is adjusted to position by means of an elevating screw.

The work is held on an arbor fitting the taper hole in the spindle and supported at the outer end by an overhanging arm bracket, which is provided with a quick-acting clamp handle to facilitate insertion and removal of the work. There is a dowel pin for locating the arm in the correct position in exact alignment with the work spindle, which is indexed through a worm and wheel, the former being of steel hardened and ground, while the latter is of bronze. An oil bath provides lubrication. The hob spindle is hardened and ground and runs in bronze bushings. It has an outer support, and the filler collars are screw adjusted. A vernier reading to 10 min. is used for setting the hob swivel, and the swivel slide is made with taper gibs that allow for adjustment for wear.

The machine is fitted with either a right- or a left-hand hob swivel, the former accommodating a range of spiral settings from 60 deg. right hand to 90 deg. left hand, while the latter accommodates a range of spiral settings from 60 deg. left hand to 90 deg. right hand. An automatic belt shifter stops the machine at the completion of the cut. A chain-driven pump, which has a capacity of 4 gal. per min., is used for cooling purposes. Speed changes of the hob are secured by transposing gears in the box at the front of the machine. Index and feed trains are positively driven and are varied by gear combinations in the index-change gear box at one end of the machine and in the feed-change gear box at the other end. The machine is of the constant-speed type and may be driven directly from a lineshaft or by a motor. Special work spindles can be supplied to hold work by means of spring collets or floating chucks.

The S.A.S. Adjustable Limit Snap Gages

The illustration shows an adjustable limit snap gage that is made in 20 different sizes, covering all sizes up to 12 in. It is so made that "go" and "no go" sizes are determined without reversing the gage. It is also quickly adjustable for various sizes or for changing limits or for wear.



ADJUSTABLE LIMIT SNAP GAGE

One end of the gage is provided with plugs that are adjusted by countersunk screws, the idea being that after the adjustment has been made the screws may be sealed, making it impossible to change the limits without detection. The anvils and plugs are ground and lapped as individual units. Each gage is provided with an insulating grip made of fiber, which is attached to the cast-iron frame. The gages are the product of the Slocum, Avram & Slocum Laboratories, Inc., 531-537 West 21st St., New York City.

Gilbert & Barker Offer Portable Lubricant Tank

The illustration shows a portable tank outfit for handling cutting oils and compounds, which has recently made its appearance on the market. It has a capacity of 50 gal. and is furnished with a quick-acting pump that may be utilized either for delivering clean oil or compound to the machine or for collecting used compound and conveying it to some point where it can be filtered.

PORTABLE LUBRICANT TANK

The outfit is mounted on wheels and may be easily moved from place to place about the factory. It is the product of the Gilbert & Barker Manufacturing Co., Springfield, Massachusetts.

Arc-Forming Attachment

The device shown by J. Christman, on page 431, as an arc-forming attachment, has been patented by me (No. 1,237,125) as a mechanical motion for multiple drill heads.

While the invention is shown and described as applied to drill heads, it is susceptible of various other uses; for example, it may be used with a grinding machine for grinding crankshafts, as described and illustrated in my patent. JOHN H. TAYLOR.

American Gear Manufacturers' Association

The second meeting of the American Gear Manufacturers' Association was held at the Edgewater Beach Hotel, Chicago, Sept. 13 to 15.

The Executive Committee of the association met Sept. 13, and on the following day a general meeting was called to order by President F. W. Sinram, of the Van Dorn & Dutton Co., Cleveland.

During the convention the following papers were read: "Advertising Dont's," J. S. McQuiston, Westinghouse Co., Pittsburgh; "Heat-Treating and Hardening of Gears," W. H. Phillips, R. D. Nuttall Co., Pittsburgh; "Inspection of Gearing," B. S. Waterman, Brown & Sharpe Manufacturing Co., Providence; "Spur Gearing by the Rotary or Disk Cutting Process," H. E. Eberhardt, Newark Gear Cutting Machine Co., Newark; "Spur Gears by the Shaper Method," F. Schneider, Van Dorn & Dutton Co., Cleveland.

The afternoons and evenings of Sept. 14 and 15 were devoted to entertainment furnished by the Chicago members.

The American Gear Manufacturers' Association numbers among its membership nearly all the large concerns in this country engaged in the manufacture or cutting of gears. The purpose of the association is "for the development, standardization and improvement of the gear industry." A large part of the discussion of the Chicago meeting was devoted to the subject of standardization.

The officers of the association are F. W Sinram, Van Dorn & Dutton Co., president; H. E. Eberhardt, Newark Gear Cutting Machine Co., vice president; F. D. Hamlin, Earle Gear and Machine Co., secretary; Frank Horsburgh, Horsburgh & Scott Co., treasurer. The Executive Committee consists of the above officers together with Milton Rupert, R. D. Nuttall Co.; George L. Markland, Jr., Philadelphia Gear Works; Biddle Arthens, of the Simonds Manufacturing Co., Pittsburgh.

Personals

H. J. Richardson has been appointed works engineer of the Berger Manufacturing Co., Canton, Ohio.

J. B. Laird, formerly with the Moore Steam Turbine Corporation, Wellsville, N. Y., has resigned to enter the machine-tool business.

J. A. Carothers, formerly superintendent of the Hunter Saw and Machine Co., Pittsburgh, Penn., and **G. W. Agerter,** office manager of the same concern, have resigned their positions and incorporated the Pittsburgh Saw and Manufacturing Co. The new concern will manufacture hot- and cold-metal cutting saws, hardened-steel specialties and circular cutting knives.

John B. Price, district manager for the Mechanical Appliance Co., of Milwaukee, Wis., has opened an office for that company at 515 Mercantile Library Building, Cincinnati, Ohio.

Edward Lurker is now in charge of the Chicago office of the Haines Stellite Co., 1829 Lytton Building. The territory of this office consists of the States of Wisconsin, Iowa, Minnesota and Illinois.

W. D. Robb, formerly superintendent of motive power of the Grand Trunk Ry., has been appointed vice president in charge of motive power, car equipment and machinery, with headquarters at Montreal.

George W. Wagstaff, formerly in charge of the Detroit, Toledo and Cleveland territory for the Onondaga Steel Co., Inc., Syracuse, N. Y., has been appointed sales manager and will hereafter be located in Syracuse.

Obituary

George B. Grant, owner of the Grant Gear Works, Boston, and founder of the Philadelphia Gear Works, Philadelphia, died in California on Aug. 7. Mr. Grant retired from active business many years ago, but has always been considered one of the best-informed men on gears and gear cutting. His book, "Grant's Treatise on Gears," has been for many years one of the standard books on the subject.

Business Items

The Bay State Saw and Tool Manufacturing Co. has removed its office and factory to Winchester, Mass.

The Simmons Machine Co., 981 Broadway, Albany, N. Y., has recently established a branch office in Buffalo, located at 358 Ellicott Square.

The American International Steel Corporation has been formed as a subsidiary of the American International Corporation. The new concern will engage in the export of steel and steel products. The board of directors is as follows: R. P. Tinsley, chairman; George J. Baldwin, J. F. Case, Edward M. Hagar, J. W. Hook, W. S. Kies, J. S. Lovering, M. A. Neeland and Charles A. Stone.

W. H. J. Fitzgerald & Co. have opened a showroom and office at 30 Oliver St., Boston, Mass. They will carry a line of new and used machinery, milling cutters and small tools. They will also represent a group of manufacturers with facilities for making jigs, fixtures, gages, duplicate parts, special machinery, etc. W. H. J. Fitzgerald, formerly purchasing agent of the United Shoe Machinery Co., is general manager.

The Pratt & Whitney Co., Hartford, Conn., has offered a bonus of 12½ per cent. on total earnings of all shop and office help from foreman down, payable every four weeks to those who have not lost more than one day's time during the four weeks' period. Absences due to sickness or real necessity will not be counted against attendance records. This bonus payment is offered in an effort to keep the shop fully manned and to avoid the loss of production consequent upon irregular attendance. The bonus is not made dependent upon length of service with the company, nor for any specified period of time, but it will be continued as long as business conditions justify such action.

Trade Catalogs

Hartford Improved Surface Grinder. National Machine Co. Circular. Illustrated.

The Wade Precision Lathe. Walter H. Wade, Boston, Mass. Catalog. Pp. 8; 8½ x 11 in.; illustrated.

Titanium Aluminum Bronze. The Titanium Bronze Co., Inc., Niagara Falls, N. Y. Booklet. Pp. 12; 5 x 8 in.; illustrated.

Link-Belt Electric Hoists. Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Book No. 246. Pp. 44; 6 x 9 in.; illustrated.

Die Cast Titanium Aluminum Bronze. The Titanium Bronze Co., Inc., Niagara Falls, N. Y. Booklet. Pp. 8; 5 x 8 in.; illustrated.

Casings for Link-Belt Silent Chain Drives. Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Book No. 342. Pp. 6; 6 x 9 in.; illustrated.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

The annual congress of purchasing agents, under the auspices of the national association, will be held at Pittsburgh, Oct. 9 to 11. The program includes business sessions for the mornings and visitation and inspection of industrial works during the afternoons. Special features are: Tour of Pittsburgh's principal business districts by automobile during the late afternoon of the first day, and cabaret dinner in the evening, to be held at one of the country clubs. The banquet will be held at the Convention Hotel the evening of the second day, Oct. 10, with speakers of national prominence. All purchasing agents and others interested are welcome and expected to attend and participate in the activities of the convention. Special arrangements are planned for the entertainment of the ladies.

American and Canadian engineers and architects of Norwegian birth or descent will hold an informal congress at the Chicago Norske Klub, Chicago, Ill., Sept. 27 to 29. Correspondence should be addressed to Joachim G. Giaver, Railway Exchange Building, Chicago.

The National Machine Tool Builders Association will hold its sixteenth annual convention at the Hotel Astor, New York City, on Tuesday and Wednesday, Oct. 30 and 31.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Scales, Computing

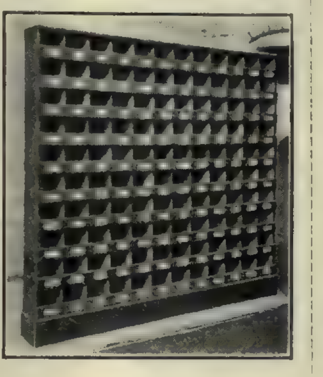
Computing Scale Co., Dayton, Ohio, manufacturer; Moneyweight Scale Co., 326 West Madison St., Chicago, Ill., sales agent

"American Machinist," Sept. 13, 1917

Capacity up to 600 lb. The tare beam has a capacity of 100 lb. and is sensitive to $\frac{1}{2}$ oz. The counting beam is graduated for use when one, five or ten units are placed in the scale pan. A third beam is also provided which reads directly in pounds

Bin, Stock

Hobart Brothers Co., Troy, N. Y.

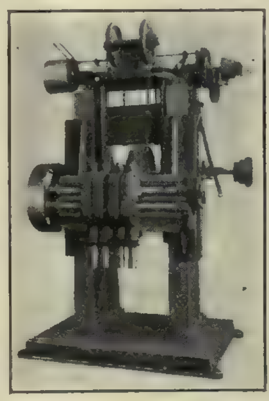


"American Machinist," Sept. 13, 1917

For storing nuts, bolts, screws or other small parts around a machine shop or toolroom. It contains 120 compartments, each measuring 6 x 8 x 10 in. The front partition and the ends of the bin are of oak, while the back is of sheet steel. Each compartment is furnished with a metal card holder for indexing purposes.

Cylinder Boring Machine

Moline Tool Co., Moline, Ill.

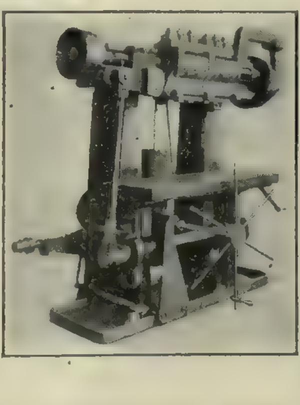


"American Machinist," Sept. 20, 1917

Number of spindles, as required; countershaft speeds, 300 and 500 r.p.m.; maximum tool travel, 28 in.; maximum distance from base to bottom of crossrail, 5 ft.; maximum distance between centers of outside spindles, 32 in.; positive stops for up and down movement; two belts, one for feed and one for cutters; floor space, 7 ft. 6 in. by 6 ft.; weight boxed, 12,000 lb. Safety stops are provided to prevent overtravel of the heads in either direction. Saddle is counterweighted, differential pulleys being used to reduce the size of counterweight required. Thrust on worms and elevating screws carried by ball bearings

Cylinder Recessing Machine

Moline Tool Co., Moline, Ill.



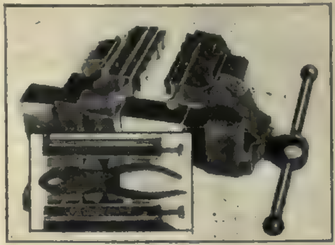
"American Machinist," Sept. 20, 1917

Number of spindles, six or less; diameter of countershaft pulley, 12 in.; diameter of driven pulley, 20 in.; speed of countershaft, 420 r.p.m.; floor space, 72 x 48 in.; weight boxed, 7500 lb. Boring head is stationary, the table and work being elevated either by power or by means of a spoked handwheel at the front. The uprights are of T-section, and the base is cast in the form of a pan to prevent waste of lubricant

Vise Equalizer

Universal Equalizer Co., Bell Block, Cincinnati, Ohio.

"American Machinist," Sept. 20, 1917



Applicable to any ordinary machine-shop vise and permits the holding of pieces of irregular shape or form. Will hold round work up to the capacity between the jaws. Small grips at one side have a specially shaped corner, which is used for gripping small round stock. Tapered parts may also be held. The same principle is used for planer and milling-machine and shaper sets. The latter is provided with a special leveling device for setting work to a taper or for permitting the operator to level up uneven castings and at the same time grip them from both sides

Lathe, Close-Coupled

Davis Machine Tool Co., Inc., Rochester, N. Y.

"American Machinist," Sept. 20, 1917

Swing over bed, $14\frac{1}{4}$ in.; swing over carriage, $8\frac{1}{4}$ in.; distance between centers with $5\frac{1}{2}$-ft. bed, $27\frac{7}{8}$ in.; hole through spindle, $1\frac{1}{2}$ in.; front bearing, 3.02 x $4\frac{1}{16}$ in.; rear bearing, 3.09 x $2\frac{31}{32}$ in.; centers, No. 8 Jarno; cone diameters, 4 to 9 in.; width of face, $2\frac{1}{8}$ in.; back-gear ratio, 8 to 1; spindle nose, $2\frac{3}{8}$ in. in diameter, 6 threads per inch; diameter tailstock spindle, $1\frac{5}{8}$ in.; travel of tailstock spindle, $6\frac{9}{16}$ in.; cuts thread $1\frac{1}{2}$ to 80; capacity of center rest, $3\frac{3}{8}$ in.; floor space, 28 in. by 6 ft.; net weight, 1450 lb.

Drilling Machine, 20-Inch

Moline Machinery Co., Moline, Ill.

"American Machinist," Sept. 20, 1917

Spindle traverse, $8\frac{1}{2}$ in.; maximum distance spindle to base, 39 in.; maximum distance, spindle to table with table at its lowest point, 24 in.; diameter of sleeve, $2\frac{3}{4}$ in.; speed of lower cone, 500 r.p.m.; capacity, drills to center of 22-in. circle; taper hole in spindle, Morse No. 4; shipping weight, 750 lb. Spindle is driven by means of a worm and gear to insure smoothness and quietness.

Switch, Safety Knife

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.

"American Machinist," Sept. 20, 1917

Consists of an ordinary single-throw knife switch and fuse holders inclosed in a cast-iron box with an operating handle outside of the housing. Designed for conduit connection and has a partition separating the switch blades from the fuses. The upper, or switch, compartment can only be opened by removing two machine screws, while the door to the fuse compartment may only be opened while the operating handle is in the off position. When the door of the fuse compartment is open, it is impossible to close the switch. Means are also provided for locking the switch handle

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Sept. 21, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$47.00	$47.00	$14.50
No. 2X Northern Foundry, Buffalo.....	53.00	53.00	19.75
No. 2 Northern Foundry, Chicago......	55.00	55.00	19.00
*Bessemer, Pittsburgh	52.95	55.95	21.95
*Basic, Pittsburgh	48.95	53.95	18.95
No. 2X, Philadelphia.................	53.00	53.00	19.50
*No. 2, Valley.......................	53.00	53.00	18.50
No. 2, Southern Cincinnati...........	49.90	49.90	17.40
Basic, Eastern Pennsylvania..........	50.00	50.00	19.75

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Sept. 21, 1917	One Month Ago	One Year Ago	Sept. 21, 1917	One Year Ago	Sept. 21, 1917	One Year Ago
Structural shapes ...	$5.25	$5.25	$3.25	$5.00	$3.25	$5.00	$3.10
Soft steel bars......	5.00	5.00	3.30	4.50	3.30	4.50	3.10
Soft steel bar shapes.	5.00	5.00	3.25	4.50	3.25	4.50	3.10
Plates, ¼ to 1 in. thick.	10.00	10.00	4.50	7.00	4.00	9.00@10	3.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Sept. 21, 1917	One Year Ago
Pitttsburgh, mill	$4.75	$2.60
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Sept. 21, 1917	One Month Ago	One Year Ago	Sept. 21, 1917	One Year Ago	Sept. 21, 1917	One Year Ago
*No. 28 black.....	8.00- 9.00	10.50	10.50	3.65	9.00	3.40	10.00	3.35
*No. 26 black.....	7.90- 8.90	10.40	10.40	3.55	8.90	3.30	9.90	3.25
*No. 22 and 24 black	7.85- 8.85	10.35	10.35	3.50	8.85	3.25	9.85	3.20
No. 18 and 20 black	7.80- 8.80	10.30	10.30	4.45	9.20	3.20	9.80	3.15
No. 16 blue annealed	8.20- 9.20	10.20	10.20	4.45	9.20	3.70	10.20	3.60
No. 14 blue annealed	8.10- 9.10	10.10	10.10	4.35	9.10	3.60	10.10	3.50
No. 12 blue annealed	8.05- 9.05	10.05	10.05	4.30	9.05	3.55	10.05	3.45
No. 10 blue annealed	8.00- 9.00	10.00	10.00	4.25	9.00	3.50	10.00	3.40
*No. 28 galvanized.	10.00-10.50	12.00	12.50	5.00	10.75	4.70	11.50	4.75
*No. 26 galvanized.	9.70-10.20	11.70	12.20	4.70	19.45	4.40	11.20	4.45
No. 24 galvanized..	9.55-10.05	11.55	12.05	4.55	10.30	4.25	11.05	4.30

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Sept. 21, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	45%
Cleveland	40%	45%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Sept. 21, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	14.30	6.30
Chicago	13.50	5.50

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16 ..	
No. 18	
No. 20	

* Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Sept. 21, 1917	Cleveland Sept. 21, 1917	Chicago Sept. 21, 1917
Tire	5.00	5.00	4.50
Toe calk	5.70	5.50	4.75
Openhearth spring steel...	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	42%	15½%	¾ to 1½.....	33%	17%
½	46%	31½%			
LAP WELD					
2	42%	29½%	2	26%	12%
2½ to 6.....	45%	32½%	2½ to 4.....	28%	15%
			4½ to 6.....	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	38%	20½%	¾ to 1½.....	33%	18%
½	43%	30½%			
¾ to 1½.....	47%	34½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4.....	43%	31½%	2¼ to 4.....	29%	17%
4½ to 6.....	42%	30½%	4½ to 6.....	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	38%	25%	38.8%	24.8%
3½ to 6 in. steel lap welded	18%	List	23%	39%	42.8%	27.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Sept. 21, 1917	One Month Ago	One Year Ago
Copper, electrolytic	27.00*	28.50	29.00
Tin, in 5-ton lots..................	61.50	63.75	39.00
Lead	8.00	11.00	6.75
Spelter	8.50	8.75	8.50

*26.50c. for last-quarter copper.

ST. LOUIS

	Sept. 21, 1917	One Month Ago	One Year Ago
Lead	7.75	10.75	5.87½
Spelter	8.25	8.25	9.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Sept. 21, 1917	One Month Ago	One Year Ago	Sept. 21, 1917	One Year Ago	Sept. 21, 1917	One Year Ago
Copper sheets, base.	35.00	39.00	37.50	38.00	38.50	36.00–37.00	38.00
Copper wire (carload lots)	38.50	38.50	32.00	38.00	33.00	38.50	33.50
Brass pipe, base...	43.00–45.00	43.00	46.50	46.00	45.00	44.00	45.00
Brass sheets	40.00	40.00	44.50	37.00	42.00	38.00	39.00
Solder ½ and ½ (case lots)	39.25	39.25	24.62½	39.50	24.75	39.25	24.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Sept. 21, 1917	One Year Ago
Mill	$30.00	$42.00
New York	35.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.................................... 19.00

	In Casks		Broken Lots	
	Sept. 21, 1917	One Year Ago	Sept. 21, 1917	One Year Ago
New York	21.00	17.00	21.50	18.00
Cleveland	23.00	16.75	23.25	17.50
Chicago	22.50	17.00	23.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Sept. 21, 1917	One Year Ago
New York	15.00	13.50
Cleveland	17.50	13.00
Chicago	16.00	13.50

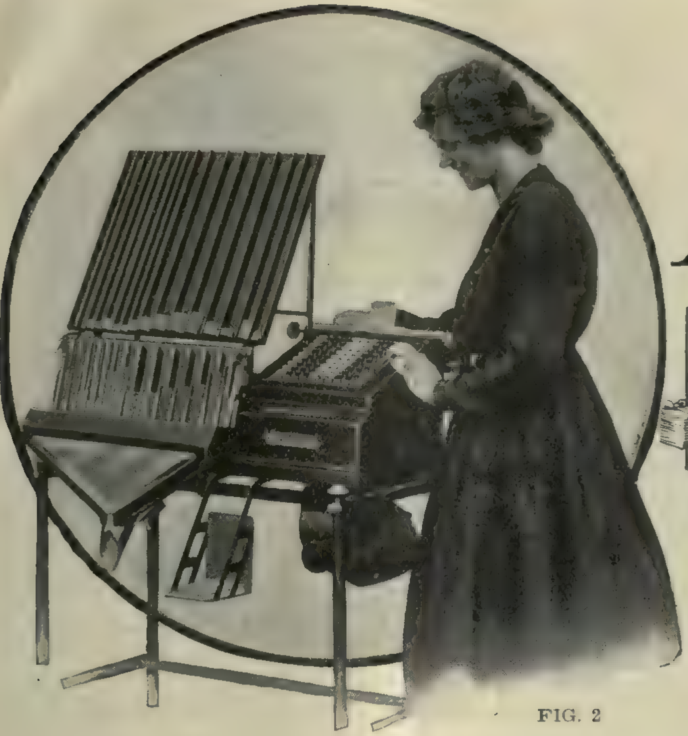


FIG. 2

Building a Payroll Machine

By M. E. Hoag

SYNOPSIS—*The various fixtures and gages described, which closely resemble those used for typewriters and adding machines, are designed and manufactured with very great care in order that the parts produced will be interchangeable.*

THE *American Machinist* has, from time to time, published articles describing tools used in the manufacture of typewriters and adding machines. The machines considered in this article are similar in many ways to adding machines, but there are so many interesting tools used that some notes on them will prove of interest to old readers as well as to the new ones.

It is not the purpose of this article to describe in detail the "International Money Machine," as made by the International Money Machine Co., of Terre Haute, Ind., but a brief outline of the action and use will not be amiss.

Fig. 1 shows the money machine with the "Coin-O-Meter" in position, ready for taking the payroll-change sheet. For this part of the work, the machine is handled just the same as an ordinary adding machine, each item being listed and added on the machine, and a record printed on a roll of paper. In addition to these operations, the Coin-O-Meter automatically registers the required number of coins of each denomination required to make up the payroll, and it does this with the fewest possible number of pieces. To illustrate this point: If the item $13.27 is listed in the adding-machine section, the Coin-O-Meter will automatically register 2 in the cent column, 1 in the quarter column, 3 in the dollar column, and 1 in the ten-dollar column, and so on down the list. When all the items are listed, the number of coins of each denomination required is noted and the money drawn from the bank.

The Coin-O-Meter is now removed from the machine, and the money trays, shown in Fig. 2, are substituted and loaded with coins. Again the operator lists the amount of each man's pay, holds a pay envelope under the coin chute, and the machine delivers the required cash into the envelope. At the same time the amount is recorded and added in the adding-machine section, which gives another check on the work. It is claimed that this method of handling payrolls saves about three-fourths of the time ordinarily required, and it practically eliminates the possibility of human error.

One very interesting mechanical feature in connection with this machine is the almost human way in which it selects the right coins to give the fewest possible number of pieces. To illustrate: If the 5 key is depressed in the right-hand column of the adding-machine section, the machine will register or deliver one nickel; if the 2 key in the second column from the right is depressed, the machine will deliver or register two dimes; but if the 5 key in the first column and the 2 key in the second column are both depressed, the machine will deliver one quarter, and not two dimes and a nickel. This "selector" device is very simple and positive in construction, and it is interesting from a mechanical viewpoint; but space will not permit a description of it in this article, which is to deal with a few of the many interesting jigs, fixtures, dies and gages used in making these machines. When one stops to consider that there are a great many parts in one of these machines, and consequently hundreds of special tools are required, he can readily see that it is impossible to

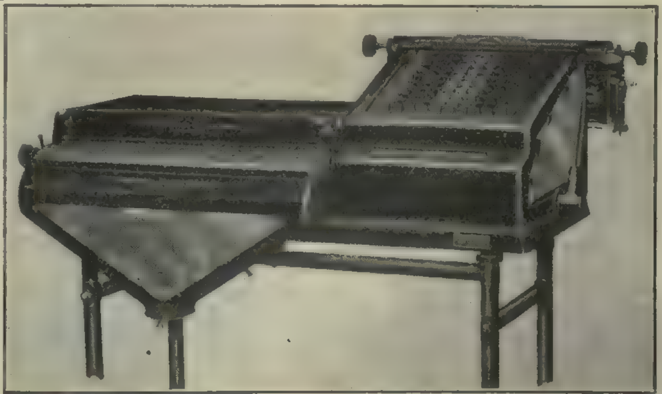


FIG. 1. MONEY MACHINE WITH COIN-O-METER IN PLACE

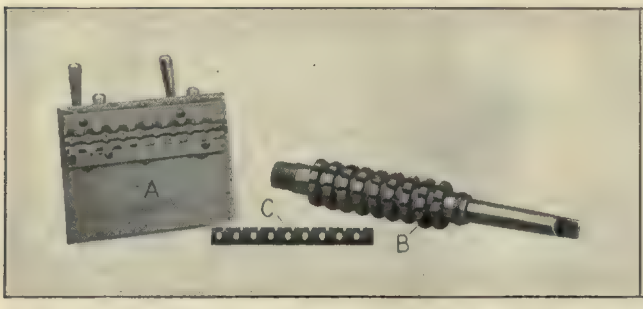


FIG. 3. FIXTURE FOR MILLING METAL SHIELDS

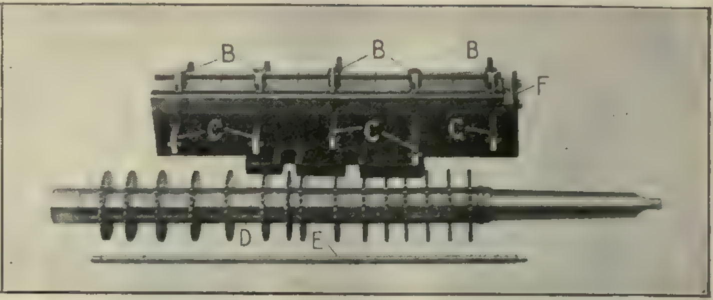


FIG. 4. FIXTURE USED IN NOTCHING SHAFTS

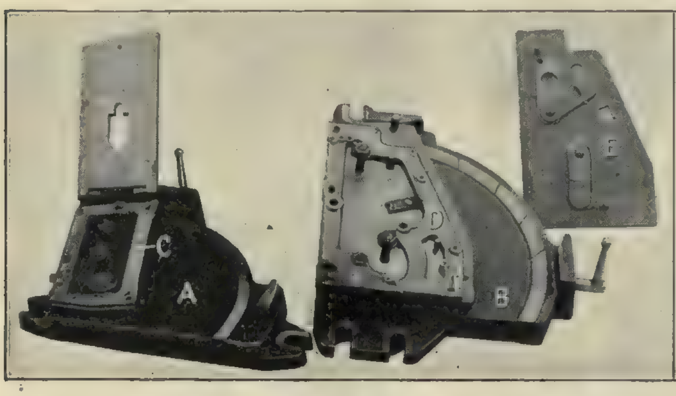


FIG. 6. TWO FIXTURES FOR MILLING FRAME EDGES

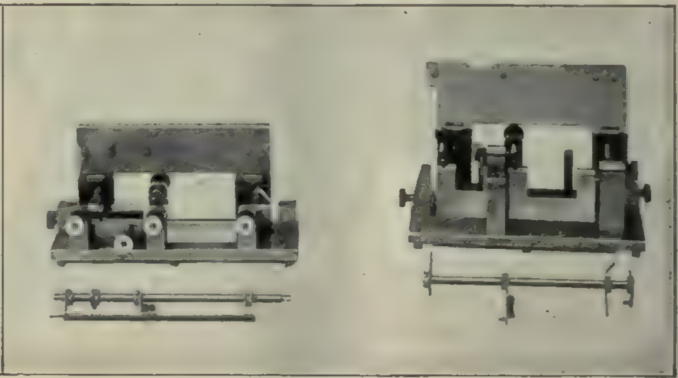


FIG. 7. ASSEMBLING, DRILLING AND PINNING JIGS

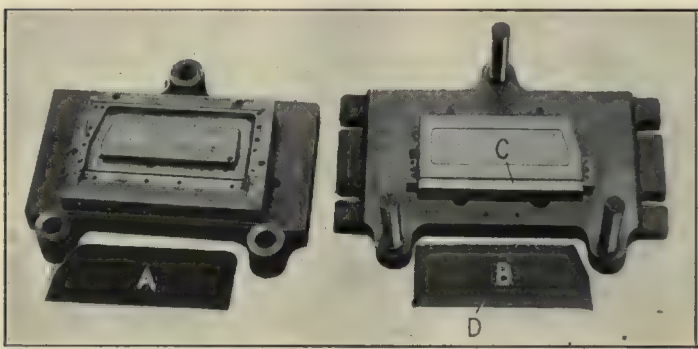


FIG. 8. FORMING AND TRIMMING DIES FOR CASE ENDS

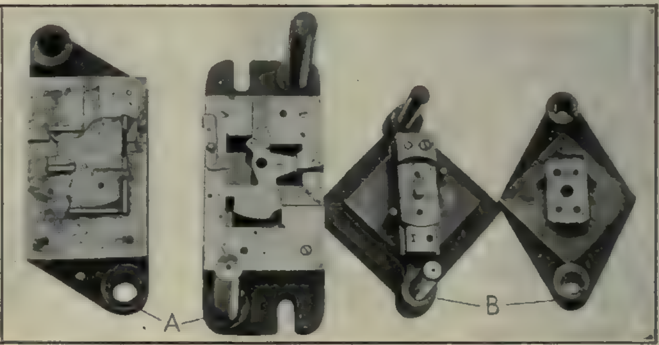


FIG. 12. BUILT-UP DIE FOR SHAVING KEY STEMS

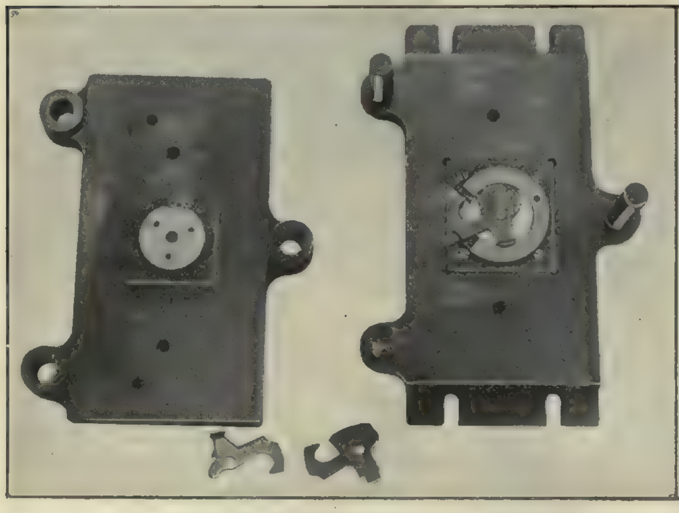


FIG. 11. SWAGING PUNCH AND DIE

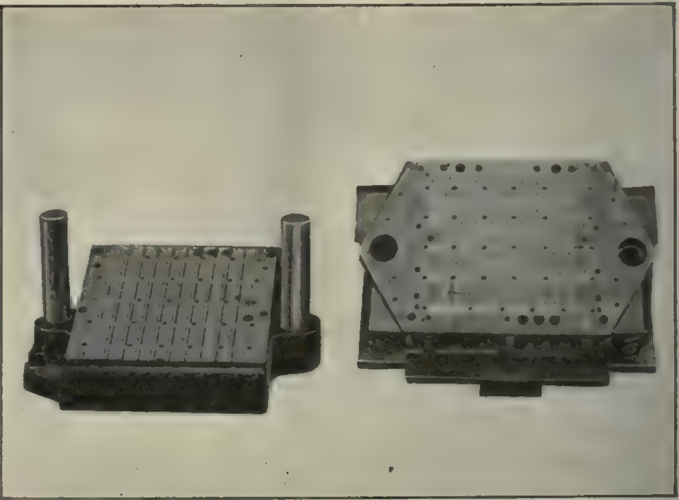


FIG. 12. BUILT-UP DIE FOR SHAVING KEY STEMS

describe more than a few in an article of reasonable length.

All dies, jigs, fixtures and special tools used in these shops are stored in fireproof vaults that are heated by steam pipes, in order that the tools may be kept as nearly as possible at the same temperature as the machine tools. This form of storage also prevents the possibility of rust, which would mean absolute ruin to many of the more delicate gages, etc. Another practice in these shops is to keep miller arbors with cutters assembled, for all work that requires great accuracy. This insures all parts being interchangeable and also saves many hours of set-up. One of these arbors and the milling fixture that goes with it is shown in Fig. 3. These fixtures are used for milling the nine openings in the metal shield that fits over the number dials of the adding machine. In operation the fixture *A* is clamped to an angle plate on the miller table, the blank is slipped in from the left end until it registers against the pin stop on the right, the two levers close and clamp the piece while the miller table is fed against the cutters *B;* *C* is a finished piece the details of which are given in Fig. 5.

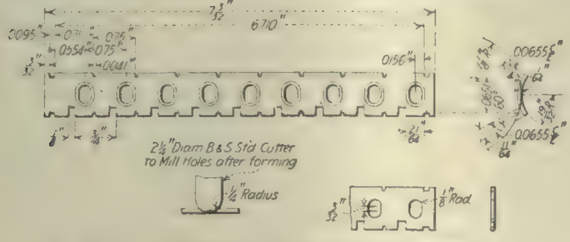


FIG. 5. DETAILS OF METAL SHIELD

Fig. 4 shows a fixture for holding the shaft *E* while milling 15 notches with the cutters on the arbor *D*. This fixture holds two shafts at once. They are slipped in from the left until they register against the stop *F;* the five wedges *C* are then driven in and draw the clamps *B* down onto the work. A feature not shown in the cut is the use of hardened rollers on the ends of the clamps and resting on the under side of the wedges. Springs always hold the clamps up away from the work as soon as the wedges are released.

In Fig. 6 are shown two indexing milling fixtures for milling the edges of the frames *C* and *D;* *A* indexes for three cuts without changing the location of the fixture or of the miller table, and *B* indexes for two cuts.

Fig. 7 shows two assembling, drilling and pinning jigs for the parts shown in the foreground. The interesting feature in connection with these jigs consists of the eccentric clamping screws, which permit handling the work very rapidly. As they are all part of the body of the jig, they are brought to bear before the lid is closed and so leave all parts in plain view of the workman until after they are firmly clamped in position.

In Fig. 8 are illustrated forming and trimming dies for the case ends seen at *B*. These pieces are first blanked out as shown at *A*, after which they are formed in the dies. The piece *C* is then removed from the dies, and the edge of the piece is trimmed on the line *D*. The other edges come so accurate that no trimming is required, a little grinding being all that is necessary in order to make a neat fit with the body of the case.

Some of the most interesting and ingenious tools used in connection with this work are the dies for punching, bending, swaging and shaving some of the pieces that enter into the construction of the machine. As these pieces must be interchangeable and fit without filing, they require very accurate work. The piece shown in detail in Fig. 9 is made in a series of blanking, forming, swaging and trimming dies. It is first blanked and perforated in the die *A*, Fig. 10. The lug is then bent up with the die *B*, which does not leave the lug properly formed nor of sufficient thickness. It is next passed to the swaging dies, Fig. 11, and the lug is upset and swaged to proper shape and thickness, after which the piece is trimmed and shaved to correct form in another die. An expensive built-up die is shown in Fig. 12. This die is for shaving the holes for the key

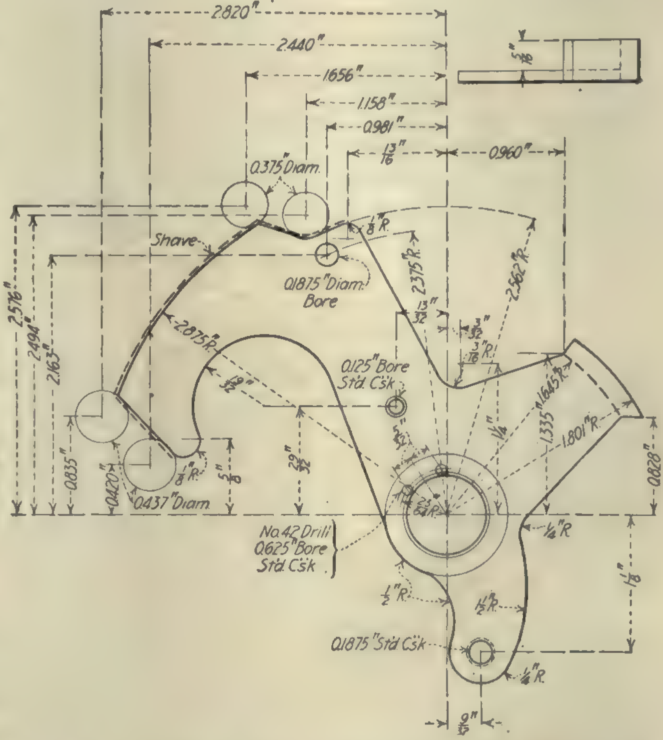


FIG. 9. DETAIL OF PART FORMED IN DIES SHOWN IN FIGS. 10 AND 11

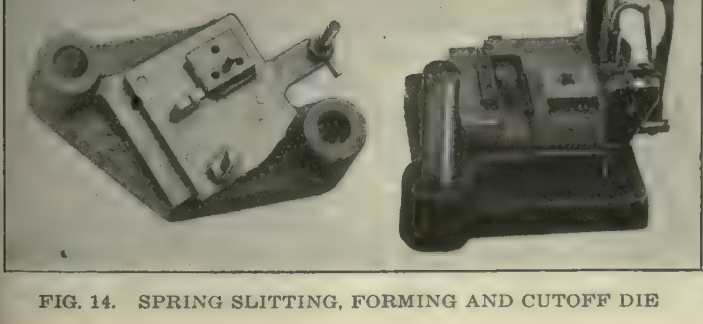


FIG. 14. SPRING SLITTING, FORMING AND CUTOFF DIE

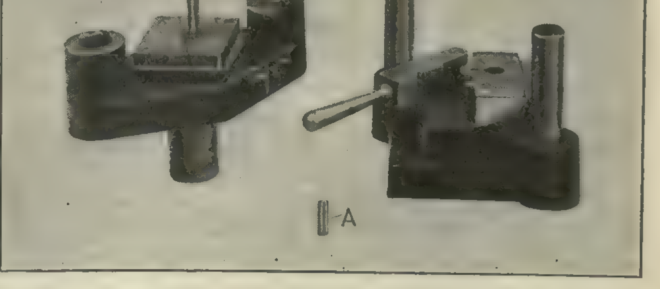


FIG. 15. PUNCH AND DIE FOR SLOTTING SHORT TUBE

stems, at an angle, the plate having been first trimmed in a shear and the 90 or more holes punched straight through. A close inspection of the photograph will give some idea of the many pieces used in the construction of this die. The cost was about $800.

In Fig. 13 is shown a steel spring that is slit, formed and cut off in the die shown in Fig. 14. For this work, rolls of tempered spring stock 0.120 in. wide and 0.004 in. thick are used. The die automatically feeds the stock, slits it into three pieces, forms to shape and cuts off. Fig. 15 shows a die for punching a slot in a short piece of seamless drawn bronze tubing. This tubing is first cut to length in the screw machine and then passed to the die, a narrow strip of stock being punched from one side, as shown at *A*. In the construction of the money machine a large number of long bars are required, all being of the same size and shape, but not having the lugs or teeth the same. They are all punched with one die, as shown in Fig. 16, after which those teeth not required are sheared off, thus doing away with a large number of very expensive dies.

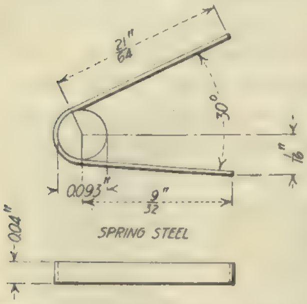


FIG. 13. DETAILS OF TEMPERED STEEL SPRING

INSPECTION GAGES

All parts used in the construction of these machines are carefully inspected at various stages of machining and are then given a final inspection in order to insure absolute interchangeability. Many fine and interesting gages are used for this work. Fig. 17 shows a gage *A* for measuring lengths of various shafts. The gage is first set so that the indicator *C* points to zero. Lines scribed on each side of the zero mark indicate the limits allowed. At *B* is a gage for testing the ways in the paper-carriage track. By simply sliding the gage along the ways, any irregularity is shown by the movement of the indicator *D*.

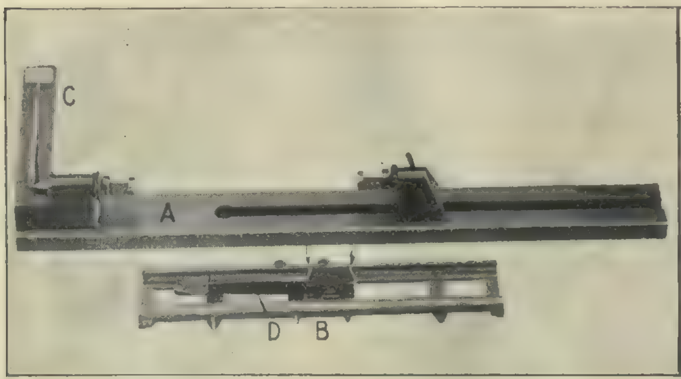


FIG. 17. LENGTH AND TRACKWAY GAGE

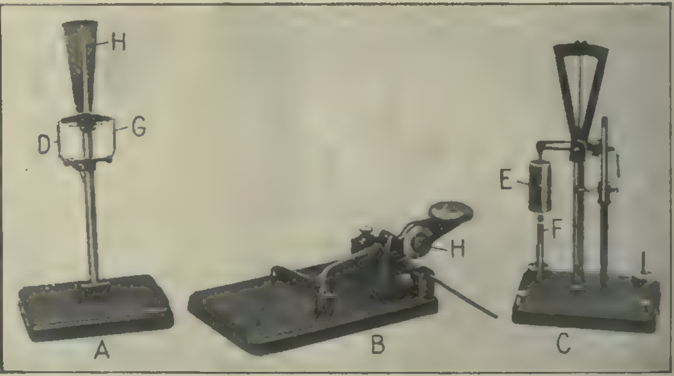


FIG. 18. SPRING CUTTING AND TESTING FIXTURES

All the springs used are very carefully tested after cutting to length with the cutter *B*, Fig. 18. The spring is fed through the opening and against the gage stop. A slight blow of the hand on the cutter lever drives the circular cutter *H* down through the spring and onto a steel block. One advantage of this fixture is that, when the cutter becomes dull, it may be loosened and turned to bring a sharpened part into operation.

The first test on springs after cutting is with the weighted gage illustrated at *C*. This gage is fitted with adjustable screws for leveling and with adjustable weights *E*. To prevent injury to this gage through carelessness, a spring recoil plunger *F* is used. After this weight test, the springs are all tested with master springs on gage *A*, *D* being the master spring for this particular case and *G* the spring being tested. This insures all springs being uniform and of proper strength, as the pointer indicates any variation.

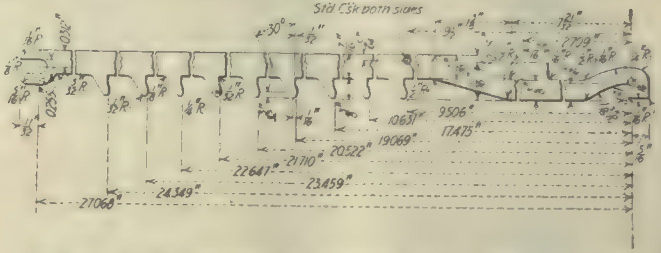


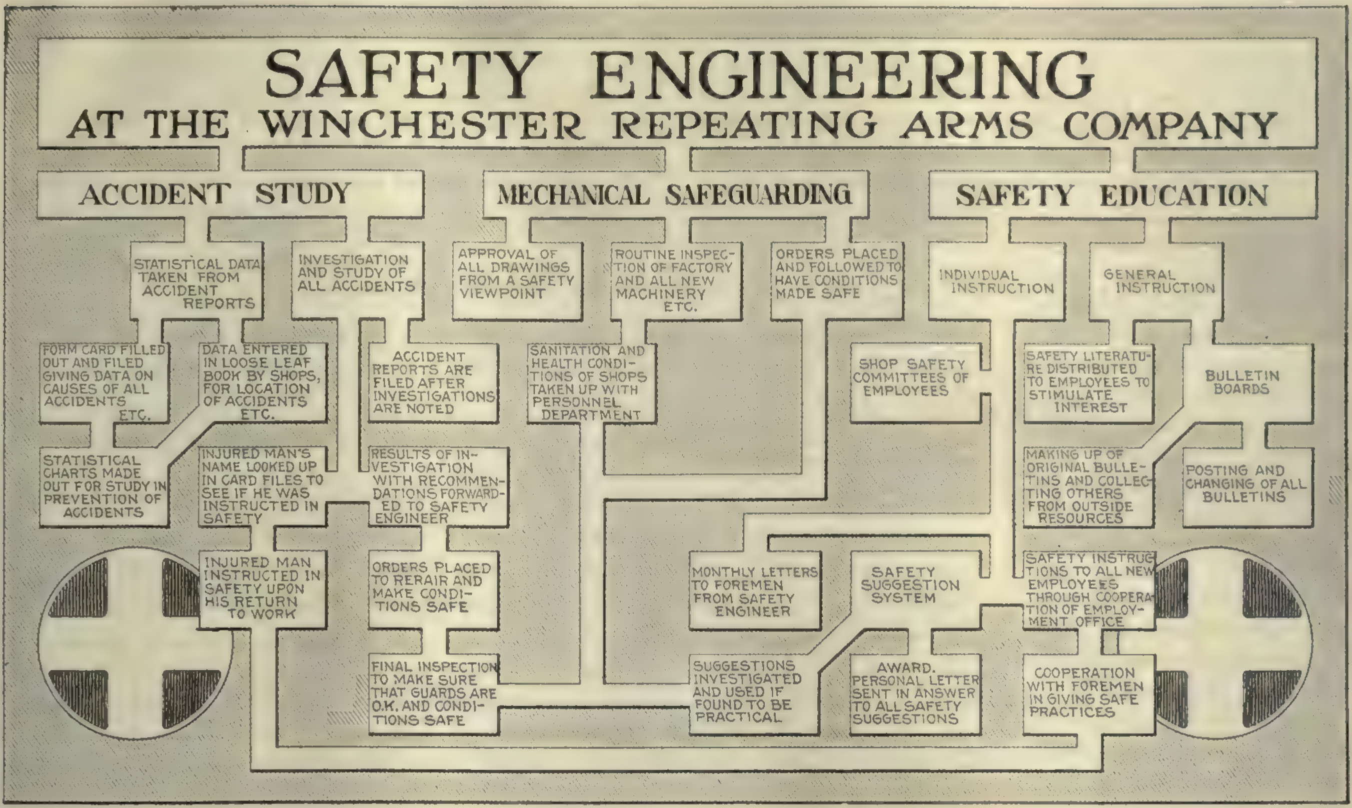
FIG. 16. BAR ON WHICH TEETH ARE SHEARED OFF AS REQUIRED

United States Wants Inspectors of Ordnance Equipment

An examination for inspectors of ordnance equipment has been announced by the Civil Service Commission, according to a notice received from the chief of ordnance of the War Department Division. One class of this examination is for inspectors of hardware and metal equipment, comprising such articles as buckles, rings, fasteners, hand axes, wire cutters, intrenching tools, canteens, cups, meat cans, cutlery and other small articles of brass, iron, steel or aluminum.

Men who have had a high-school or equivalent education and in addition have had four years' experience in a manufacturing plant making such articles as those described above will qualify for one class of inspectors; another class of inspectors requires men over 25 years of age who are graduates from a college or university of recognized standing and who have had one year's experience in a manufacturing plant.

Those who are interested can obtain additional information from the Equipment Division, inspection Section, 1330 F St. N., Washington, D. C., or from any office of the United States Civil Service Commission.


SAFETY ENGINEERING
AT THE WINCHESTER REPEATING ARMS COMPANY
ACCIDENT STUDY
MECHANICAL SAFEGUARDING
SAFETY EDUCATION
STATISTICAL DATA TAKEN FROM ACCIDENT REPORTS
INVESTIGATION AND STUDY OF ALL ACCIDENTS
APPROVAL OF ALL DRAWINGS FROM A SAFETY VIEWPOINT
ROUTINE INSPECTION OF FACTORY AND ALL NEW MACHINERY ETC.
ORDERS PLACED AND FOLLOWED TO HAVE CONDITIONS MADE SAFE
INDIVIDUAL INSTRUCTION
GENERAL INSTRUCTION
FORM CARD FILLED OUT AND FILED GIVING DATA ON CAUSES OF ALL ACCIDENTS ETC.
DATA ENTERED IN LOOSE LEAF BOOK BY SHOPS, FOR LOCATION OF ACCIDENTS ETC.
ACCIDENT REPORTS ARE FILED AFTER INVESTIGATIONS ARE NOTED
SANITATION AND HEALTH CONDITIONS OF SHOPS TAKEN UP WITH PERSONNEL DEPARTMENT
SHOP SAFETY COMMITTEES OF EMPLOYEES
SAFETY LITERATURE DISTRIBUTED TO EMPLOYEES TO STIMULATE INTEREST
BULLETIN BOARDS
STATISTICAL CHARTS MADE OUT FOR STUDY IN PREVENTION OF ACCIDENTS
INJURED MAN'S NAME LOOKED UP IN CARD FILES TO SEE IF HE WAS INSTRUCTED IN SAFETY
RESULTS OF INVESTIGATION WITH RECOMMENDATIONS FORWARDED TO SAFETY ENGINEER
MAKING UP OF ORIGINAL BULLETINS AND COLLECTING OTHERS FROM OUTSIDE RESOURCES
POSTING AND CHANGING OF ALL BULLETINS
INJURED MAN INSTRUCTED IN SAFETY UPON HIS RETURN TO WORK
ORDERS PLACED TO REPAIR AND MAKE CONDITIONS SAFE
MONTHLY LETTERS TO FOREMEN FROM SAFETY ENGINEER
SAFETY SUGGESTION SYSTEM
SAFETY INSTRUCTIONS TO ALL NEW EMPLOYEES THROUGH COOPERATION OF EMPLOYMENT OFFICE
FINAL INSPECTION TO MAKE SURE THAT GUARDS ARE O.K. AND CONDITIONS SAFE
SUGGESTIONS INVESTIGATED AND USED IF FOUND TO BE PRACTICAL
AWARD. PERSONAL LETTER SENT IN ANSWER TO ALL SAFETY SUGGESTIONS
COOPERATION WITH FOREMEN IN GIVING SAFE PRACTICES

BY C. B. HAYWARD
Safety Engineer

SYNOPSIS — *This article outlines the principles and routine back of the safety-engineering work at the Winchester plants, which resulted in practically eliminating machine accidents and in cutting lost-time accidents some 60 per cent.*

ACCIDENT prevention at the Winchester Repeating Arms Co., previous to the year 1913, was for the most part haphazard in its application. This was due to the fact that matters of this nature were put in the hands of men specializing in other lines of work. There was little or no systematic central direction or supervision of such work. Many safety devices and practices were in use prior to 1913, and conditions were as good as could be expected.

In special cases, such as cartridge-loading machinery and similar work that was liable to be hazardous, safety in operation was given more study than the actual producing of loaded shells. It was at such a time, therefore, when the agitation of mill and railroad officials, the passing of laws, the creation of industrial commissions and the demands of the workmen themselves resulted in the formation of safety organizations in factories and railroads, that this company, with its foundation in safety, desired to improve conditions further by establishing a definite safety organization, supervised by a safety engineer.

Plans for this new development were formulated in the latter part of 1912, and in the early part of 1913 definite work started. No stones were left unturned to make it a successful part of a successful and long-established company. Our president, Winchester Bennett, gave his efforts and good will toward the project. All the officials of the company showed their personal interest in this new movement by assisting in every way possible. The object of the plan was to increase the safe and sanitary conditions of the plant, to prevent accidents and to keep the plant up to standard in all lines of safety engineering.

A safety committee was appointed immediately to put into action the adopted plan and guide the work. Two men from the various departments were appointed to serve as members with three of the executive officials. The safety engineer served as one of the members of this committee, and it was his duty to bring up for discussion all matters requiring definite action and advice. Meetings were held twice each month, and at these times all manner of propositions covering the whole range of work and dangerous practices, dangerous machinery, unprotected gears, unsanitary conditions and the general welfare of the employees were brought up to be studied and passed on.

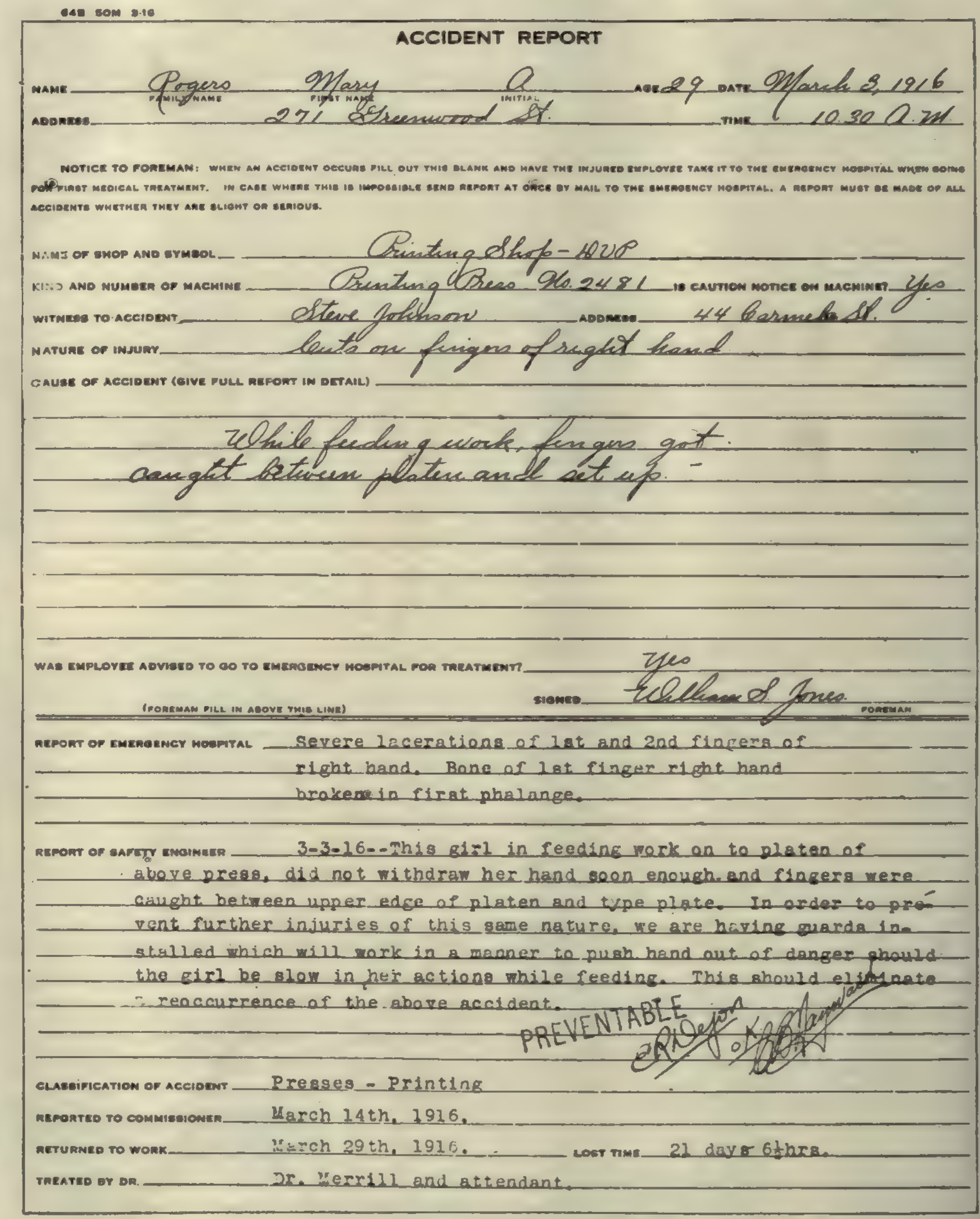
MANY COMMON DANGERS HAD BEEN ELIMINATED

That considerable progress in safety work had been made previous to 1913 was soon realized by the fact that a large proportion of the so-called common dangers were found to have been eliminated.

The inspecting of guards already installed, the placing of new protecting devices on all the various types of machines where necessary and the improvement of what had been considered sanitary conditions were given much serious thought and study.

Many of the existing guards were changed to provide more complete protection. Hand rails and safety stair treads are examples of standards adopted in building construction. Exhaust systems, ventilation and lighting have each one received their allotment of study as part of the safety plans. Caution signs and bulletin boards have been placed where thought necessary and instructive. Toilet rooms have been enlarged, the equipment standardized and ventilation improved in all parts of the plant. Drinking-water facilities have been studied and modern systems of furnishing pure, clean water to the employees considered. Bubbling fountains are being installed throughout the entire factory. Step ladders, pole ladders and staging platforms have been put under constant inspection and standard designs of each adopted. It is not necessary to describe further the mechanical safeguarding of the factory against accident and disease. All these plans mentioned form only a part of the general progress of safety engineering in the Winchester company. The study of accidents and safety education are developing more and more to be the main phases in the prevention of accidents. As the work progresses, mechanical safeguarding—or the necessity of it—assumes less importance in the safety organization. The future of conserving life and limb depends upon interesting the employees in carefulness and thoughtfulness through personal education and coöperation. The bulletin board, safety-instruction sheets, accident study, safety-suggestion system, shop safety committees, shop talks, literature and other similar plans develop a broader scope of the work each year. Mechanical safeguarding, which in the beginning occupied the majority of our plans, now constitutes about 25 per cent. This compares favorably with other industries which are carrying on intelligent safety work.

Our present organized efforts are divided into three phases of the work—that pertaining to accidents and their study, that having to do with mechanical safeguarding and that part relating to safety instruction. The first phase constitutes 35 per cent., the second 25 per cent. and the third 40 per cent. of the work. The accompanying chart shows the breaking down of these three main divisions and gives a clear conception of how the results are obtained.



648 50M 3-16

ACCIDENT REPORT

NAME Rogers (FAMILY NAME) Mary (FIRST NAME) A (INITIAL) AGE 29 DATE March 3, 1916
ADDRESS 271 Greenwood St. TIME 10.30 A.M.

NOTICE TO FOREMAN: WHEN AN ACCIDENT OCCURS FILL OUT THIS BLANK AND HAVE THE INJURED EMPLOYEE TAKE IT TO THE EMERGENCY HOSPITAL WHEN GOING FOR FIRST MEDICAL TREATMENT. IN CASE WHERE THIS IS IMPOSSIBLE SEND REPORT AT ONCE BY MAIL TO THE EMERGENCY HOSPITAL. A REPORT MUST BE MADE OF ALL ACCIDENTS WHETHER THEY ARE SLIGHT OR SERIOUS.

NAME OF SHOP AND SYMBOL Printing Shop - HVP
KIND AND NUMBER OF MACHINE Printing Press No. 2481 IS CAUTION NOTICE ON MACHINE? Yes
WITNESS TO ACCIDENT Steve Johnson ADDRESS 44 Carmel St.
NATURE OF INJURY Cuts on fingers of right hand
CAUSE OF ACCIDENT (GIVE FULL REPORT IN DETAIL)
While feeding work, fingers got
caught between platen and set up.

WAS EMPLOYEE ADVISED TO GO TO EMERGENCY HOSPITAL FOR TREATMENT? Yes
SIGNED William S. Jones FOREMAN
(FOREMAN FILL IN ABOVE THIS LINE)

REPORT OF EMERGENCY HOSPITAL Severe lacerations of 1st and 2nd fingers of
right hand. Bone of 1st finger right hand
broken in first phalange.

REPORT OF SAFETY ENGINEER 3-3-16--This girl in feeding work on to platen of
above press, did not withdraw her hand soon enough and fingers were
caught between upper edge of platen and type plate. In order to pre-
vent further injuries of this same nature, we are having guards in-
stalled which will work in a manner to push hand out of danger should
the girl be slow in her actions while feeding. This should eliminate
a reoccurrence of the above accident.

PREVENTABLE

CLASSIFICATION OF ACCIDENT Presses - Printing
REPORTED TO COMMISSIONER March 14th, 1916.
RETURNED TO WORK March 29th, 1916. LOST TIME 21 days 6½hrs.
TREATED BY DR. Dr. Merrill and attendant.

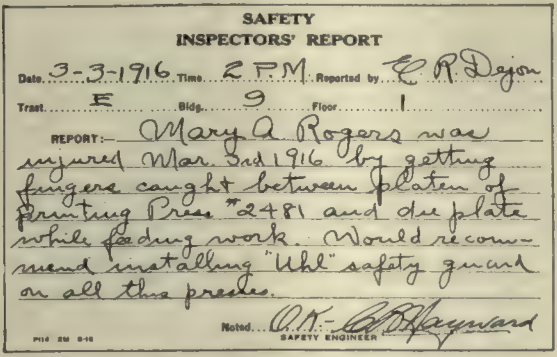
FIG. 1. THE ACCIDENT REPORT IS MADE IN DETAIL

Under the heading of accidents there are the three divisions—statistical data, investigation and filing of reports. To facilitate and make this outline more tangible, the accompanying accident report, Fig. 1, can be used as an example and the various steps it would take explained more clearly.

For the collection of necessary useful data pertaining to accidents, two things are necessary to know—the causes and the locations. The first is obtained by filling in accident record cards and classifying the causes when filing them for study, Fig. 2; the second, by entering the data in a book on loose-leaf sheets according to shops, Fig. 3.

The purpose of the card information is to locate the causes of accidents repeated often and is a plan found to be both simple and practical. The loose-leaf compilation of data affords us a means of keeping together by shops such information as will assist in reducing accidents in coöperation with the foremen of the various shops.

The investigation of an accident is important. Two measures are taken here—first, to find out if the accident was preventable on the part of the company through the application of a safety device; and second, to find out if the injured man received safety instructions when starting in to work for the company. The first subdivision after an investigation in the factory is taken care of by a recommendation being made on the safety inspector's report blank, Fig. 4, to repair the condition causing the accident if possible. In the specific instance of the sample accident report an order, Fig. 5, was placed to eliminate the reoccurrence of a similar accident. After the guard is installed, the safety inspector views the installation to see if the guard is O.K. and the conditions safe.



SAFETY
INSPECTORS' REPORT

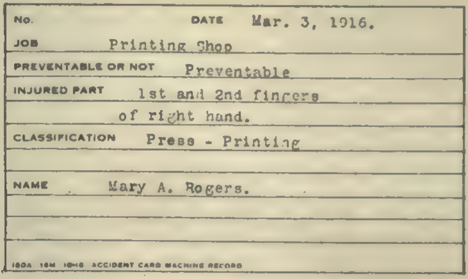
Date 3-3-1916 Time 2 P.M. Reported by E. R. Dejon
Tract E Bldg. 9 Floor 1

REPORT:— Mary A Rogers was injured Mar. 3rd 1916 by getting fingers caught between platen of Printing Press #2481 and die plate while feeding work. Would recommend installing "Uhl" safety guard on all this presses.

Noted O.K.– C. B. Hayward
SAFETY ENGINEER

P114 2M 8-16

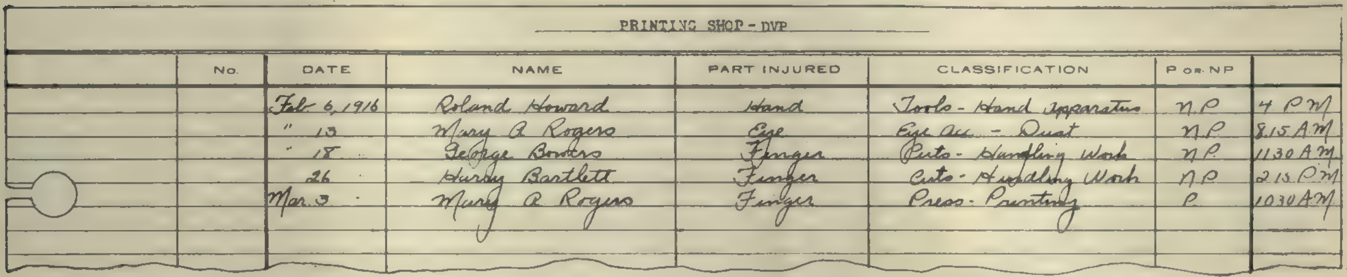
FIG. 2. CARD RECORD IS FILLED OUT



No. DATE Mar. 3, 1916.
JOB Printing Shop
PREVENTABLE OR NOT Preventable
INJURED PART 1st and 2nd fingers of right hand.
CLASSIFICATION Press - Printing
NAME Mary A. Rogers.

160A 10M 10-16 ACCIDENT CARD MACHINE RECORD

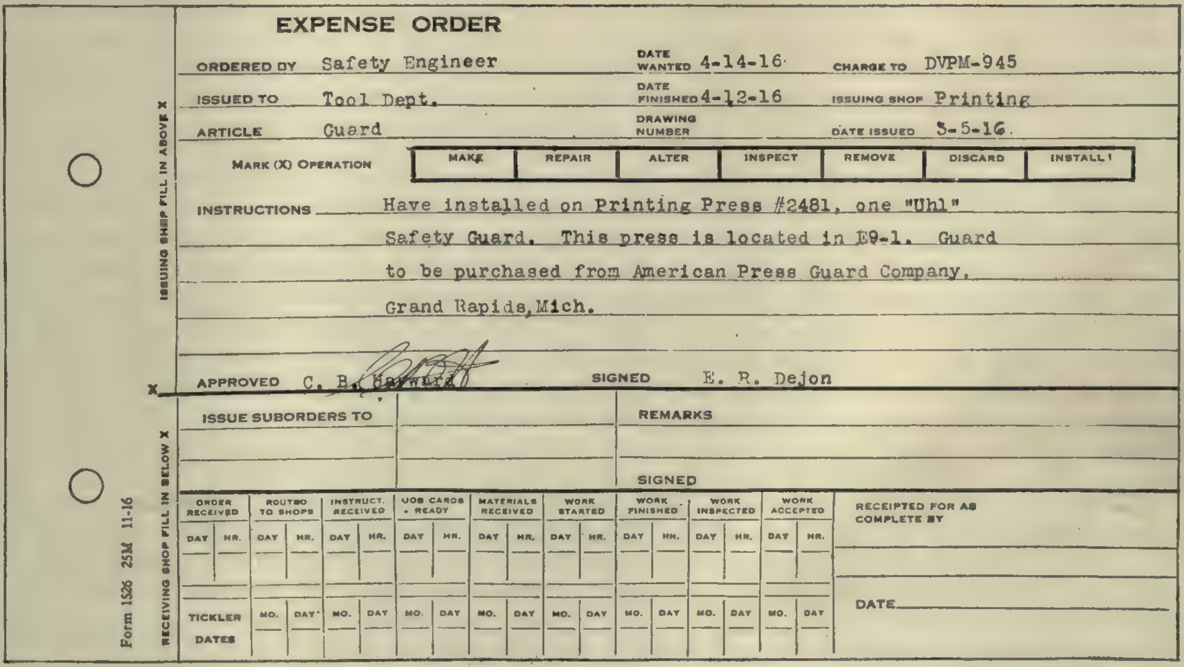
FIG. 4. SAFETY INSPECTOR REPORTS



PRINTING SHOP - DVP

	No.	DATE	NAME	PART INJURED	CLASSIFICATION	P OR NP	
		Feb 6, 1916	Roland Howard	Hand	Tools - Hand apparatus	N.P.	4 P.M.
		" 13	Mary A Rogers	Eye	Eye acc. - Dust	N.P.	8.15 A.M.
		" 18	George Bowers	Finger	Cuts - Handling Work	N.P.	11.30 A.M.
		26	Harry Bartlett	Finger	Cuts - Handling Work	N.P.	2.15 P.M.
		Mar. 3	Mary A Rogers	Finger	Press - Printing	P.	10.30 A.M.

FIG. 3. THE ACCIDENT DATA ARE ENTERED IN A LOOSE-LEAF BOOK



EXPENSE ORDER

ISSUING SHOP FILL IN ABOVE X

ORDERED BY Safety Engineer DATE WANTED 4-14-16 CHARGE TO DVPM-945
ISSUED TO Tool Dept. DATE FINISHED 4-12-16 ISSUING SHOP Printing
ARTICLE Guard DRAWING NUMBER DATE ISSUED 3-5-16

MARK (X) OPERATION ☐ MAKE ☐ REPAIR ☐ ALTER ☐ INSPECT ☐ REMOVE ☐ DISCARD ☐ INSTALL

INSTRUCTIONS Have installed on Printing Press #2481, one "Uhl" Safety Guard. This press is located in E9-1. Guard to be purchased from American Press Guard Company, Grand Rapids, Mich.

X APPROVED C. B. Hayward SIGNED E. R. Dejon

RECEIVING SHOP FILL IN BELOW X

ISSUE SUBORDERS TO
REMARKS
SIGNED

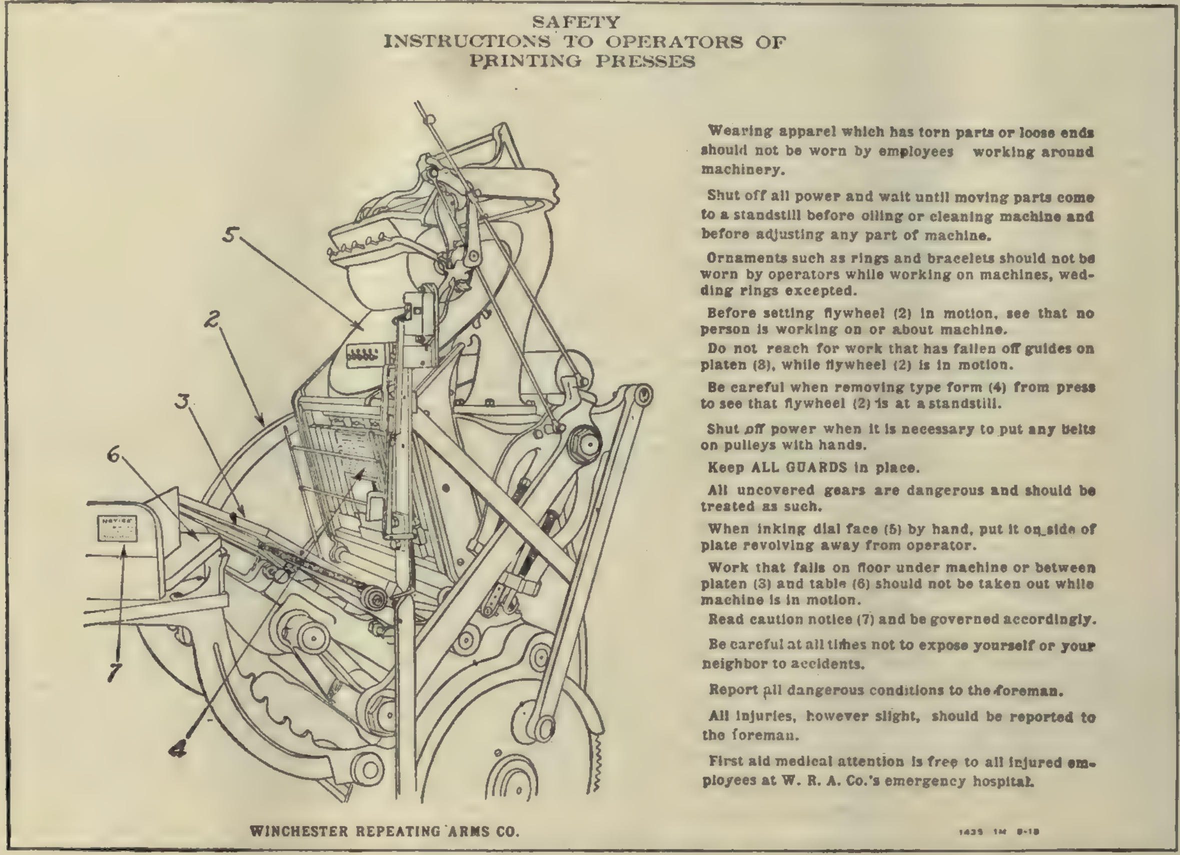
ORDER RECEIVED		ROUTED TO SHOPS		INSTRUCT. RECEIVED		JOB CARDS READY		MATERIALS RECEIVED		WORK STARTED		WORK FINISHED		WORK INSPECTED		WORK ACCEPTED		RECEIPTED FOR AS COMPLETE BY
DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.	DAY	HR.	
TICKLER DATES		MO.	DAY	MO.	DAY	MO.	DAY	MO.	DAY	MO.	DAY	MO.	DAY	MO.	DAY	MO.	DAY	DATE

Form 1526 25M 11-16

FIG. 5. AN ORDER IS FILLED OUT FOR THE PROPER GUARD

The second subdivision is that of looking up in the files the injured man to see if he had been instructed in the safe operation of his machine. When the employee enters the portals of the company to operate a machine, the employment bureau furnishes the safety department with that information; and it is the latter's duty to see that safety is not forgotten in the new man's instructions. Fig. 6 is an example of these safety-instruction sheets, and Fig. 7 is an example of the card filed in the safety department. If it is found that the injured person's name is not in the file on a card, coöperation with the foreman makes it possible to instruct the injured employee upon his return to work. Over 7000 employees have so far been personally instructed in safety in this manner, and a machine accident is a rare occurrence. This completes the first phase of safety engineering.

The second phase of safety engineering has to do with mechanical safeguarding. This work is subdivided into three separate headings. The first, the approval of drawings for safety, is accomplished through coöperation with the drafting and engineering departments. The amount of work here naturally depends upon the amount of new work and repairing done. The second subdivision, covering the inspection of the plant for hazards and unsanitary conditions, should not take up a great deal of the time of the safety department after the foremen and employees have been educated to do this for themselves. The safety engineer then needs only to have the condition made safe. In cases where the safety inspector does make recommendations, the report blank, Fig. 4, is handed in, and orders are placed to make conditions safe. This completes the second phase of safety engineering.



SAFETY
INSTRUCTIONS TO OPERATORS OF
PRINTING PRESSES

5
2
3
6
7
4
NOTICE

Wearing apparel which has torn parts or loose ends should not be worn by employees working around machinery.

Shut off all power and wait until moving parts come to a standstill before oiling or cleaning machine and before adjusting any part of machine.

Ornaments such as rings and bracelets should not be worn by operators while working on machines, wedding rings excepted.

Before setting flywheel (2) in motion, see that no person is working on or about machine.

Do not reach for work that has fallen off guides on platen (8), while flywheel (2) is in motion.

Be careful when removing type form (4) from press to see that flywheel (2) is at a standstill.

Shut off power when it is necessary to put any belts on pulleys with hands.

Keep ALL GUARDS in place.

All uncovered gears are dangerous and should be treated as such.

When inking dial face (5) by hand, put it on side of plate revolving away from operator.

Work that falls on floor under machine or between platen (3) and table (6) should not be taken out while machine is in motion.

Read caution notice (7) and be governed accordingly.

Be careful at all times not to expose yourself or your neighbor to accidents.

Report all dangerous conditions to the foreman.

All injuries, however slight, should be reported to the foreman.

First aid medical attention is free to all injured employees at W. R. A. Co.'s emergency hospital.

WINCHESTER REPEATING ARMS CO.

1435 1M 8-19

FIG. 6. INSTRUCTIONS ARE ISSUED TO THE OPERATORS OF ALL THE PRINTING PRESSES

The third phase of safety engineering covers that of safety instruction, individual and general. The work included under this heading is considered the most important of all accident-prevention work. A guarded machine is unsafe in the hands of a careless, thoughtless or ignorant man.

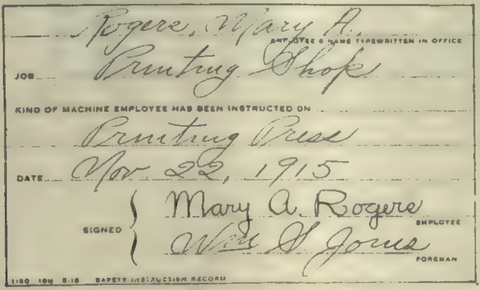
Individual instruction is subdivided into four different sections—shop safety committees, monthly letters to foremen, safety-suggestion system and safety instructions to new employees. Shop safety committees have been tabled for the time being. This part of safety education has its important connection. The training of men to note hazardous conditions and practices through spending only one or two hours of their regular working period every other week is a course not to be belittled. These men, if properly handled, turn out to be efficient safety boosters.

Monthly letters to the foremen, giving a monthly record of their accident standing included in an interesting appeal for reduction of accidents, have been helpful in coöperating with these men along accident prevention lines. These communications have made it possible for them to compare each record with the previous month's and see how accident prevention is progressing. We have found that the plan, if developing nothing else, has been one means of keeping the safety department and its work before the eye of the various foremen. It helps maintain a closer relationship between us.

The safety-suggestion system has not been worked to the possibilities that we hope for in the future. The system is clear from the accompanying letters. The suggestion system at present incurs no remunerative rewards. The plan of materially rewarding suggestions may be given consideration at some future time. For the time being, a letter of thanks and appreciation telling how the suggestion has been used is signed by the first vice president and general manager and forwarded to the man making the suggestion. We have had many very good safety suggestions. The numbers have not been great, but those we have received have been practical, thoughtful and useful.

Safety instructions to new employees have already been referred to under the investigation of accidents. Figs. 6 and 7 are included in this work. When the instruction sheet is given to the new man on the job and the practices are described, the employee signs the safety-instruction record card; and after the foreman has added his signature, the record card is sent to the safety department.

Photographs and cuts are always attractive means of presenting the subject to all classes of help. The second division takes in the maintaining of bulletin boards. This work is broken up into two parts, the making up and collecting of bulletins and the posting and changing of them on the bulletin boards. Making up and collecting of bulletins and exhibits require careful consideration. The words, pictures and subjects must be attractive and interesting. Many of our bulletins in use are those put out by the National Safety Council. Many we make ourselves. The posting and changing are done once every week. Bulletins remaining too long posted distract interest instead of attracting it.



Rogers, Mary A.
EMPLOYEE'S NAME TYPEWRITTEN IN OFFICE
JOB Printing Shop
KIND OF MACHINE EMPLOYEE HAS BEEN INSTRUCTED ON
Printing Press
DATE Nov. 22, 1915
SIGNED Mary A. Rogers EMPLOYEE
Wm. S. Jones FOREMAN
1150 10M 8-16 SAFETY INSTRUCTION RECORD

FIG. 7. DATE OF INSTRUCTION IS RECORDED

In conclusion, it might be of interest to mention that our safety efforts of the past four years have reduced machine accidents to practically none; our lost-time accidents (one day or more) have been reduced to one in 3640 employees per day in 1916; and compensated cases of one in about 15,200 employees per day for the same year of 1916. Our records show that, during the last three months of 1916, there were 7390 accidents studied in the safety department; and out of that number only 39 were found to have been preventable through mechanical means, on the part of the company. But 0.5 of 1 per cent. of our accident prevention in those three months depended upon mechanical safeguarding.

Although definite organized efforts are being followed, many problems arise, which have to be studied before passing on them, because of their originality and practicability in use. This necessitates constant study and keeping up to date in all lines of safety work by following work carried on in the various industries throughout the country. Safety engineering is not different from other lines of work where the progress of the science requires continuous study.

Following will be found an example of the monthly letters to foremen and of the way in which safety suggestions are handled:

April 15, 1917.

J. Herbert,
Sheet-Metal Shop.

You know that accidents occurring in your shop are brought to our attention through the medium of the accident report. You know that we investigate the cause. You know that dangerous conditions have been guarded. You also know of others that should be, in a like manner, made safe—conditions that we could not locate even with most careful investigation. These are the ones we are after and have not found because as yet no injuries have resulted from these causes.

These conditions are known to the men who are on intimate terms with them; men who work around them day in and day out, and are well acquainted with their every move. Give us a hand in trying to reduce next month's accident record. Give us your suggestions—we will do the rest.

Below is the accident record of your shop for February and March:

	February	March
Eye accidents	6	2
Hand tools	4	1
Falling objects	2	
Handling objects and handling work	5	7
Dropping tools on work	2	
Infections	..	6
Strains	..	1
Total	19	17

C. B. Hayward,
Safety Engineer.

April 19, 1917.

To the Safety Department: I noticed a man from the brass-casting shop, the other day, in his working clothes. Besides having torn clothes, the shoes were particularly noticeable. They were tied at the top with laces or pieces of cord, the cord being wound around the top several times, while the lower part of the shoe was slashed in several places. Those shoes would not protect his feet from molten metal, and if some did get in his shoes, his fellow workman would have to hunt around for a knife to cut the cords loose from his ankle. These men earn more than the average pay of shop workers, and there seems to be no necessity for their being without shoes that are all together.

The army type of shoe with its broad toe and no tongue —that is, one solid piece in front—is an ideal shoe.

Suggestion—Look 'em over!

John T. McMahon,
Winchester Patrol.

Suggestions—Shoes for Brass Casters

John T. McMahon,
Winchester Patrol, A5-2.

Your safety suggestion of Apr. 19 is appreciated, and I am pleased to note your interest in such matters.

The question of proper shoes and leggings has several times been considered, and efforts have been made to have the men of the brass-casting shop adopt them.

However, the footwear of these men is optional with them, and I regret that all have not acted upon the advice given them. Further efforts along this line will be made.

If at any time you have further suggestions to offer, they will be given careful attention.

J. E. Otterson,
First Vice President and General Manager, Winchester Repeating Arms Co.

Removing Cutters, Chucks and Centers

By A. J. Machek

In a recent issue of the *Machinist*, in the selling section, an illustration shows a man in the act of taking off a large cutter from an ordinary miller spindle and one from a new-style Brown & Sharpe spindle. It does not take long for one to see which is better; we have all been there.

In looking at this picture, an old problem again presented itself to me for solution, and perhaps your readers can help me solve it; namely, What is the proper way to remove a center from a dividing-head spindle, and why does one have to use the barbarous method of screwing the chuck off the dividing-head spindle? If driving out the center from the spindle with a lead hammer is crude, surely twisting the chuck off with a flat bar in one of the slots and letting the dividing worm and wheel take the stress is just as crude. Yet I have not seen a dividing head that has provision for removing either the chuck or the center in an efficient and simple manner. How much better it would be if all the chucks and centers were held in place in the spindle like a drawback collet.

Series for Draftsmen and Designers

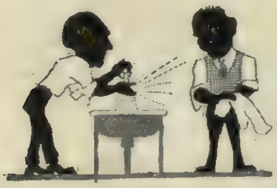
Drafting-Room Etiquette*

By CHARLES M. HORTON

DRAWING-ROOM conduct and drafting-room etiquette are—or should be—practically the same thing. One does not find cuspidors in the drawing rooms of homes—at least, not in our set—and certainly one should not find cuspidors in the sanctums known as drafting rooms. Yet I fear me there are many such. With the exception of this minor difference, the rules of conduct for both are practically identical.

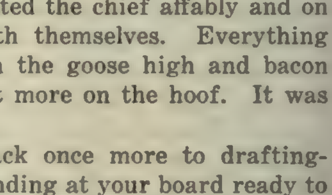
When you enter the drafting room for the day, you will greet the bunch with a cheery "Good morning!"—that is, if you are a draftsman. If you are only the chief, or foreman of a division, or boss of a squad, you will not say anything. Instead, you will glare around you, just as any hostess of the home glares about at her guests in search of the usual absent or tardy ones, and you will sit down at your desk or table and proceed to set a vigorous example to the others by ruffling papers and pawing over blueprints—make a noise, generally, like a man ready and eager, even anxious, to begin to get ready to start to eat up the day's work. All this, if you are a chief, or a foreman, or a squad boss.

If you are a draftsman, you will not do these things. You will slip out into the washroom, instead, as soon as you get your board uncovered, and spend ten minutes washing already immaculate hands, gossiping with your fellow-workers in the vineyard—in this case, the washroom—and, altogether, give an imitation of a man who loves work dearly and would not be denied it for life itself, should it come to that. But presently—Wait! I have just thought of a story.



In a certain drafting room in an Eastern city, there was a chief draftsman named Cowper. He was a confirmed bachelor, who worked because he liked to work, since a certain distant relative had died and left some fifty or seventy-five thousand dollars to Cowper in his will. Cowper lived in a suite of rooms in one of the leading hotels, and he wore extremely good clothes and a wig. Yes; Cowper wore a wig. He had lost his hair early, owing to some unfortunate attack of disease—probably typhoid fever.

Every last man under him in that drafting room knew the state of Cowper's temper when he entered in the morning, by the wig itself. If Cowper was in good humor, his wig in the back, just where it almost touched his collar, invariably was flat and closely hugging the nape of his neck. If Cowper was in an irritable mood, as he frequently was, the back and lower part of his wig stood out—curled out and up—like the end of a coil spring or a feather. The bunch read this sign every morning as regularly and correctly as they read the morning papers, and also they shaped their conduct and deportment for the day from that sign. If the wig said, "Keep your heads down and plug like blazes," the gang kept their heads down and plugged like blazes. If the wig said, "I'm feeling pretty good today and will talk on almost and subject but that of drafting," the gang instantly relaxed and smiled and greeted the chief affably and on an equal social footing with themselves. Everything was all right and fine, with the goose high and bacon in the smokehouse and a lot more on the hoof. It was a great indicator.



But presently—to get back once more to drafting-room etiquette—you are standing at your board ready to begin work, though you do not immediately begin. You spend twenty minutes sharpening your pencils, and another ten minutes out in the washroom getting the black off your fingers, and then five minutes more at your board studying your drawing to find the precise place where you left off the night before. But at last you are ready to begin to start to commence to go to work. Everything is all set—your instruments are out, and your stool is back where it was before the night sweeper moved it into the adjoining county, and you have swept off your drawing with your neighbor's duster and forgotten to return it—everything is all right to go ahead. And so, after a time, having found your commencement point on the drawing, and having got yourself adjusted properly on the stool, with your feet and legs just so, you bend forward and square your elbows and with your trusty pencil in hand begin to make lines. You have, of course—I almost forgot this—you have, of course, first rolled up your shirtsleeves, to show the sunburn you got on that canoe cruise the Saturday before —and—well, you're making lines. Good! Go to it!

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But now comes an interruption—and Lesson One in this series. The chief engineer is steaming down the aisle toward you, followed by a couple of scientists—you know they are scientists by their stooped shoulders and more or less careless and shabby attire and by their spectacles, men evidently responsible for the idea upon which you are working. Lesson Number One. If you are a fathead, when the distinguished group assembles itself about your board, you will stick to your stool. You will not get up. You will remain glued to your seat and, with the chief engineer and the scientists craning their necks to see your work, you will continue in your place, the biggest and fattest—fathead—in that drafting room.

But maybe you are not a fathead. Maybe you are a gentleman and a scholar—a man of breeding, one accustomed to drawing-room etiquette—both kinds. Then you will not remain seated. Instead you will quietly slip off your stool, as quietly step to one side out of their way and continue quiet and speechless throughout the consultation, unless spoken to, when you will of course answer in as quiet and inconspicuous a way as you know how. And then, when the distinguished group departs, you will twist yourself back on your stool and resume work, following the instructions for changes which the engineer may have suggested to you.

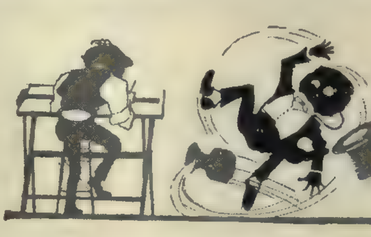
Now for Lesson Number Two. You will remain seated and at work. You will not, unless you are the aforesaid fathead, get down off your stool again, as soon as the group disappears, and begin to cruise about among your brother workmen, whispering gentle knocks against the scientists and the engineer. You may know more than they know put together—you very likely do—but you must keep it to yourself. Keep quiet about it. Some day your genius will be discovered—and then you, too, can wear shabby and careless attire, together with the spectacles, and troop down some drafting-room aisle behind some chief engineer, the center—or cynosure—of all eyes, admiring and otherwise, depending on the nature of the chief engineer. But not yet—not now. You must wait. If the scientists made you rub out a tap bolt and show a stud bolt instead, or if they criticized a mechanical movement or looked distressed upon learning some of the fiber stresses—keep all these things to yourself. Do not peddle them around among the other draftsmen.

Rule Number Three. Do not—but, wait; I have just thought of another story.

In a certain large drafting room Somewhere in the Middle West, there was a tobacco chewer of the most virulent kind. In fact, he was such a strong chewer he had to have a cuspitoon all by himself, where the rules and regulations requisitioned one to every two men. But half a cuspidor to this gent was exactly three-quarters of a spittoon too small. He proved it. Where he hit the receptacle once, he hit the surrounding territory a dozen times. But that was all right. He was an active, nervous, tireless worker, and I doubt whether he realized at all that he was chewing—most of the time, anyway. It was a kind of habit with him.

One afternoon, the Big Guy himself—worth forty millions and the employer of from fifteen to twenty thousand hands—came down the aisle alone to see about a job he was interested in. The job was being worked out by the tobacco chewer. The Big Guy walked down to our friend's table, recognized him as the man engaged on this particular job and whirled in between the two boards—the one upon which our friend was working and the board of the draftsman immediately to the rear. The Big Guy, as he whirled, slipped, caught himself, uttered a mild exclamation of annoyance, looked down to see what he had slipped upon.

Rule Number Three. Do not chew tobacco. Cuspidors were removed instanter from that drafting room, on orders from the Big Guy, and our friend took to chewing gum. He was lucky. Had the Big Guy been other than what he was—the biggest individual, humanely speaking, ever to ascend in the industrial world—our friend would have been fired, no doubt. But all they did was to remove the cuspidors. It was enough, probably, for our friend.



There is another breach of drafting-room etiquette which I might well mention. I refer to the habit of borrowing instruments. That in itself is bad enough —though it is not so bad. What transcends it as an unforgivable breach—especially to the man who owns the instruments—is when you neglect to return the instruments after you are through with them. But even that will be overlooked by the more generous spirited. But what will not be overlooked, even by the most kindly disposed, is the return of instruments in bad shape—the pens uncleaned, the leads blunted, the points out of adjustment. One does not borrow in drawing rooms—one should not borrow in drafting rooms. Sometimes borrowing is unavoidable, however. But not so one's neglecting to return what has been borrowed, and certainly not so one's returning instruments in as good shape as when one got them. One is one flivver, if one does any one of these things. All of which is Rule Number Four.

Rule Number Five. Once upon a time there was a consulting engineer's office that needed draftsmen. They engaged two men at the same time. One of these men was capable, and the other was not so capable. Both went to work the same morning. The less capable man, arriving a few minutes ahead of the other, was assigned the more difficult of the jobs to be worked up. He did not make a very good showing. The other man did, on the job which had been assigned to him. As a consequence, when the second man had finished his job, he was promptly given the other man's job to do, while this man, the less capable of the two, was put on more simple work. Which of course was not his fault. Along toward the second or third day, the man at work on the job the other man had fallen down on, discovered that he needed some additional information in order to go on. At the moment the chief was out of the room. Knowing that the other draftsman had worked on the job and even being aware that this man's unfinished drawing was still tacked down on his board, the capable draftsman, instead of losing time awaiting the return of the chief, stepped across to the other's board in quest of the desired information. The drawing containing this needed information was still tacked down, but it was underneath two or three other sheets, the several false starts of the less capable man on his new job.

"What was the clearance between that paddle and the bottom of the kettle?" he asked, having already been to lunch with this man and feeling on somewhat familiar terms with him.

The other looked sore. "I don't remember," was the surly reply.

"But you've got it here," persisted the capable draftsman. "It's under those sheets, isn't it? You worked on this job, didn't you?"

"Yes," mumbled the other. "But I know what you want. It was either two inches or six—I can't remember."

By this time the capable man was getting onto the other scout. He perceived that the man was sore and inclined to steer him off, or wrong. That got his goat, and he decided to stick.

"Can't you come any closer than that? Two inches or six inches is kind of a wide guess." As a matter of fact, his own engineering instinct told him it was neither—not so much. "Let's take up a couple of these tacks and look at that drawing you started. You had that information in order to start the work. Let's take a look." And he began to remove one of the tacks.

The other stopped him with a sheepish mean look in his eyes. Knowing that he was cornered and being, as he evidently was, a poor misguided animal anyway—possessed in the extreme of Kultur—he had to show his hand, because there was not enough subtlety about him to escape it.

"Do you think I'm going to give you information to take over there and put on your drawing?"

That was all he said. But it was more than too much. Sometimes too much is just enough—like beer at a shop picnic. But not in this case. By that remark and that attitude, this man revealed himself as one who decidedly did not belong. He was far from being a draftsman in his work; he was very, very far removed spiritually from being one of a very generous body of men as a whole. Of course, that ended him in that drafting room socially. It was not long before they canned him physically. He probably thought the capable man was trying to sneak some needed information without bringing his ignorance to the knowledge of the chief. A man never made a bigger mistake. The capable man, perceiving this evidently, when the chief finally returned, asked for the information in a good loud tone of voice—and the other skate grew red behind the ears and kept his nose down for the rest of the day.

So we have Rule Number Five. Be a gentleman, even if it hurts you. And be generous spirited. Nothing is gained by the other attitude. I know a man who once asked another son of Kultur for certain information regarding a formula that was troubling him in a job he was at work upon. The son of Kultur blazed up indignantly and informed my young friend that his education had cost him money and that he—my friend—had better go pay for a little education on his own account. Now, that did not get that *hombre* anything. My young friend went big in that concern, and he never forgot—never could forget—that slurring reply at a time when he needed help from any source available. He grew to a position of power; and the other man stayed where he was, until there came a day when he awoke to the fact that he had no friends at court—and quit.

So we have Rule Number Five some more. Help others all you can. Go out of your way to help the young man working near you, and somebody sometime will go out of his way to help you. It is always so—it always works. It pays. And so, as a general rule and guide, one to be borne in mind always, I might conclude with a well-known quotation. It begins with "Do unto others," and it ends with "others unto you."

Thus endeth the lesson on Drafting-Room Etiquette.

Fusible Metal for Soldering

By Frank A. De Hart

Some time ago, while doing pattern work, I received orders that the lead figures, or pattern numbers, should be attached with soft solder. The only solder available at the time was half and half. I attempted to use it, but soon found that the lowest heat which would cause it to flow was sufficient to melt or bring the figures to a soft spongy state in which they could not be moved.

I was about to give up in despair when I happened to remember a small piece of composition that had found its way into the corner of my tool box. It was one of those little curios that all mechanics, while drifting from place to place, pick up, only to toss into some obscure corner, little dreaming of the important uses to which such things may be put at some future time—and this was one of those times. This piece was fusible metal, a composition of bismuth, lead, tin and cadmium, and had a melting point of 60 deg. C., or about 140 deg. F.

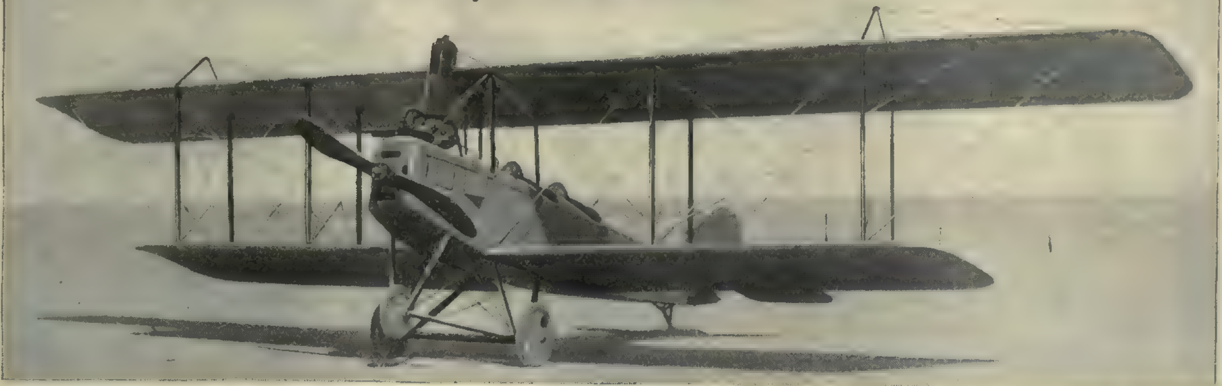
The pattern was heated and tinned in the customary manner, except that the fusible metal took the place of solder. I surprised my shopmates by spreading the melted solder with my bare fingers and also used my fingers to align the figures, which remained perfectly hard at this low temperature.

Anyone who has tried to solder sheet zinc for the first time will remember how, with an iron too hot, a large hole is melted in the article being soldered. This trouble is eliminated with fusible metal, as the temperature required is much lower than the melting point of zinc.

Several good formulas for fusible metal may be found in the "American Machinist Handbook."

Building a Military Training Airplane

By Fred H. Colvin



THE machine illustrated in the headpiece is a biplane that has been designed particularly for training-school purposes. This means that it must be of sturdy construction to withstand the constant hard usage given in a military preliminary training school, where it is handled almost exclusively by untrained men. It will be noticed that this machine has a three-wheeled landing gear, the small front wheel being for the purpose of preventing the machine from nosing into the ground, even if the landing is not exactly as it should be. There is of course the usual tail landing skid in addition to the three wheels in front.

In common with all modern training machines, there are provisions for two persons, each in a separate cockpit, one in front of the other, and each provided with a separate control so that the student can gradually become accustomed to handling the machine when it is in the air.

THE MAIN DIMENSIONS

The span of the upper wing is 43 ft. 10 in., and of the lower wing 32 ft., making an overhang of nearly 6 ft. on each end. The chord, or width of the wing, is 6 ft.; and the gap, or distance between the wings, 71 in. This follows common practice of making the distance between the wings about the same as the chord. Increasing this distance adds to the length of the wing struts and requires that they be of heavier section, owing to the increased length. Lessening the distance between wings decreases their efficiency as supporting surfaces.

The stagger, or the distance which the upper wing projects in advance of the lower, forms an angle of 4¼ deg. with the front edge of the lower frame. This amount is often given in inches, and in this case would be about 5¼ in. The over-all length of the machine is 26 ft. 7 in., and the height 10 ft. 10 in. The angle of incidence, which means the angle of the under side of the plane when the machine is in a horizontal flying position, is 2½ deg. The dihedral angle, or the angle which the wings assume with the horizontal, is 3 deg., and the sweep back 5 deg. This means that the front edge of each plane is 85 deg. Both the dihedral and the sweep-back angles add to the stability of the machine when it is in the air.

The machine, including engine, water and accessories, but without fuel, weighs 1350 lb., and the machine fully loaded 1950 lb., including the passengers. Its maximum speed at full load is 68 miles per hour, and its minimum speed 37 miles. This low minimum speed is particularly advantageous in a training machine, as it enables the student to land at a comparatively low speed. Its range of action at economical speed is 350 miles and its gliding angle 1 in 8. This means that if the aviator is 2000 ft. in the air, he can glide 16,000 ft. before making a landing. This possibility gives him a range of 3 miles in picking a landing place, which is ample distance in almost every case. It also shows the safety of flying at a considerable height instead of near the earth. The machine can climb 2600 ft. in 10 minutes.

It is equipped with a Hall-Scott four-cylinder water-cooled motor, rated at 90 hp. at 1400 r.p.m. This motor weighs 410 lb. and has a 5 x 7-in. cylinder. The fuel consumption is 9½ gal. per hour, and the fuel tank holds 31 gal. The lubricating-oil capacity in the crank case is 3 gal. The landing gear can be readily replaced by pontoons for use over water, so that the same machine may be employed for training either army or navy students.

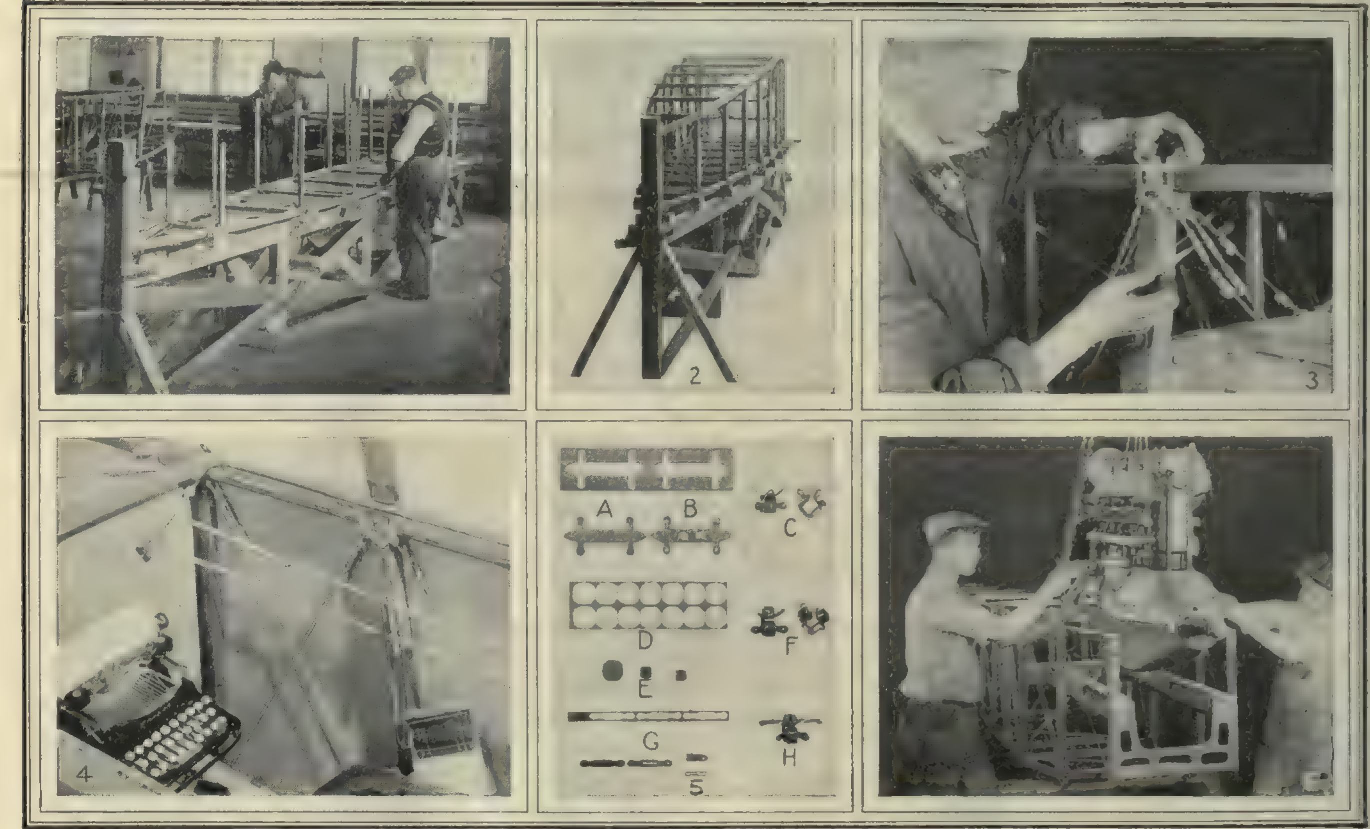
BUILDING THE FUSELAGE

Beginning with the construction of the frames, it is interesting to observe how they are built up from standard parts. Fig. 1 shows the two upper longerons, or side frames, placed on the assembling stands, with both the cross and the upright straps in place. These longerons are usually of ash, carefully selected and spliced in the center, owing to the difficulty of securing single pieces long enough for this work. The splice is long, with the two parts riveted together and then carefully wrapped and varnished. These splices are so securely made that they rarely give trouble or show weakness of any kind. The fuselage is built bottom side up, because the upper longerons are straight.

With all the struts, which are usually of selected spruce carefully made to measurement beforehand, and with the various metal fittings by which they are held in position at the proper point on the longeron, it is a comparatively easy matter to assemble this part of the fuselage. Great care, however, must be taken to have it absolutely straight with regard to a central line, as only a small deviation makes itself felt in the flying of the machine. After the vertical struts are located in their proper fittings, the curved longerons, which become the lower side of the fuselage when it is completed, are put in place with the aid of similar fittings that hold the struts in their correct position, as in Fig. 2. Then the wires are put in place, each of suitable length and with its proper turnbuckle; and after all are in position, the adjustment of these various wires to their proper tension begins.

This adjusting, or tensioning, of the strut wires is a somewhat delicate operation, as each wire must be tight enough to take its proper amount of the load, but not so tight as to impose unnecessary stress on either the wires or the wooden struts. When one carefully studies the various truss wires, usually two in each panel on both the sides and the bottom, he begins to realize the possibilities of building up a light structure that shall at the same time be exceedingly strong in every direction. It is considerable of a job to have all these wires cut to proper length, and one that requires the utmost care in every particular, as the wires must not be bent too sharply nor injured in any way that will weaken them and make failures probable at that point.

Some idea of the way in which the fittings are put in place on the longerons can be had from Fig. 3. This fitting surrounds the longerons and also provides a socket for the upper end of the vertical strap; in addition, there are several gears on this fitting, to which the truss wires or their turnbuckles are attached. The illustration shows the workman tightening one of the pair of turnbuckles at this particular point. It also shows how the wires are connected to the turnbuckles and gives some idea of the crossbracing and connections for the supports shown in the foreground.



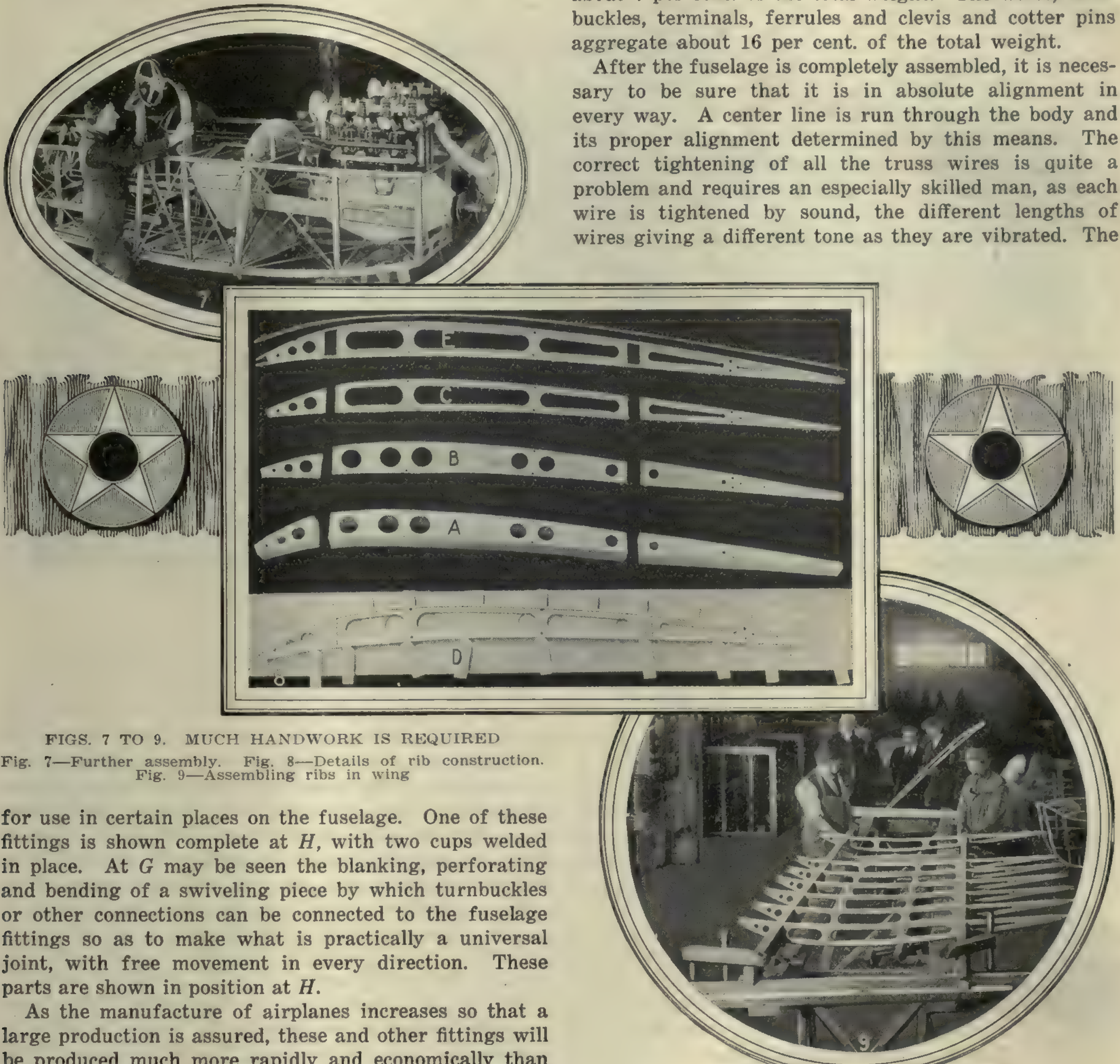
FIGS. 1 TO 6. GREAT CARE MUST BE EXERCISED IN EVERY DETAIL OF AIRPLANE BUILDING

Fig. 1—Starting the fuselage. Fig. 2—The assembled fuselage. Fig. 3—Adjusting the turnbuckles. Fig. 4—Close view of fittings. Fig. 5—Details of fitting. Fig. 6—Putting engine in place

Another close view showing some of the connections is presented in Fig. 4. This is a view in the cockpit of one of these machines and shows, in addition to the fittings on the end of the straps, some of the control rods and a portable typewriter, which was being tried out. The illustration gives some idea of the care that must be taken to prevent any possible chafing between the wires and the fuel tank, which is in front. A heavy pad of soft felt may be seen between the ends of the turnbuckle and the tank, to prevent vibration from ever bringing these two points together.

It will also be noticed that lengthwise tension wires are used to insure the fittings shown being always in their proper position. These wires are connected in swiveling ears, so as to have the tension in a direct line at every joint.

Some idea of the metal fittings may be had from Fig. 5, which shows what is known as a universal fuselage fitting. The main portion of the fitting is seen blanked out at *A*, and with the holes all punched at *B*. At *C* is one of these fittings bent up into its proper shape for application on the longeron of the fuselage. At *D* is shown the blanking out of a piece that is afterward formed into a square cup, as at *E*. This cup is welded into position on the other fittings for use in certain places on the fuselage. One of these fittings is shown complete at *H*, with two cups welded in place. At *G* may be seen the blanking, perforating and bending of a swiveling piece by which turnbuckles or other connections can be connected to the fuselage fittings so as to make what is practically a universal joint, with free movement in every direction. These parts are shown in position at *H*.



FIGS. 7 TO 9. MUCH HANDWORK IS REQUIRED

Fig. 7—Further assembly. Fig. 8—Details of rib construction. Fig. 9—Assembling ribs in wing

As the manufacture of airplanes increases so that a large production is assured, these and other fittings will be produced much more rapidly and economically than is now possible. At the present time, the number required has not seemed to warrant the necessary expenditure for punches and dies, in order to have these pieces practically completed on the punch press. The time is not far distant, however, when this is bound to be the case, and both designers and makers of punches and dies that can be used for this purpose are sure to be in demand. Some idea of the number of these fittings and their weight can be had from the following list of parts, which are among those used in the construction of the fuselage:

Wire—164 ft. of No. 9 aviator wire 0.037 lb. per ft.	6.06 lb.
120 ft. of No. 10 aviator wire 0.029 lb. per ft.	3.48 lb.
Turnbuckles—106 @ 1.25 oz	8.28 lb.
Clevis pins—174 @ 0.125 oz	1.36 lb.
Cotter pins—174 app.	.25 lb.
Ferrules—220 @ 0.25 oz	3.44 lb.
Lock wire—135 ft. of No. 20 copper wire @ 0.31 lb. per 100 ft.	.42 lb.
Terminals—74 @ 0.45 oz	2.08 lb.
Fittings—38 (main)	7.25 lb.

Ball and socket fittings, of which 4 are used, weigh approximately 10 oz. each. Number of fittings required—approximately 65. The entire fuselage weighs approximately 160 lb., the sheet-metal fittings forming about 7 per cent. of the total weight. The wires, turnbuckles, terminals, ferrules and clevis and cotter pins aggregate about 16 per cent. of the total weight.

After the fuselage is completely assembled, it is necessary to be sure that it is in absolute alignment in every way. A center line is run through the body and its proper alignment determined by this means. The correct tightening of all the truss wires is quite a problem and requires an especially skilled man, as each wire is tightened by sound, the different lengths of wires giving a different tone as they are vibrated. The completion of the frame includes the fastening in place of the two beams which support the motor and which are usually known as the engine bed. They are shown in Fig. 6, where the motor is being lowered into position. The front of the fuselage is braced by the U-shaped steel support that surrounds the engine bed and ties together the whole front, or nose, of the machine.

The engine is shown in place in Fig. 7. The gasoline tank is in position, and the man at the left is putting the controlling mechanism into position. This view shows the wheel control, sometimes known as the "Dep," this wheel being mounted on an arch frame that swings back and forth and in so doing controls the movement of the elevating planes, or flippers, at the rear. Turning the wheel controls the ailerons for balancing and banking on curves.

The wings of this type of airplane are almost entirely of wood construction, as can be seen in the illustrations which follow. Fig. 8 shows the development of the ribs. They consist of three parts in addition to the top and bottom member, which comes in contact with the cloth covering. As can be seen from *A*, these ribs are first cut from fairly thick material and are then sawed into thin strips, as shown at *B*. The openings are sawed out for the sake of lightness, as at *C*, and the whole rib is assembled in a suitable fixture, as at *D*, when the top and bottom pieces are tacked and glued into place, being held by means of the small cam-shaped clamps shown. The completed rib is illustrated at *E*. These ribs are then assembled, as shown in Fig. 9, by threading over the main spars, which are clamped in their proper position at the front end while the ribs are being slid into their proper place.

Owing to the sweep back of the wings of this machine, the ribs are not at exact right angles to the spars, but make an angle of 85 deg. on one side and 95 deg. on the other. This is because the ribs must be in line with the direction of flight in order to reduce the resistance that the machine presents to the air with which it comes in contact. The wing being covered might seem to make this unnecessary, but all cloth sags a little between the ribs and leaves them a trifle higher than the plane between. This is one of the finer details to avoid resistance and skin friction.

Fig. 10 is another view of wing construction in various stages and gives a good idea of the appearance of the ribs in place on the main spar. These spars, it will be noticed, are cut away on the side so as to approach the I-beam construction as much as possible. After the ribs are properly located, they are fastened in position by small nails, and the front and rear edges are fastened in place. At the top of the front, or leading, edge is a veneer of perhaps ⅛ in. covering the upper curve of the ribs on their entering edge, in order to support the cloth thoroughly at this point. Experiments are being made in some places to eliminate this veneer as a support to the linen, but no other construction has as yet proved itself entirely successful.

A completed wing frame is shown in Fig. 11. It is an upper wing, as can be noted by the space left for the aileron at the back, or trailing, edge. It will also be observed that the cross-wing is braced with truss wires extending through the hollow ribbed construction, the finished frame being more rigid than would usually be considered possible in so light a structure of this size.

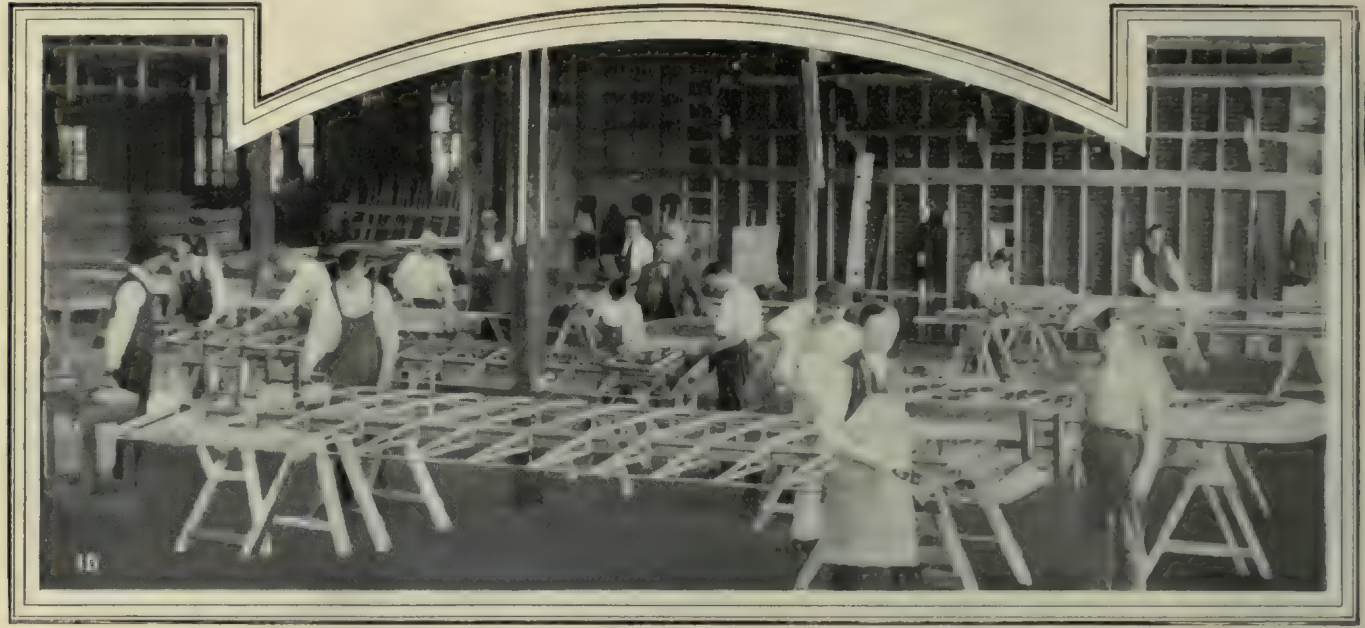
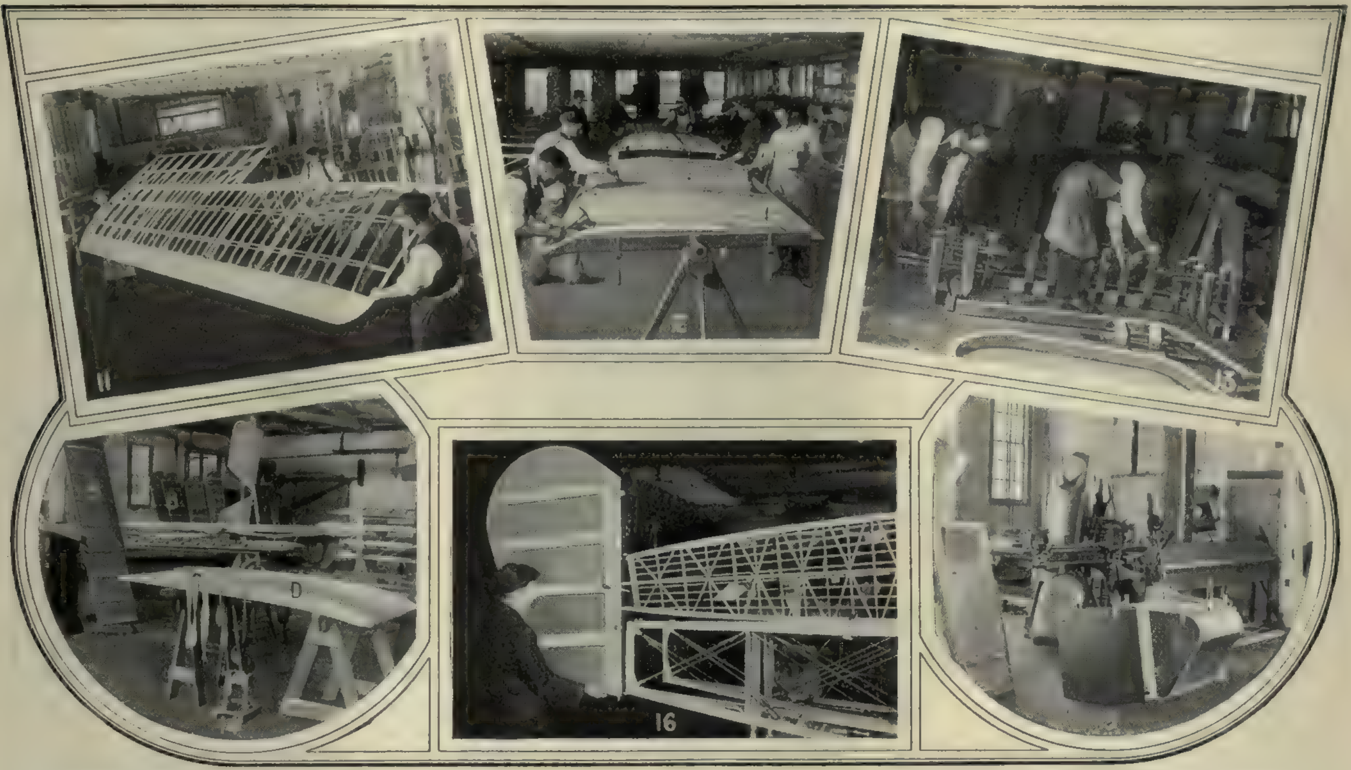


FIG. 10. IN THE WING SHOP ARE SEEN VARIOUS STAGES OF WING CONSTRUCTION

The wing is now ready to receive its linen cover, which is carefully sewed to pattern and held in position with small tacks and finally by sewing with linen thread. It is fastened with thread to each of the ribs, these seams being finally covered by a strip of linen that is held in position by the varnish, or dope, used. The application of this dope shrinks the linen tight on the frame and takes up all slackness in the covering. The final coating of dope renders the cloth absolutely waterproof and presents a solid surface to the air. Provision is made through eyelets located at the lower portion of the under side of the wing for allowing the escape of any moisture that might condense on the inside surfaces of the wing or otherwise work its way into them. A partly covered wing can be seen in Fig. 12.

The curved edges of ailerons, rudders and elevated planes are made of metal in some factories, either tubing or a specially drawn U-section being employed. In this machine, however, no metal is employed for this purpose, all the pieces forming the curved edge being built up from veneers and bent to form without seaming. Fig. 13 gives some idea of the way in which this is done.

Substantial wooden forms are provided of the proper shape for the pieces to be bent. Thin strips of the wood from which these pieces are to be formed are then put in a hot-box supplied with steam pipes and are thoroughly heated to as high a temperature as can conveniently be handled with the bare hand. These pieces, perhaps ⅛ in. thick, are then thoroughly coated with carefully prepared glue, and as many of the strips as may be required are placed one on top of the other. While the pieces are yet warm and the glue is still perfectly soft and liquid, they are placed between the forms, bent to conform with them, and the whole thing is clamped by the hand clamps, as shown. When the wood and the glue have thoroughly dried, there is a section of the proper shape built up of several laminations. It does not go out of shape, but has proved perfectly reliable.



FIGS. 11 TO 16. MANY OPERATIONS ARE NECESSARY BEFORE THE DIFFERENT PARTS ARE COMPLETED

Fig. 11—Completed wing. Fig. 12—Covering the wings. Fig. 13—Bending laminated frames. Fig. 14—Ailerons and tail planes. Fig. 15—Cockpit covers. Fig. 16—Streamline frame and rudder

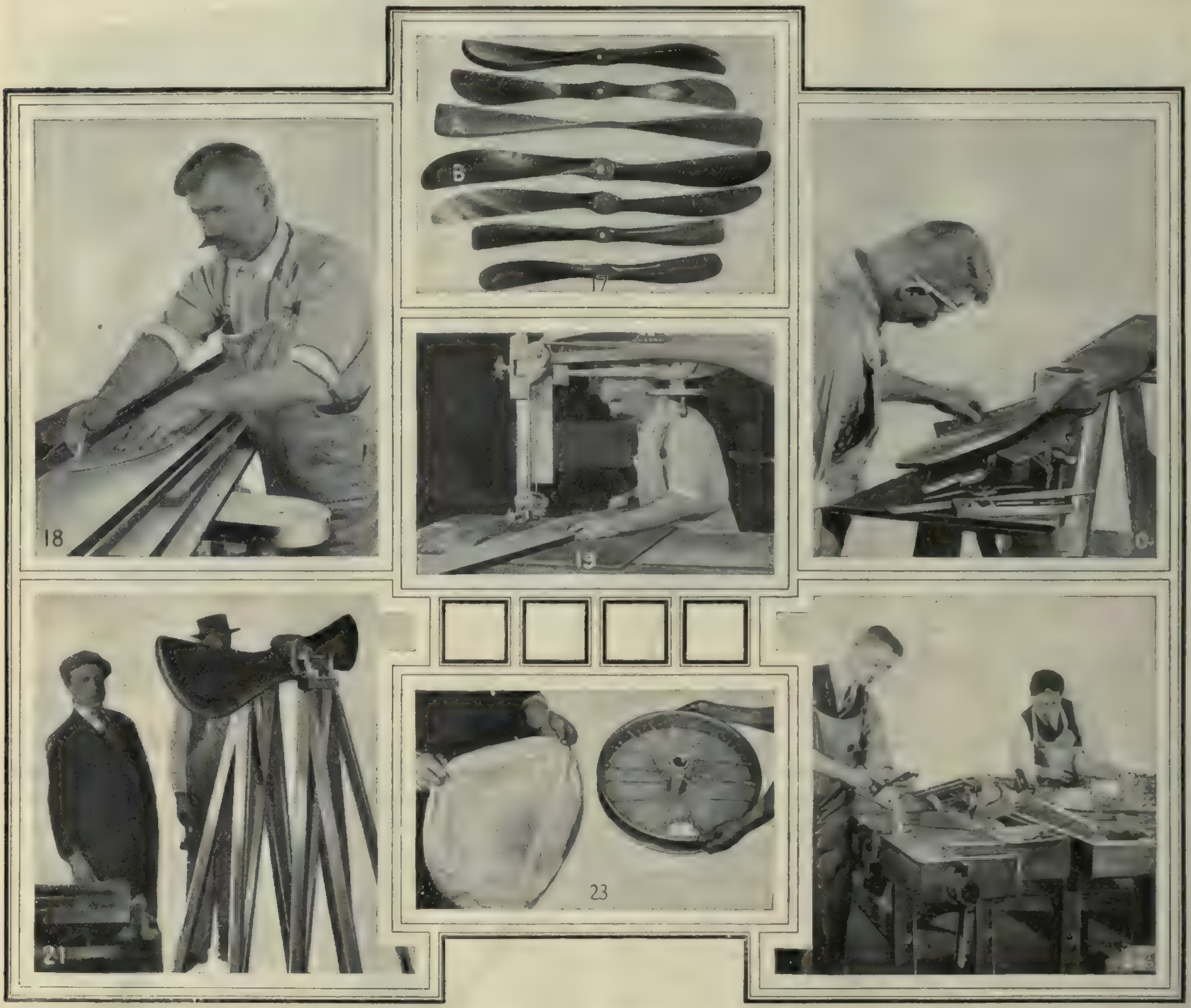
In Fig. 14 can be seen several ailerons, at *A* and *B*, an elevating plane, at *C*, and a center panel, or that part of the upper wing which goes over the engine and fuselage, at *D*. This view shows the center panel mounted on horses, where it has just been covered. It also shows the spool of linen thread by which the covering is sewed, and the strips of linen cloth that are varnished in position over the stitches that hold the fabric to each rib. These strips can be seen already pasted in place on the ailerons and the elevating planes.

For covering the top of the fuselage so as to give it the streamline effect, a sheet aluminum top is put on just behind the engine. Some of these covering plates, in which are the openings for the two cockpits, can be seen in Fig. 15. Behind this aluminum top a light wooden framework is built up. It is covered with the same fabric as the wings and continues the streamline back from the metal plates. Fig. 16 shows this framework rolled up on its side, also a rudder held up in position. The short metal plates seen standing by the post, Fig. 15, form part of the covering, or hood, around the engine, the one shown being a plate for covering the forward part of the under side of the fuselage. Near this are two tanks, one for water and the other for gasoline, from which it will be seen that there is considerable sheet-metal work in the modern airplane in addition to the wooden plane and propeller and the fabric used for covering.

The edges of the cockpit are well padded and covered with either leather or some of its imitations, and the seats for the pilots are padded and covered in the same way. In this connection it is interesting to mention that there is a tendency toward extreme simplicity in the design of these seats and the upholstery that covers them, leather being no longer absolutely required except by a few governments. It is one of the many cases where specifications, as originally written, call for an article that is perhaps no more expensive than its substitute; but in too many cases these specifications are never changed, regardless of conditions that may arise. We find many instances of unnecessary expense in matters of this kind.

PROPELLER IS MADE BY HAND

Among the many airplane parts that remain to be standardized is the propeller. A group of different styles is shown in Fig. 17. Here, propeller *A* is of very old design, while *B* is the type that is being used most largely at the present time. The other designs illustrate different ideas that have been tried out during the past few years. Propellers may be considered somewhat akin to the wing of an airplane, so far as the design of their surface is concerned. As we find the upper side of the wing convex, so we also find the front side of the propeller curved in the same way, while the back side is hollowed out somewhat in the manner of the under side of the airplane wing. When we add to this the constantly changing shape from the pit to the hub, we can see that it becomes a job for a skilled woodworker when the propellers are made by hand, as nearly all of them are at the present time. Fig. 17 shows two of the propellers with protecting tips on the ends of the blades. These tips are of thin sheet copper riveted in place.



FIGS. 17 TO 23. SKILLED WOODWORKERS ARE ESSENTIAL FOR MAKING THE PROPELLERS

Fig. 17—Group of propellers. Fig. 18—Laying out propeller. Fig. 19—Sawing propeller. Fig. 20—Shaping to templet. Fig. 21—Balancing the propeller. Fig. 22—Shaping and testing struts. Fig. 23—Covering the wire wheel

Beginning with the actual manufacture of the propeller, we come to the laying out of the different pieces on the black-walnut board from which they are to be cut, as shown in Fig. 18. Black walnut is used very largely for this work, although in some cases it is alternated with layers of spruce, each layer being from ¾ to ⅞ in. thick. After the various pieces that are to be built up to form the propeller have been laid out, they are cut out on the band-saw, as shown in Fig. 19. One of the long pieces is here shown being sawed into shape before gluing and building up.

In some places the propeller blades are roughed out on a sort of routing machine, using a form to guide the routing tools, but in most cases they are still worked out by hand from the rough built-up propeller blank. Great care must be taken in building up the layers that form the propeller, as it is absolutely necessary that there be a perfect union at all points of the surface. The parts to be glued must be thoroughly covered with a thin layer and then firmly held in position until absolutely dry. After this, the propeller is ready to be worked out by whichever method may be employed in the shop. In this case, nearly all the work is done by hand, Fig. 20 showing one end of a propeller cut almost to its proper shape and being tested by carefully made templets.

As can be seen from the tools on the workman's bench, the planes and draw-knives of various shapes are the main tools required. In addition to these a steel straight-edge, a level and a surface plate are necessary in testing the various parts of the propeller at frequent intervals. As shown, the propeller is supported on a central shaft, or peg, about which it can be turned so as to bring either end in position for measuring. This is an extremely interesting job and one requiring the utmost patience, as there can be very little variation allowed from the standard shape, length or width, and the matter of balance is of the utmost importance.

Fig. 21 shows more of the propeller portion of the shop, with several propellers in various stages of completion. It also shows, in its final balancing stages, a propeller built of black walnut and spruce. This is a case of static balance, the propeller being very carefully mounted on knife-edges that actually can be leveled by special screws at each end. The propeller must stay in any position in which it is placed. The final balancing is secured by applying a light coat of varnish near the outer end, in many cases a mere touch of the varnish brush serving to supply all the extra weight that is necessary to put the propeller in perfect static balance. This is one of the points that is very strictly watched, as an unbalanced propeller can do much damage to the whole machine, as well as be a source of danger to the aviator.

The struts have to be carefully made to secure maximum strength with least wind resistance. They are finished while held between centers, as shown in Fig. 22, one man shaping a strut with a draw-knife and the other gaging a strut for size and contour. Fig. 23 shows how the wire wheels are covered with cloth to reduce wind resistance, a hole being left to get at the air valve of the tube. The covers are then roped to draw them tight on the wheels.

Location of Cam Followers—II

By ARTHUR B. BABBITT

SYNOPSIS—*In this article the oscillating follower type of cam is studied with the purpose of showing how the angles of cam advance and the angles of the cam curves are affected by various positions of the follower fulcrum.*

With the oscillating follower the angle of the curve of the cam is liable to be acute more often than with the type of motion shown in Figs. 1 to 9 inclusive. This is due to the fact that a compensation has to be made for the offset of the line of motion from a radial line of the cam. In Fig. 10, with the direction of motion as indicated by the arrow and the angle of advance of the cam 102 deg., the angle of the curve of the advance is only 82 deg. This is due to the fact that a compensation has to be made for the divergence of the line *SP*, the line motion of the follower, and *SL*, the line that may be called the zero position of the timing of the cam. The line *OM* makes an angle of 102 deg. with *OL*.

When the line *OM* revolves through this angle of advance, or 102 deg., it occupies the position *OL*, and the center of the follower has moved from *S* to *P*. If we make the arc *MN* equal in length to the arc *LP*, the point *N* will be in the position *P* when the line *OM* has revolved to the position *OL*. This causes the angle of the curve of the advance to be less than the angle of advance and consequently increases the wedge angle of the curve.

By changing the direction of rotation of the camshaft, advantage may be taken of this compensation that has to be made, and the cam curve will be lengthened, thereby increasing the angle of the curve of the advance. In Fig. 11 is shown the curve of a cam with conditions the same as those for Fig. 10, with the direction of rotation reversed. It will be noticed that the angle of the curve of the advance is greater than the angle of advance. When the line *OM* swings into the position *OL*, the cam has made 102 deg. of revolution and the follower has moved from *S* to *P*. If we make the arc *MN* equal in length to the arc *LP*, the point *N* will be at *P* when *PM* has revolved to the position *OL*, or through 102 deg. The angle of the curve of advance has been increased to 122 deg., thereby reducing the wedge angle of the curve.

If it is impossible to change the direction of motion of the camshaft, still another method may be used for increasing the angle of the curve of the advance. This is illustrated in Fig. 12. The same angle of oscillation of follower is used, but the advance is toward the center of the cam instead of out, as in Figs. 10 and 11. This is accomplished by placing the follower on the opposite side of the cam. This condition also increases the angle of the curve of the advance to 122 deg.

In Figs. 10 and 11 the same motion of the follower is produced as with the cams shown in Figs. 1 and 2, on page 504, but the curves of the cams are different, due to the difference of direction of revolution of the camshaft. Several positions of the cam that was illustrated in Fig. 10 are shown in Figs. 13, 14 and 15, with the wedge and the pressure angles for each position. The wedge angle for the position of the cam shown in Fig. 13 is the angle *BEC*, found by the line *BE*, which is a tangent to the cam curve, and the line *CE*, drawn perpendicular to *AO*, which for this position is the instantaneous radius of the cam. The wedge angle in this figure is 44 deg. The center of the follower *A* is moving in the arc *AM*, and its instantaneous motion when at *A* is along a tangent to the arc at *A*, or the line *AD*. The angle of pressure against the roll is the angle *BED; BE* is the line of the wedge, and the line *DA* is the line of instantaneous motion of the follower. This angle in the diagram, Fig. 13, is 58 deg. In Fig. 14 we have the same cam and follower that are shown in Fig. 13, with the roller halfway of the stroke. The line *BE* is drawn tangent to the cam curve, and the line at right angles to the instantaneous radius of the cam is *CE*. These lines form the angle *BEC*, which is the wedge angle. The magnitude of this angle is 30 deg., as shown in the figure. The instantaneous motion of the follower when the cam is in this position is *AD*, and the angle formed by this line and the line *BA* is the angle of pressure against the cam roll. This angle measures 83 deg. The cam roll at the highest point in its stroke is illustrated in Fig. 15. When the cam is in this position, the wedge angle *BEC* is 14½ deg., and the pressure angle *BAD* is 112 deg.

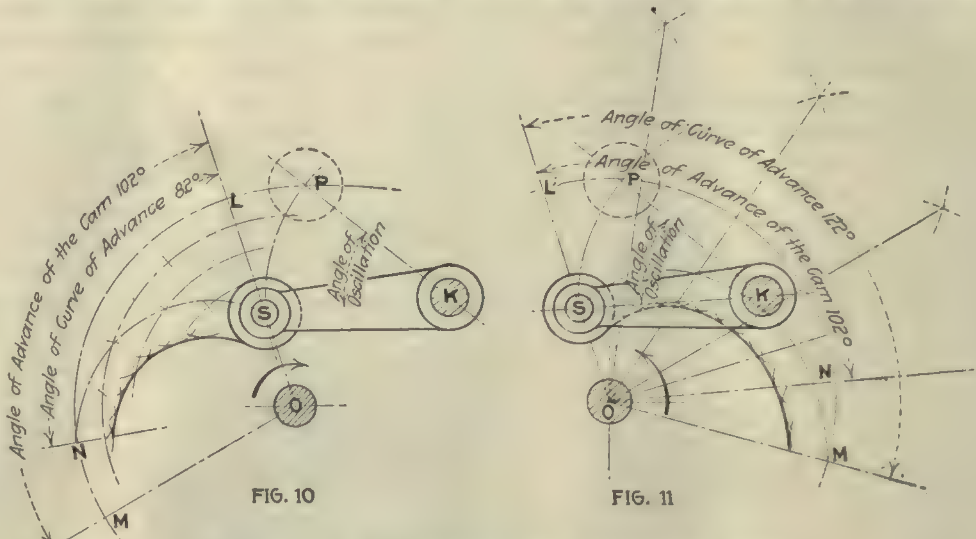

Angle of Advance of the Cam 102°
Angle of Curve of Advance 82°
L
P
S
K
Angle of Oscillation
O
N
M
Angle of Curve of Advance 122°
Angle of Advance of the Cam 102°
L
P
S
K
Angle of Oscillation
O
N
M

FIG. 10

FIG. 11

FIGS. 10 AND 11. OSCILLATING FOLLOWER CAMS COMPARABLE TO FIGS. 1 AND 2, PAGE 504

In Figs. 16, 17 and 18 are shown three positions of the cam that is illustrated in Fig. 11, giving wedge and pressure angles. The positions of the follower correspond to the positions shown in Figs. 13, 14 and 15, making it possible not only to compare outlines, but also to note and make comparison of the values of the wedge and pressure angles for the two curves. In Fig. 16 the line *SK* is tangent to the cam curve, and *SL* is perpendicular to the instantaneous radius of the cam. These two lines form the wedge angle, which measures 37½ deg. The pressure angle is formed by *KH* and *NH*, and measures 45 deg. The line *NH* is tangent to the arc *HM* at *H* and is the direction of the instantaneous motion of the follower. In Fig. 17 the wedge angle *KSL* measures 16 deg., and the pressure angle *NHK* is 49 deg. The wedge and pressure angles when the roller is in its highest position are 10 deg. and 42 deg. respectively, as shown by Fig. 18.

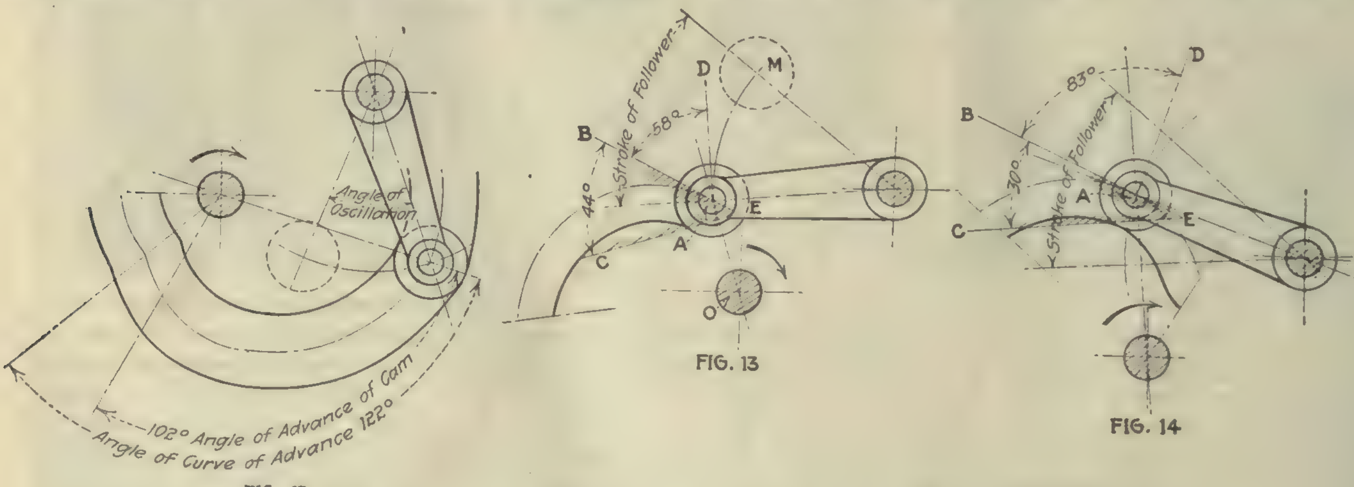


FIG. 12

FIG. 13

FIG. 14

FIGS. 12 TO 14. ANALYSIS OF ANGLES AT VARIOUS POINTS OF THE CAM STROKE

A tabulation of angle values for the cams when running with the lever arm and when running against it is given, so that a comparison of the effectiveness of the two cams may be more easily made.

A reference to this table shows that the wedge angles of the cam are materially less when the cam is running with the lever arm. This is due to the longer curve caused by the compensation made necessary by the swinging action of the cam roller. The pressure angles also show less variation when the cam runs with the lever than when it runs against it. This combination of smaller wedge angles and more uniform pressure angles will give greater and more uniform forces acting upon the cam roll.

A graphical method for determining the effective force at right angles to the lever arm and the thrust upon the lever-arm fulcrum is illustrated in Figs. 20 to 23 inclusive. In Fig. 20 let us assume that the power for driving the camshaft is applied at *X*. The distance *XO* may be considered as the radius of a pulley that is driving the camshaft, and *XR* the pull of the belt or the magnitude of the force applied at *X*. The forces at *X* and at *A* will vary inversely as the distances of these points from the center of rotation *O*. Letting *F* represent the force acting at right angles to *OA* at *A*, we may determine its value by the following:

$$F : RX = XO : AO$$

or

$$F = \frac{RX \times XO}{AO}$$

A graphical method for determining this value is shown in Fig. 19, in which *XR* equals the value of the force applied at *X* in Fig. 20, and *OA* and *OX* are equal respectively to the correspondingly lettered lines in Fig. 20. It may readily be proved that $X1 : A1_1 = XO : AO$.

COMPARATIVE ANALYSES OF WEDGE AND PRESSURE ANGLES

	Wedge Angles, Deg.		Pressure Angles, Deg.	
	BEC	KSL	DAB	KHN
Lowest position...	44	37½	58	45
Middle position...	30	16	83	49
Highest position..	14½	10	112	42
	Cam running against the lever arm	Cam running with the lever arm	Cam running against the lever arm	Cam running with the lever arm

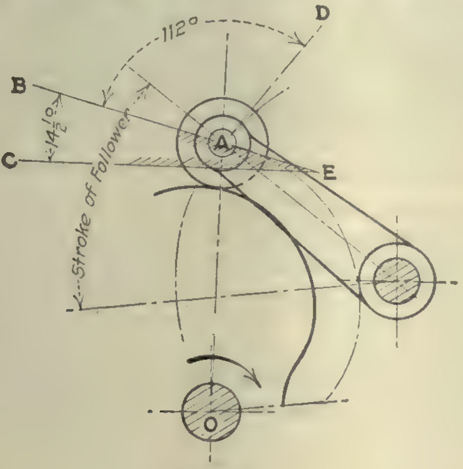


FIG. 15

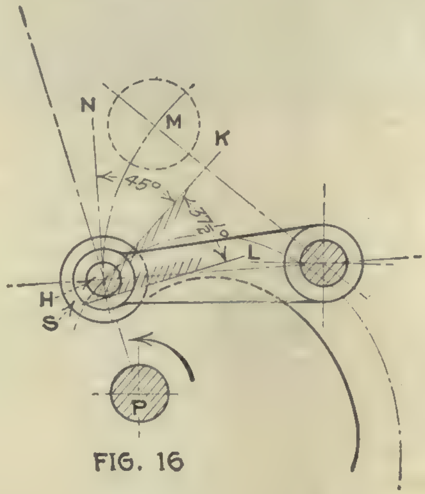


FIG. 16

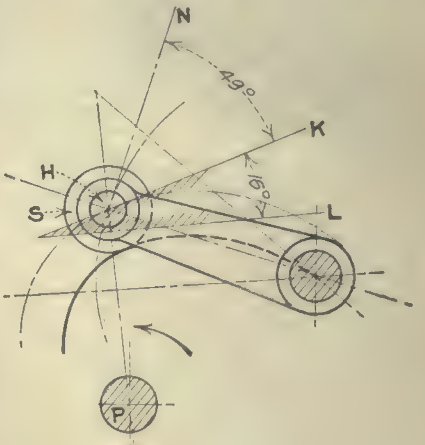


FIG. 17

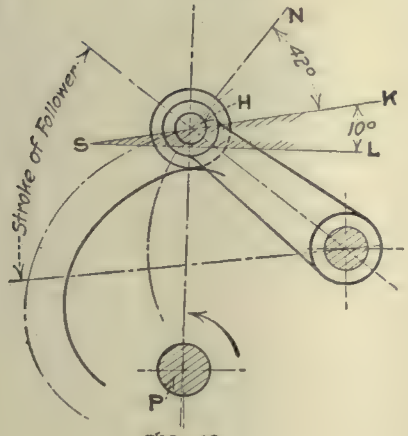


FIG. 18

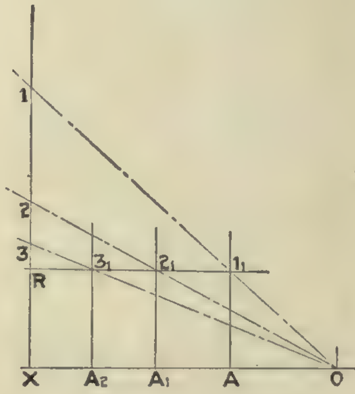


FIG. 19

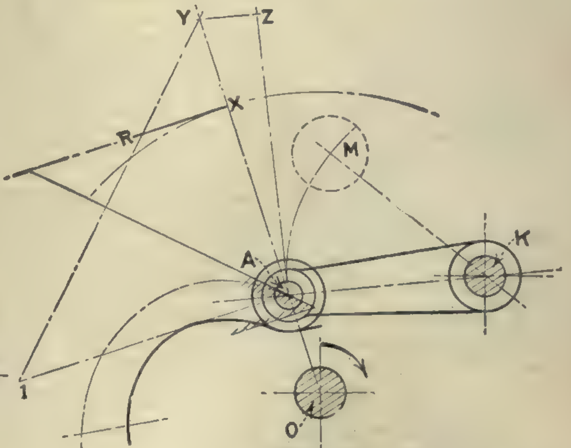


FIG. 20

FIGS. 15 TO 20. ANALYSIS OF ANGLES AND METHODS OF DETERMINING GRAPHICALLY THE EFFECTIVE FORCES AND THRUSTS

As $A1_1$ is equal to *RX*, the line *X*1 will be equal to the value of *F* or the force applied at *A*, in Fig. 20, at right angles to the instantaneous radius of the cam *AO*. In Fig. 21 the instantaneous radius of the cam acting about the center *O* is *AO*. If we take this distance and lay it off from *O* in Fig. 19, it gives us the point A_1 from which a perpendicular may be drawn to 2_1. A line from *O* through 2_1 gives the value *X*2 as the force acting at right angles to *A*, in Fig. 21.

In Fig. 20 the line *A*1 represents the magnitude of the force acting at right angles to the lever arm *AO*, which is the instantaneous radius of the cam when it is in this position. This force will be resolved into two forces by the wedge angle of the cam—one in the direction 1*Y*, which is at right angles to the wedge line, and the other along the line *AY*, which is at right angles to the force 1*A*. The magnitude of these forces may be measured by the lengths of the lines 1*Y* and *AY*. The force acting at right angles to the lever arm will be along the line *AZ*. The force *AY* may be resolved into two forces, *AZ* and *YZ*, in which *AZ* represents the direction and magnitude of the force acting at right angles to the lever arm, and *YZ*, which is drawn parallel to *AK*, represents the thrust upon the lever shaft *K*.

In Fig. 21 the value *A*2 is the same as *X*2 in Fig. 19, which was determined as previously described. This is the force acting at right angles to the instantaneous radius of the cam *OA*, Fig. 21. The magnitude of the force at right angles to the wedge line of the cam is *Y*2, and the force acting along the radial line *OY* is *YA*. The force at *A* at right angles to the lever arm is *AZ*, and the thrust on the shaft *K* is *YZ*. Figs. 22 and 23 show the graphical method just described when applied to the cam when the direction of rotation is with the lever arm. The line *H*2, Fig. 22, which is taken from Fig. 19, represents the direction and magnitude of the force acting at right angles to the instantaneous radius *PH*, Fig. 22. The angle of the wedge gives a force of *Y*2, at right angles to the wedge, and the force *YH*, along the radial line *PY*. The force *YH*, resolved into two forces, gives *ZH*, which is at right angles to the lever arm, and *YZ*, the thrust along the center line of the arm. The two forces acting respectively at right angles to the lever arm and along its center line when the roll is in its highest position are shown in Fig. 23. The value *H*3 is the force at the roller obtained from Fig. 19. The force at right angles to the lever is *HZ*, Fig. 23, and the thrust along the arm is *YZ*.

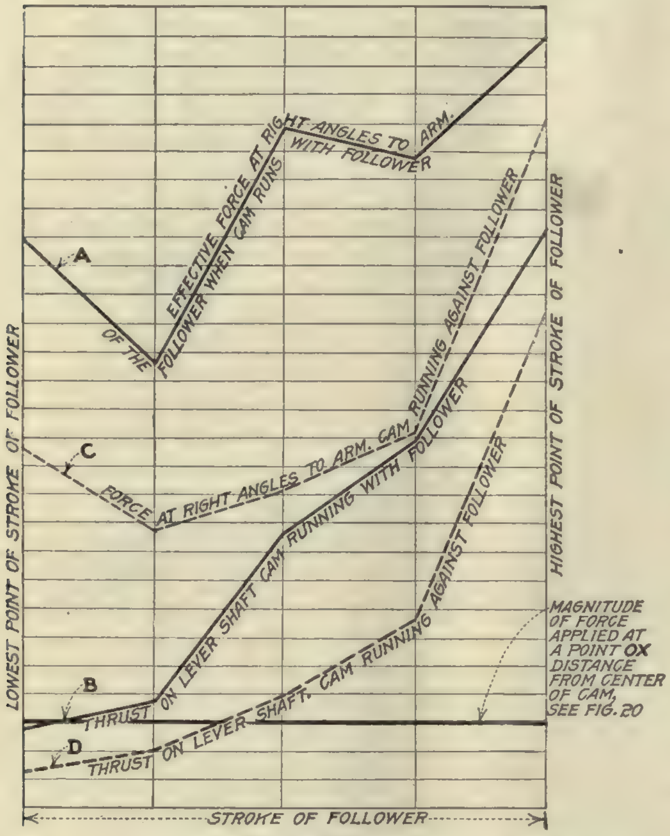


FIG. 24. GRAPHICAL COMPARISON OF THRUSTS AND FACES FOR FOUR DIFFERENT CAMS

A diagram, laid out to the scale of forces used in Figs. 19 to 23 inclusive, is given in Fig. 24. The full lines *A* and *B* show respectively the forces acting at right angles to the arm and the thrust on the lever-arm shaft when the cam runs with the lever arm, while the dotted lines *C* and *D* represent similar forces when the opposite condition exists. A study of the diagram shows very conclusively the advantages and disadvantages of the different combinations. There are so many different positions in which the roller may be placed with relation to the axis of rotation that it is not fair nor conclusive to make comprehensive deductions from the data gained from the examples used in this article. This discussion of cams in general, the advantages of different locations of the follower, together with graphical methods for determining effective forces, may be useful in producing easier-working mechanisms.

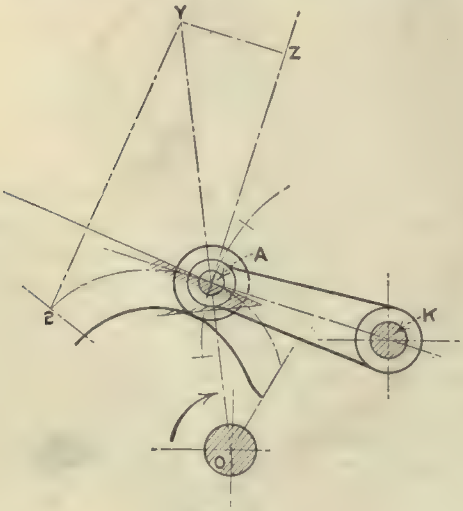


FIG. 21

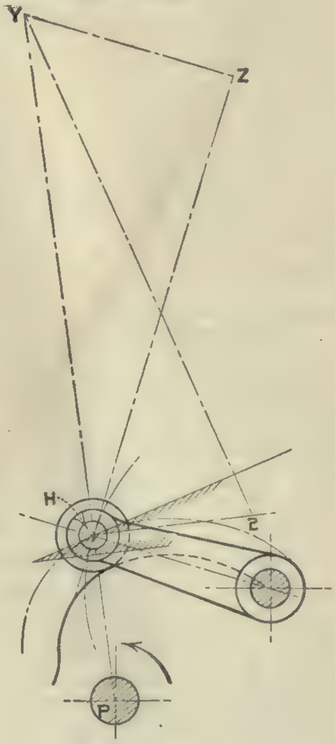


FIG. 22

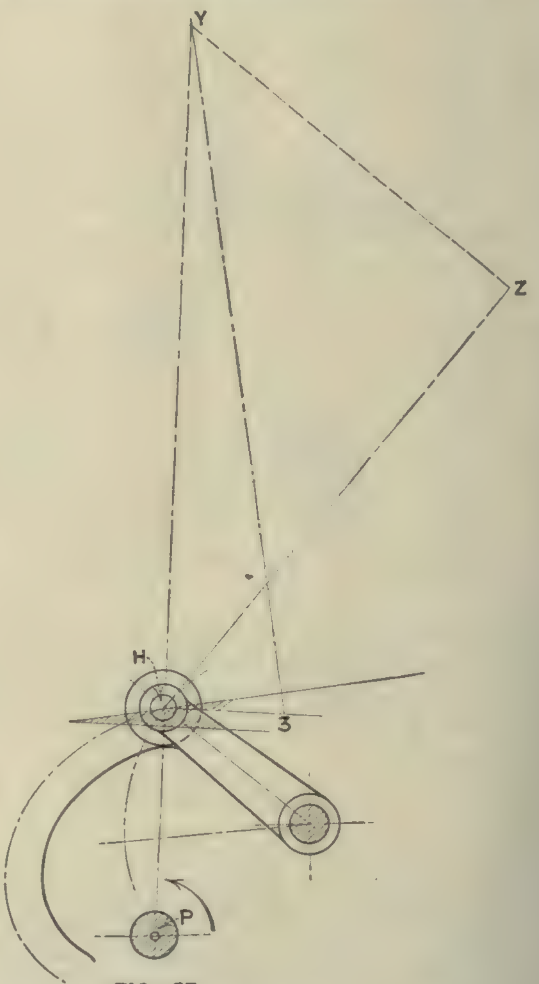
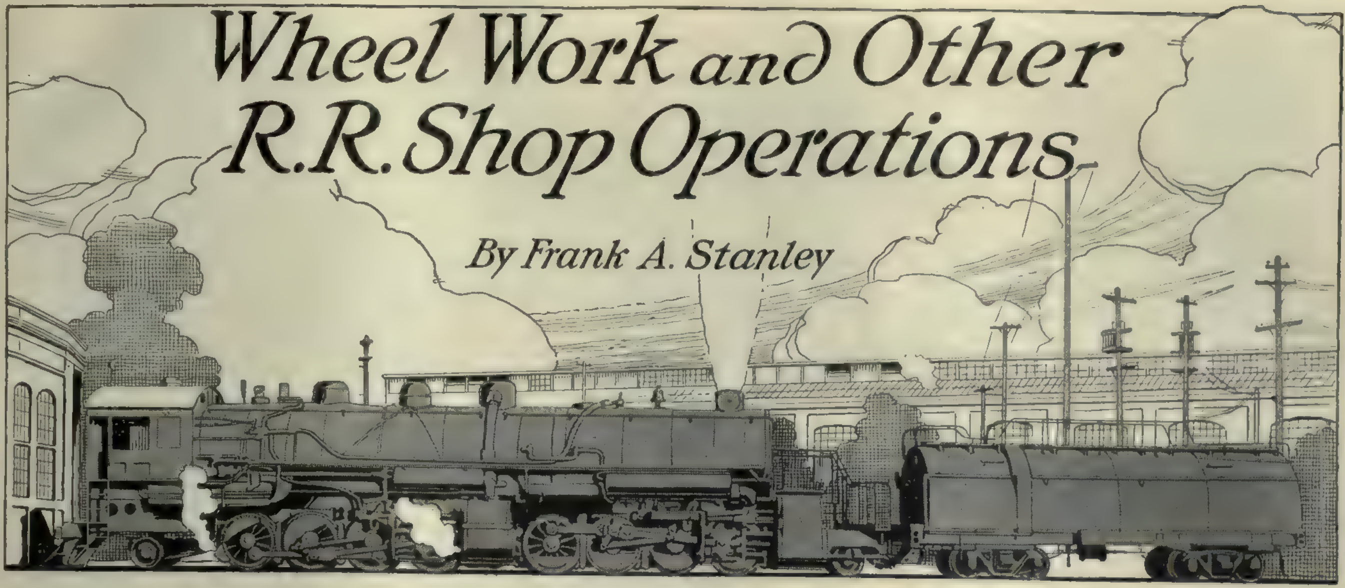


FIG. 23

FIGS. 21 TO 23. GRAPHICAL METHOD OF OBTAINING THE VALUES OF EFFECTIVE FORCES AND THRUSTS

Wheel Work and Other R.R. Shop Operations

By Frank A. Stanley



SYNOPSIS—*Some of the methods of a Nevada railroad shop in handling driving wheels and tires in the lathe and on the heating apparatus, together with data on allowances for fits of various sizes of tires. Boring and turning of valve cages with special checking tools and the grinding-in of steam joints are also described and illustrated.*

The accompanying illustrations show some of the operations on driving wheels and some of the miscellaneous work performed in the Southern Pacific shops at Sparks, Nev. In Fig. 1 is a view of a pair of 84-in. drivers in the big wheel lathe preparatory to the turning of tire treads and flanges. The illustration shows the double hook sling with triangular frame for spreading the hooks and supporting the work evenly with a hook under each end of the axle, so that the load is carried horizontally and placed easily between centers or removed from the lathe readily when the machining operations are completed.

The tools for turning and finishing the treads and forming the flanges are not shown in place in this view, but they have been illustrated already in a previous article describing general methods in these shops. The treads are finished by broad-faced flat form tools made of Mushet steel. The form tools are ½ in. thick and are secured to heavy holders by two bolts. The back and side thrust on the tools is taken by shoulders on the toolholder against which the edges of the tool abut when clamped in place by the bolts.

Ordinarily, the rough turning of the tires is accomplished with the work running at about 13 ft. per min., the turning tool having a feed of $\frac{3}{16}$ in. and a depth of cut of ¼ in. With the finishing cut under the flat form tool the wheel is revolved at the rate of 9 ft. per min. and the same speed is used in the forming of the flange. In fact, the final finishing of the beveled tread and the flange is accomplished with one and the same tool, about $\frac{1}{16}$ in. of stock being left in the roughing process for removing with the form tool.

Fig. 2 represents a pair of balancing ways for drivers, and the illustration shows most of the features distinctly. The knife-edge ways are carried upon a metal frame which is itself supported upon four leveling screws at the corners, the screws being carried in the outer corners of the heavy wood framework which forms the base of the structure. When in use the balancing rig is placed between the shop track rails so that the wheels merely require to be lifted from the track by the crane and dropped upon the balancing ways. When the balance test is completed the wheels are replaced upon the track and rolled out of the way.

Figs. 3 and 4 show methods of heating tires for removal from the wheel centers. Just outside the shop there are a pair of rails supported upon piers of such height that the largest sizes of drivers will swing well clear of the ground when their axles are resting upon the rails, and here all driving wheels are placed when their tires are to be removed or replaced. Fig. 4 shows the special long-arm crane which is installed at the end of the rails for handling drivers on and off the supporting structure.

TIRE HEATING AND REMOVING

Referring again to Fig. 3, this view illustrates a Mahr oil heater for tires and shows the method of confining the heat to the circumference of the work by means of a sheet-metal hood which is placed completely around the wheel, leaving merely a narrow opening at the bottom in front of the hood to admit the torch, or head, of the apparatus by which the heat is transmitted to the work. The nature of the heater proper is well shown, and the arrangement of oil tank and oil and air pipes will be understood from the illustration.

With this method of heating but a few moments are required to expand the tire sufficiently to permit it to be taken off the wheel center.

Another heating rig, this one home-made, is shown in Fig. 4. It consists of a pair of pipes, for oil and air, bent to a circle to inclose the tire and the inner one perforated to allow flame jets to act completely around the surface of the work. Fuel and air are supplied to this rig in the same manner as in the case of the other heater.

This photograph was taken just after a tire had been removed, but the application to the surface of the tire itself as carried out in practice will be understood.

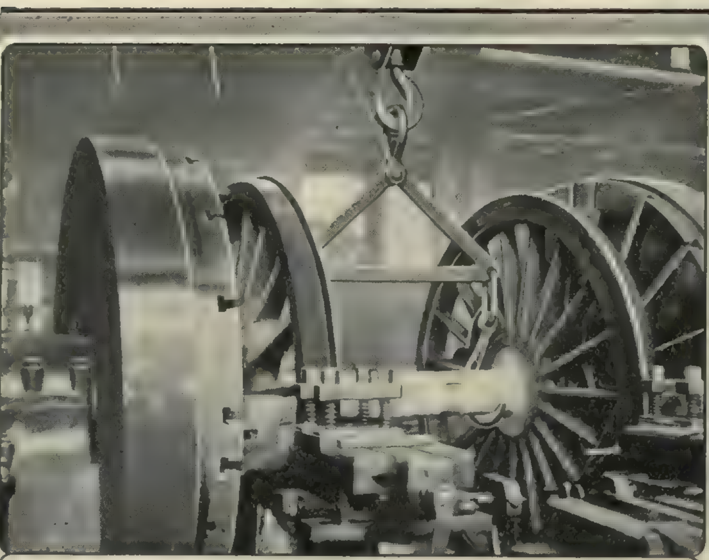


Fig 1 Swinging Big Drivers in the Wheel Lathe

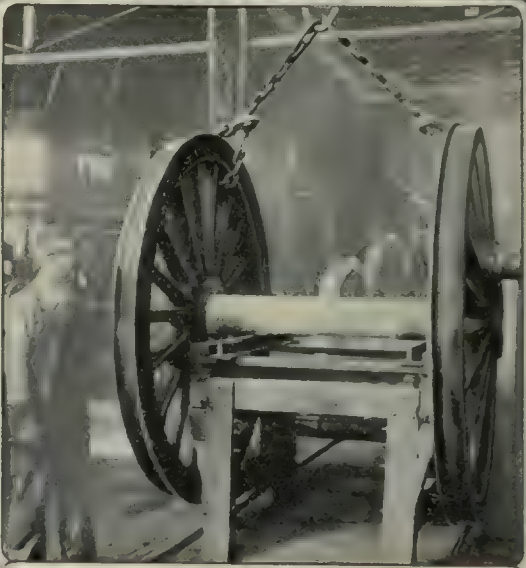


Fig 2 Pair of Drivers on the Balancing Ways

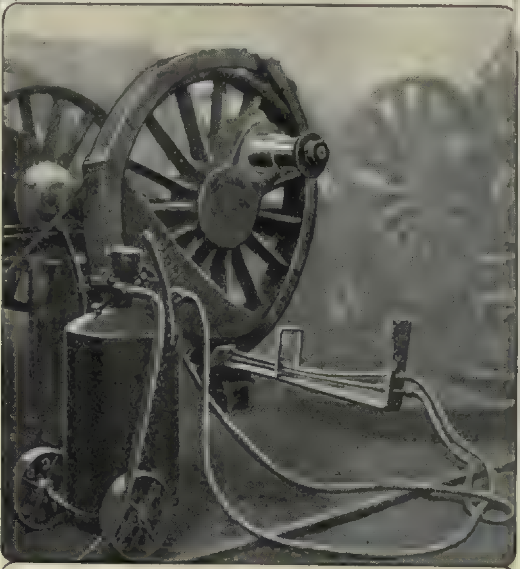


Fig 3 Rail Rack for Wheels & Method of Heating Tires

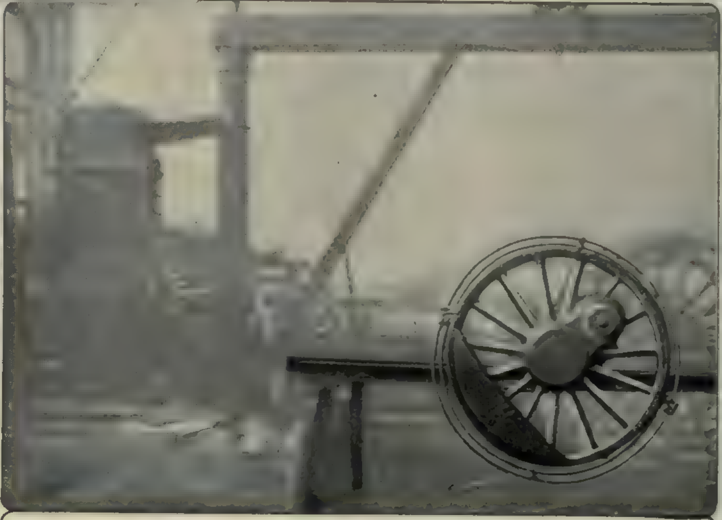


Fig 4 Another Tire Heater

Something has been said in earlier articles on the practice of these shops regarding the allowances for shrink fits for driving wheel tires of various diameters, and it may be well to incorporate certain data of the kind here as these allowances are of prime importance in connection with the subject of driver upkeep.

The driving wheels range in sizes as follows, the dimensions being nominal outside diameters: 45, 51,

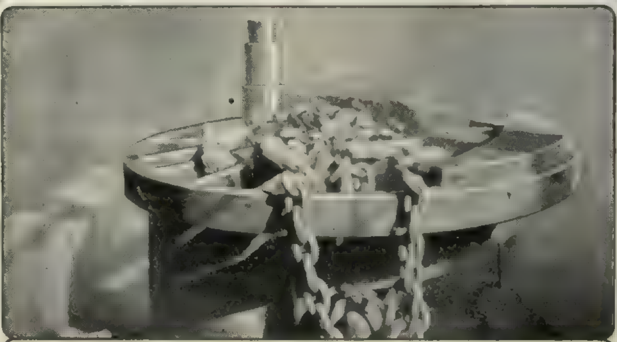


Fig 5 Preheating Driving Wheel for Welding

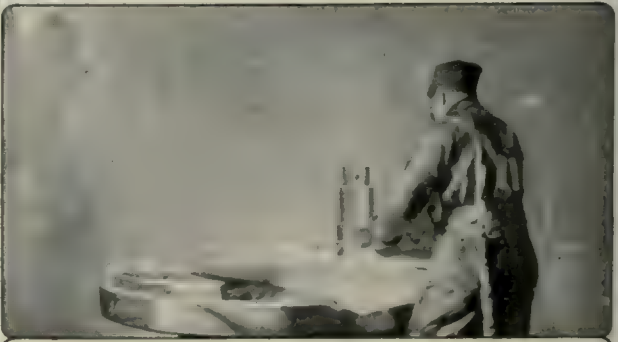


Fig 6 The Welding Operation

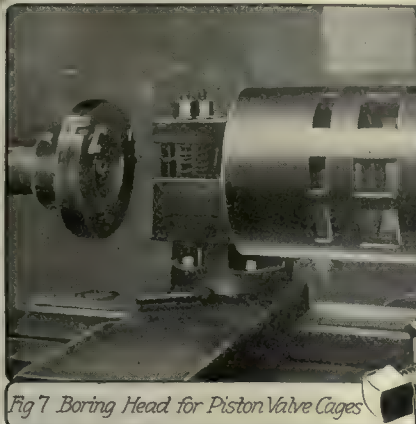


Fig 7 Boring Head for Piston Valve Cages

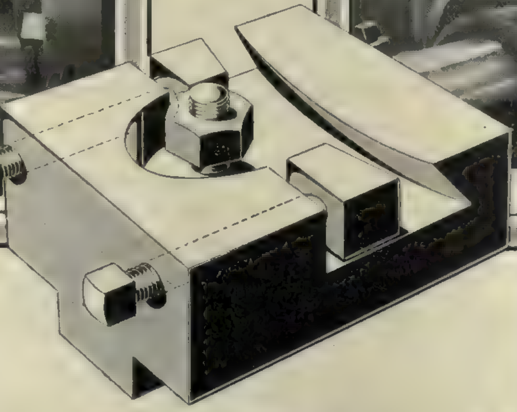


Fig 8 Method of Chucking the Work

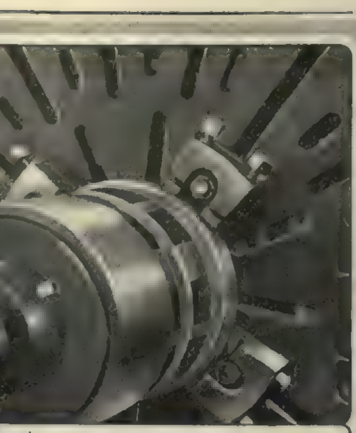


Fig. 9 Chuck Jaws for Valve Cages

55, 57, 63, 69, 73, 77, 79, 81 and 84 in. The diameters of the corresponding wheel centers are: 38, 44, 48, 50, 56, 62, 66, 70, 72, 74 and 78 in. That is, in these sizes there is a difference of 7 in. between the outside diameter of wheel centers and the outside diameter of tires. The allowances made in boring the tires for shrinking in place on the wheel centers range from $\frac{1}{32}$ in. in the case of the smallest size of driver, of 45-in. to $^7/_{64}$ in. for the 84-in. or largest drivers. The following table gives the allowances for all sizes:

Diameter of Wheel Center	Diameter To Bore Tire	Nearest 64th or 32d	Diameter of Wheel Center	Diameter To Bore Tire	Nearest 64th or 32d
38	37.9603	37$\frac{31}{32}$	66	65.9144	65$\frac{29}{32}$
44	43.9505	43$\frac{61}{64}$	70	69.9078	69$\frac{29}{32}$
48	47.9500	47$\frac{61}{64}$	72	71.9045	71$\frac{29}{32}$
50	49.9406	49$\frac{15}{16}$	74	73.9012	73$\frac{29}{32}$
56	55.9308	55$\frac{59}{64}$	78	77.8947	77$\frac{57}{64}$
62	61.9209	61$\frac{59}{64}$			

Figs. 5 and 6 illustrate a job of oxyacetylene welding, the work being a driving wheel cracked in the boss. The wheel was preheated for a couple of hours before starting the welding process, the method of heating being shown in Fig. 5, where a steel plate will be noticed over the portion requiring heating and over the plate a body of coke, so that the heat from below was well confined to the immediate area around the crack, the latter being chipped out to form a narrow gap for the weld prior to starting the fire. Fig. 6 shows the application of the welding torch and rod to the work. Fig. 7 illustrates a new boring head for piston-valve cages which consists of a casting carrying three boring cutters each 1 in. square, the boring head itself being mounted upon a shank reduced at the rear end to fit the taper hole in the tail spindle of the lathe. The three cutting tools fit into slots in the face of the boring head and are held therein by clamps across their outer faces. The cage to be machined is held to the lathe faceplate by a set of four special chucking jaws, as seen in Fig. 9. These jaws are designed to permit the work to be bored and turned simultaneously, and hold the casting without the possibility of springing it because of the undue pressure of the clamping jaws. The clamping method will be understood from this view and from the sketch, Fig. 8.

Fig10 Grinding in Steam Joints

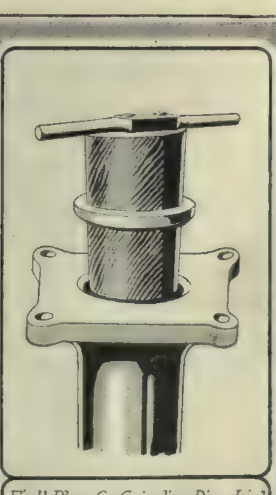


Fig11 Plug for Grinding Pipe Joint

Referring to the latter engraving, it will be seen that the inner end of the valve-cage casting is provided with an extension for the purpose of holding it to the faceplate, this extra metal being scrapped when the cage is cut off after boring and turning to size. Inside the casting is an annular ledge with an angle of about 45 deg. which provides a gripping surface for the hooked inner ends of the four clamping jaws. Opposite the dovetail mouth of the jaw is a pair of clamping screws with a steel shoe under each to seize the edge of the work between jaw and shoes.

In placing the cage casting in position, three jaws are loosened on the faceplate of the lathe, and the fourth is allowed to grip it tightly while the other three remain floating on the faceplate. Setting up the two screws of the jaw tightens the work in the mouth of the fixed jaw, and then the other three jaws are located in their radial slots in the faceplate by the edge of the work itself, after which they are secured fast to the faceplate by the nuts on their square-head bolts. The individual pairs of tightening screws in each jaw are then set up to grip the work securely between the clamping shoes and dovetail surface on each jaw.

Fig. 10 represents the grinding-in of steam-pipe joints with a hand-operated wood plug which is worked back and forth to allow the abrasive—fine emery and oil—to act upon the ring and pipe surfaces. The sketch of the plug and joint ring given in Fig. 11 shows the manner in which the plug is piloted in the mouth of the pipe and made to serve as a guide for the ring. For a 6-in. plug like the one shown, the length is about 8 in. The body of the plug is somewhat tapered so that it will fit into the ring and hold it while it is being worked back and forth by the handle during the grinding-in operation.

Wire Clamping Hose To Stay

By J. V. Hunter

One of the most serious causes of irritation to a man driving rivets with an air "gun" is to hitch his air hose into position just after a hot rivet has been stuck in the hole and have the air line part at some joint because of an insecure method of fastening at that point. Many men, in addition to wrapping a piece of twisted wire about a piece of coupling pipe on the hose, will twist the ends of the wires together so that the wire, and not the coupling pipe, will act as a bond to prevent pulling apart. Such joints are apt to catch on many things and make the hose rough and uneven for handling.

Joints made by simply twisting the wire in order to tighten it will grow leaky sooner or later, resulting in a constant loss of the air supply. Manufactured band clamps, which are usually held together by stove bolts, are more effective in preventing air leakage, but the parts are always being dropped about and lost, so that it is not long before wire will be seen replacing these clamps on a hose that is out on a construction job.

There are now several clamping devices on the market for drawing up a piece of wire into a tight joint in a manner similar to that illustrated in Fig. 5, but the little tool that is shown in Fig. 1 can be made in a few minutes in the shop toolroom and will serve admirably for producing a strong air-tight wire clamp that will stay in place.

Referring to the sketch of this clamping device, it will be seen to consist of but few parts. The head *A* has a groove at the end, which is really only a slight depression for catching and holding the wire. The other end of the head has been drilled out to receive the stem *C*, which is free to revolve, being held in by the pin *B*, which acts as a key in the small groove that has been turned in the stem. This stem *C* is about 6 in. long and has the solid end *E* fitted with a pin handle, so that it may be turned to tighten up the wires.

On the threaded portion of the stem runs the special nut *D*, which has four small arms forged out from it at right angles, these arms serving both as handles and for the purpose of fastening the wire during the operation of binding the hose.

In joining two broken sections of hose, use a straight nipple of pipe that will force in to a snug fit. A length of 6 in. is sufficient for most cases, and it is preferable to have it free from threads, since the hose manufacturers claim that the cutting of the inside lining of the hose by the threads of a nipple damages its fabric and shortens its life. If you feel that a straight piece of pipe will not hold firmly, then on the corner of a grinding wheel grind a couple of shallow grooves at each end so that the wire will have a small depression to force the hose into, and there will be no sharp edge there to damage the hose. Also grind a short taper on each end of the nipple, to remove the burr and the sharp edge.

For a binding wire, a piece of No. 14 soft steel from 20 to 24 in. in length will be suitable. Bend the two ends back, in the middle, making a square-bottomed U, with the center section about ¾ in. wide. This wire can then be looped into the form shown in Fig. 3. While in this shape it can be slipped over the end of the hose, or before looping it can be threaded around the hose in any manner to suit the convenience, provided the final condition is as shown in Fig. 2.

The next step is to fit the nose groove in the end of the tool into the straight section that was prepared in the center of the wire. The two loose ends are tightly wrapped about the arms of *D*, as shown in Fig. 4, and given a final twist on the far side to prevent unwrapping. Everything is then ready for the final operation of tightening up the wire clamp. To accomplish this hold *D*, Fig. 1, with one hand, and with the other turn the handle head at *E*, which automatically pushes forward one end of the wire while drawing back on the other.

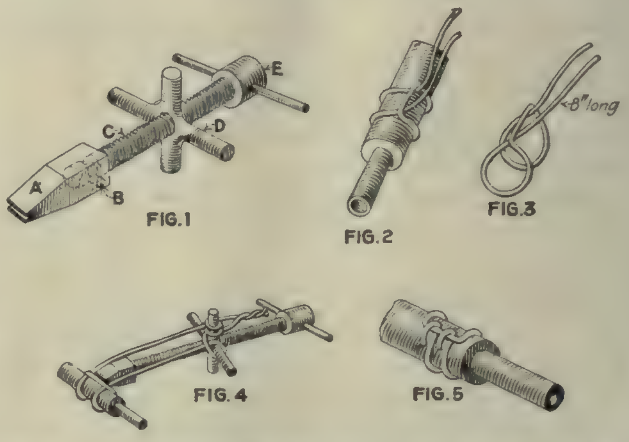


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5

FIGS. 1 TO 5. WIRE-CLAMPING TOOL AND SOME SAMPLES OF ITS WORK

In this manner the wire can be drawn to any desired degree of tightness. One operator claimed that he could draw it so tight that he could cut the hose in half. But anyone with judgment will instinctively know when the wire is pressing firmly into the hose and discontinue the drawing up. At this point the tool is swung over in an arc of 180 deg., which turns the wires back sharply upon themselves about the bottom of the original U, and so provides an automatic lock. Then snip off the long ends of the wires with your pliers, removing the tool at the same time and bending the ends down sharply against the surface of the hose, as shown in Fig. 5. This will make the coupling smooth for handling and prevent the wire ends from catching and cutting everything that may come in contact with them.

Getting Potash Kelp with a Submarine Lawn Mower Is a War Industry

SPECIAL CORRESPONDENCE

AMONG the resources of Germany are the great natural beds of potash. In the long years before the war we imported this product so freely that we almost forgot how dependent we were on that country for our supply. With the opening of hostilities and the watchful waiting of the British fleet, we suddenly awoke to the fact that potash was one of the things we had to get busy about.

One of the results of that awakening is now much in evidence on the Pacific Coast, in the region of the southern end of California. From Los Angeles to San Diego various companies are busy gathering kelp, from which they make a very good grade of potash, although the cost is very much higher than that which was formerly paid for the imported. Should the war last as long as some are predicting, the activities may be extended to other sections. Whether the cost of producing potash by this method can be reduced or some other source of supply found remains to be seen.

The firms now in the business are the Hercules Powder Co. and Swift & Co., both at San Diego; the Larned Manufacturing Co., the Pacific Products Co., the National Kelp Potash Co. and the Sea Products Co., all at Long Beach, which is near Los Angeles.

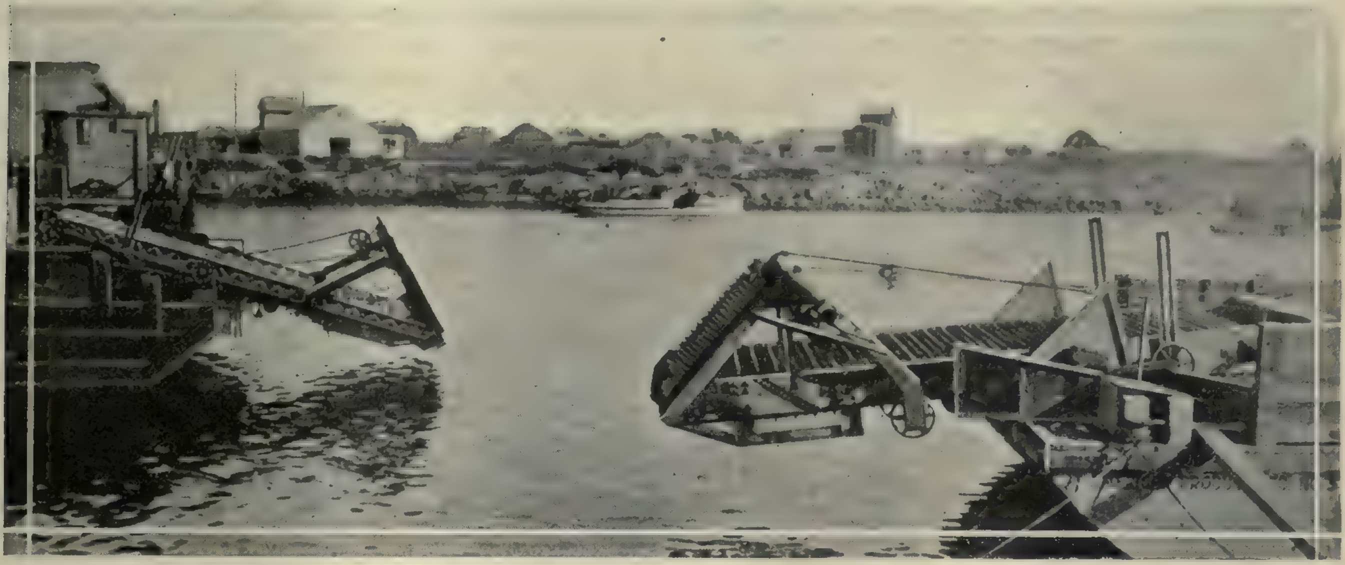


FIG. 1. A SIDE VIEW OF THE KELP CONVEYOR AND SUBMARINE LAWN MOWER

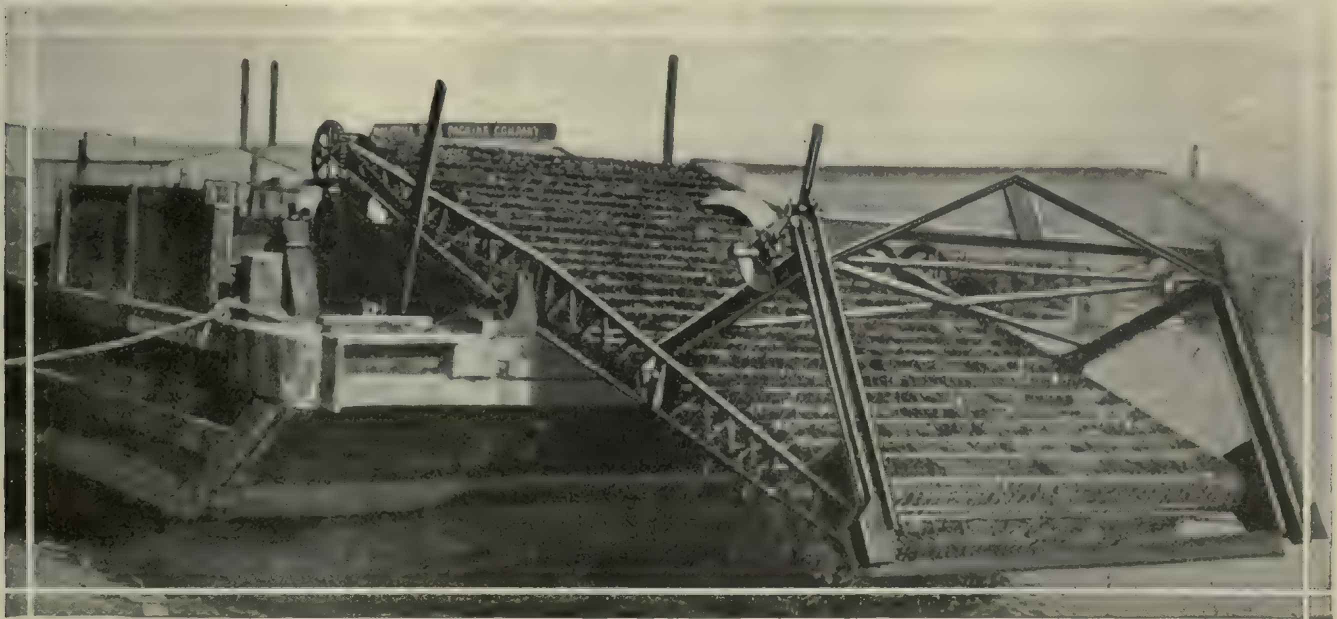


FIG. 2. THE BUSINESS END OF A KELP-GATHERING BARGE IN USE ALONG THE PACIFIC COAST

Near-by, at Wilmington, Calif., the Diamond Match Co. has put up a plant, and there is a Government plant under way at Summerlands, near Santa Barbara.

The kelp, which grows up from the ocean bottom, has long, thick stems that are of little value for potash, the foliage that grows at the top and floats on the water being the desirable part of the plant. The first step is to gather this upper portion of the kelp, and this is the most interesting feature from the mechanical point of view.

Good sized barges are used, the illustrations giving some idea of their capacity. At one end of these barges is a conveyor that is equipped with knives at the lower end, these being of the same type as those used in mowing machines and reapers, in which the knives are triangular in shape and oscillate over suitable combs that form the cutting edges. These knives vary from 10 ft. to as high as 14 and even 16 ft. in length, and some of the conveyors are equipped with side knives to clear the kelp completely and make it easier for it to come up on the conveyor. These knives, as well as the conveyors, are run by chain from a small gasoline engine on the barge.

The conveyor, carrying the knives, is lowered into the water to the desired depth, which is usually about 4 ft. with 6 ft. as a maximum. Below this the kelp is not so productive of potash, and it is also correspondingly hard to handle. The barges are usually towed, although a few of them are motor driven, the latter form of propulsion seeming to be the tendency in the new barges. The power required is very small as they only move at the rate of about two miles per hour, approximately the same speed as the tractor plows that are used so largely in the grain section of the West.

The capacity of the barges, or kelp lawn mowers, which cost about $65,000 each, varies widely, some being capable of gathering 60 tons an hour while others handle only 300 tons in 24 hours. The kelp can be gathered for a distance of perhaps two or even three miles from shore in calm weather, and the beds are marked off so that they will not be cut at too frequent intervals. About three crops a year seem to be the average, cutting to a depth of from 4 to 6 feet.

As the kelp is gathered it is about seven-eighths water, and it takes from 21 to 22 tons of wet kelp to make one ton of the ash, for the kelp is first burned to an ash and then ground. The ash yields about 32 per cent. of potash, or about 4 per cent. of the weight of the wet kelp, which accounts in a measure for the price of $550 a ton for the potash itself.

Suggestion Systems

By Entropy

No concern can afford to overlook any means by which it may secure every good method of improving its product or its methods. No one would fail to have some system of securing suggestions from every employee, if it were not for a fear that the cure might prove worse than the disease.

The danger in the suggestion system as usually practiced is that the employee is apt to magnify the importance of his suggestion and also to suspect his employer of making a larger profit than is really made. If suggestions are solicited and the broad statement made that acceptable suggestions will be paid for according to their value, there will be an immediate influx of suggestions whose value in the minds of the senders is only to be expressed in very large figures. Some of the suggestions may seem to the owners to be worth trying out. If they are finally adopted, it is easy for the man who offered them to imagine that pretty much the whole of the company's profit is derived from them. If they are paid for at the company's rating, the inventor is pretty sure to find his own valuation discounted.

The cure, or preventative, is perfectly simple. Just let the agreement be complete. Say that we will pay so much for the best suggestion in any given month and so much for the second and third best and so on. Have the privilege of withholding any given month's award and adding it on to that of the next month, if no good suggestions appear. If the prize is $10, then everyone understands that that is all that he gets for his suggestion. No one with a $10,000 suggestion will enter it; but then no man with a $10,000 suggestion ought to make it in this way, no matter what the prize. It is really the little suggestions, and particularly those relating to the peace of mind of the workman, that are most wanted in any suggestion system.

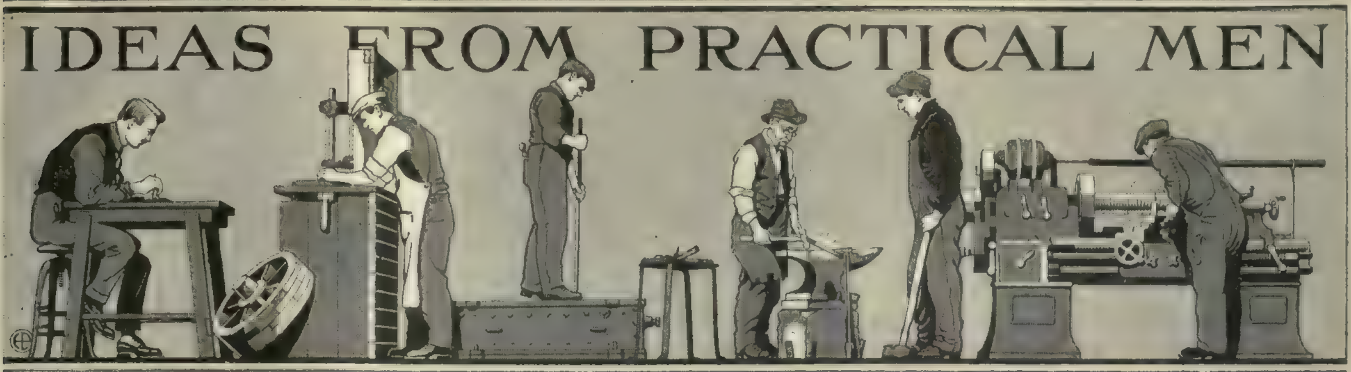
Another thing—no suggestion should be ignored, not even if it is silly and foolish. By this we do not mean that an employee should be strung along and made to think that any suggestion has a false value. The truth should be told, but it should be told tactfully. False hopes, blasted, do nobody any good, but thoughtless suggestions may lead to thoughtful ones if rightly handled.

Workmen see a great many things from a different point of view from the management, but it is a mighty poor management that does not want to get every possible view. Suggestions show how the men are thinking. They show whether men are going along in the same direction or whether they are working at cross-purposes. If a man makes a seemingly silly suggestion, a few minutes' talk with him at his machine, where he is at home, may make him see the futility of doing anything with the plan. If the suggestion will possibly save some money, the employee should have extra consideration, though as a matter of fact in any honestly run concern the continuity of employment, which comes from the management's knowledge of the workman's interest, is worth more than any prize that is likely to be awarded.

It may be honestly contended that every man, by accepting employment, obligates himself to give his best thoughts and energy to the company's business and that no further effort should be necessary to insure that attention, but so many concerns have very distinctly objected to the employees taking an active interest in what the management is pleased to term "None of their business" that it does require something pretty vigorous to draw out the help that is possible.

It is easy enough to secure men who can think big thoughts and who can do the larger things that are required, but the great difficulty is to be sure that in saving at the bunghole there is not a continual and expensive dripping at the spigot.

IDEAS FROM PRACTICAL MEN



Gasoline-Engine Crank-Case Pattern

By G. M. Strombeck

In the making of the patterns for the crank cases of a certain type of gasoline engine, it had been the practice to leave it to the patternmaker to work out the curved portion, from a drawing giving the shape only in a general way.

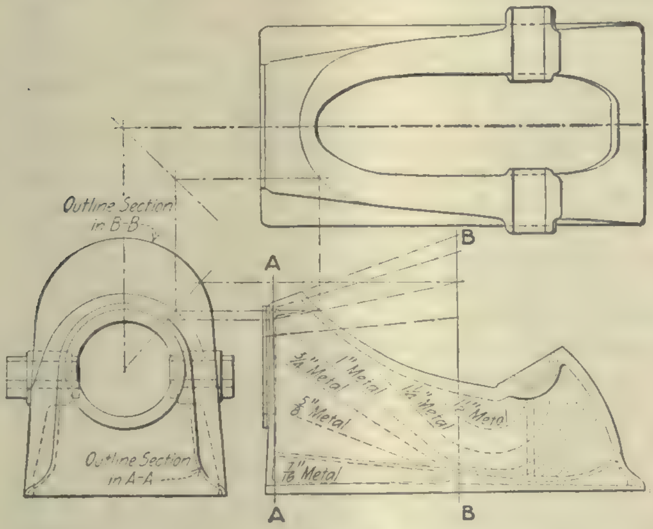


FIG. 1. THE CRANK-CASE PATTERN

While this was very well so long as the production was too small to permit of the extensive use of jigs and fixtures, it did not prove satisfactory when the volume increased and it became necessary to replace patterns, as there was no positive way of getting exactly the same shape on the new pattern which was necessary in this case.

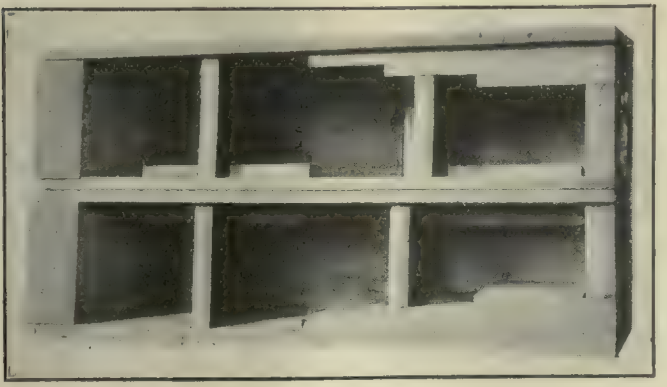


FIG. 2. GUIDE OF PATTERN

The illustrations show how the exact shape of the casting as well as the proper distribution of metal was determined before the pattern was begun and how it worked out in the making.

Two reference planes *A* and *B*, Fig. 1, were established and the outline of the sections in these determined. The intervening surface was generated by a straight line passing through these sections and intersecting the axis of the cylinder bore.

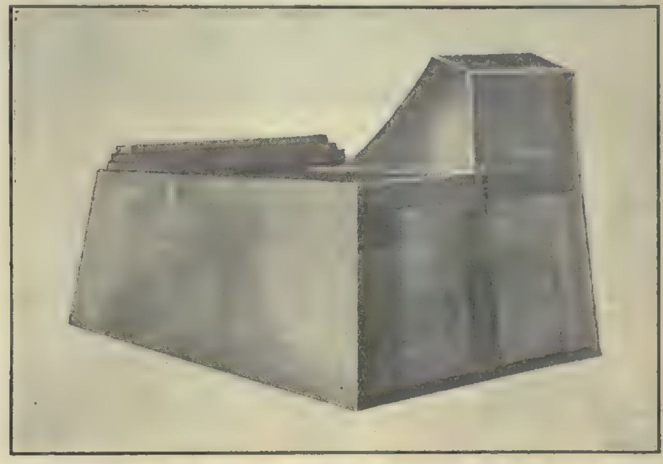


FIG. 3. THE TWO LOWER HALVES OF THE PATTERN WITH ONE OF THE TOP SECTIONS IN PLACE

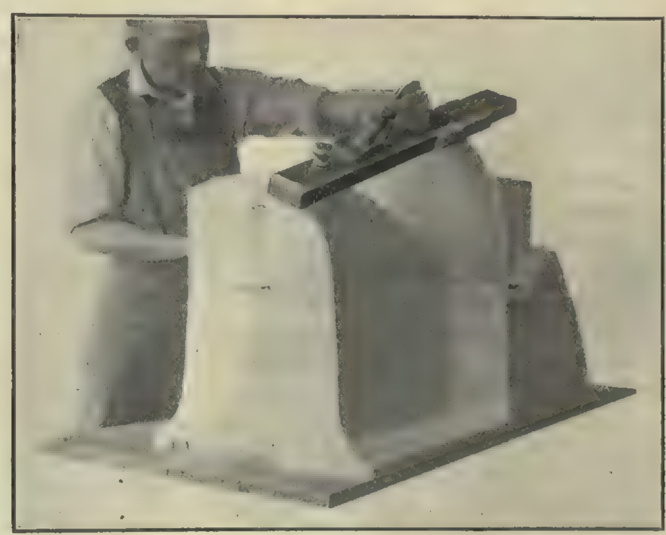


FIG. 4. FINISHING THE PATTERN BY THE REFERENCE PLANES

To determine the distribution of iron so that the heaviest section would come at the critical point of greatest tensile stress, light dash lines indicated where the metal was to be of a given thickness.

From the information thus given the pattern was built up as shown in the illustrations. Fig. 2 shows the inside construction of the lower part, Fig. 3 the two halves of the lower part and one of the upper solid halves. Fig. 4 shows the two reference planes, one on the front end and the other on the temporary board templet. After roughing down the pattern, it was finished to the lines with a plane, temporarily lengthened as shown in Fig. 4.

To determine the thickness of metal it was only necessary to lay out the guide lines on the inside surfaces of the two halves of the pattern. By calipering a sufficient number of points and deducting the thickness of metal, there remained the thickness of the core at these points. Having this information, the construction of the core box was easy. The bottoms of the boxes are shown in Fig. 5.

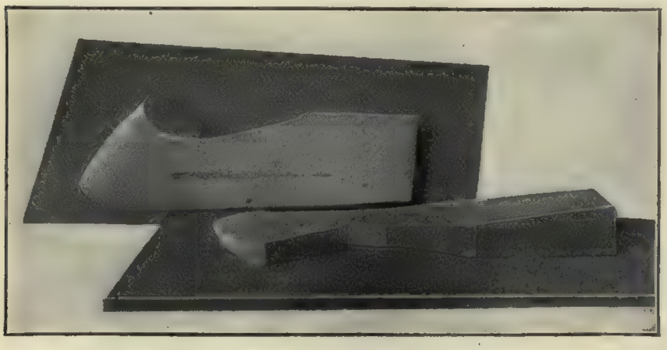


FIG. 5. THE CORE-BOX BOTTOMS

This method of specifying the shape of the pattern and thickness of metal has always given positive and exact results and is liked much better by the patternmaker than the previous indefinite practice.

Are Ambitious Young Men Really Wanted?

BY ROY C. BURCKES

On page 602, Vol. 46, there is an article by E. P. Baker that expresses the sentiments that I have long held, and I as well as he am looking for some light as to how to connect. The editorial comment at the end of the article strikes me as being in the class of the advice to young men on "how to get rich," "Make something that everybody will buy and sell it to them at a profit." Simple, isn't it?

Do you mind having someone write an article in words of one syllable, or its equivalent, on how to meet these men highest up? The law does not allow one to hit them over the head with a club in order to draw their attention to one's moral excellence, and you certainly are aware that they are penned in with a corps of clerks whose particular duty it is to choke off anyone under the rank of captain of industry who attempts to get in contact with the chief.

As an example of the strenuous efforts big men make to get their valuable men, President Vail, of the Bell Telephone Co., is continually preaching of the difficulty of getting men who are worth (to him) $13,000 a year. Now I know the manager of one exchange in a city of some 20,000 who went to the head of the repair department, one of the $3000 men, to get the pay of his head lineman raised. This bright intellect told the manager: "If we raise his pay, he will know that will be as much as he will ever get here and we will lose him."

That is an example of the iridescent minds that clog the ladder of progress; and if the big men really wanted to get hold of the man who is worth while, he would take half a day off once in a while and clean house in the higher departments. This same manager turned in a profit of over $600 a month over the previous year's record in a total turnover of less than $50,000, and they would not sweeten his pay a dollar, so they are going to lose an efficient manager also.

Button-Setting Job

BY E. W. HARRIS

On page 382, Vol. 46, Mr. Pusep describes a means of accurately spacing holes by the button method. While the plan commends itself as an accurate means of attaining the end in view, it is obviously very slow. It is, I admit, a quicker method and more sure than affixing buttons by angle plate. It appears, however, that the job would have been done far more quickly and quite as accurately by the disk-in-contact method. The character and dimensions of the job illustrated by Mr. Pusep lend themselves readily to this method.

A disk would be machined a full cylinder to fit the 4-in. hole, having as an extension a button turned with it, 3 in. in diameter by $\frac{3}{4}$ in. long. (By the way, it would be interesting to know why Mr. Pusep chose a partial disk, as it seems to lack more than one element of permanent accuracy.) Thus, we have a button true to the hole which serves for the inner base of contact for the disk.

Now it is a well-known mathematical fact that in a circle divided into six equal parts—that is, of 60 deg. each—the length of each chord joining the divisions is equal to the radius of the circle. Accordingly, to use Mr. Pusep's job as an illustration, the radius of the three holes being 3 in., the chord of each 60-deg. division will also equal 3 in.; therefore, six disks in contact, with their centers coincident with the circle, will each measure 3 in. The periphery of each disk will now be equidistant from the center a radius of $1\frac{1}{2}$ in. and obviously will accurately inclose a 3-in. button.

Each of these six disks would be produced having a $\frac{3}{4}$-in. standard hole, each alternate one of which, when in position, would give the accurate location desired. The six would be bound into position by producing an outer ring bored 9 in. in diameter, which would inclose the whole, it being made wide enough to embrace fully the disks when lying on a plate, the bottom face of the ring, of course, being trued. The disks also must necessarily have their sides flat and square to the holes, so as to lie perfectly flat upon the ring to be bored.

Two methods then present themselves in locating the position of the holes for boring. Buttons correctly fitting the holes in the disks can be affixed to the ring; and when each is in position, the outer ring and disks and center plug can all be removed and the job set up on the miller, as Mr. Pusep describes. Or another method equally good is to finish the holes in the disks a size larger than $\frac{3}{8}$ in. and set up altogether on the miller. A true setting bar is used in the machine spindle in conjunction with a hardened and ground collar made just a moving fit to the bar and to the hole in the disk. The miller table is then raised to allow the bar to enter fully the hole in the disk, and the collar is slid down until it enters the hole without spring, by moving the machine table.

The tools once made and handled with the necessary care, the job could be done far more quickly than by the tedious button method.

Cone-Point Bearings

By Joseph A. Ahlers, Jr.

Cone-point bearings are not so extensively used as they might be, and they have not gained popular favor probably because of the limited possibility of their application. The value of cone-point bearings cannot be more fully illustrated than in machines where power and movement are transmitted by the lever principle. Fig. 1 shows a numbering and marking machine composed of side frames and operating levers with eight distinct lever movements. There are a total of twenty-six bearings on this machine, and of these twenty are cone-point bearings (see Fig. 2). It is seldom that one encounters such a complete application of a mechanical principle as this.

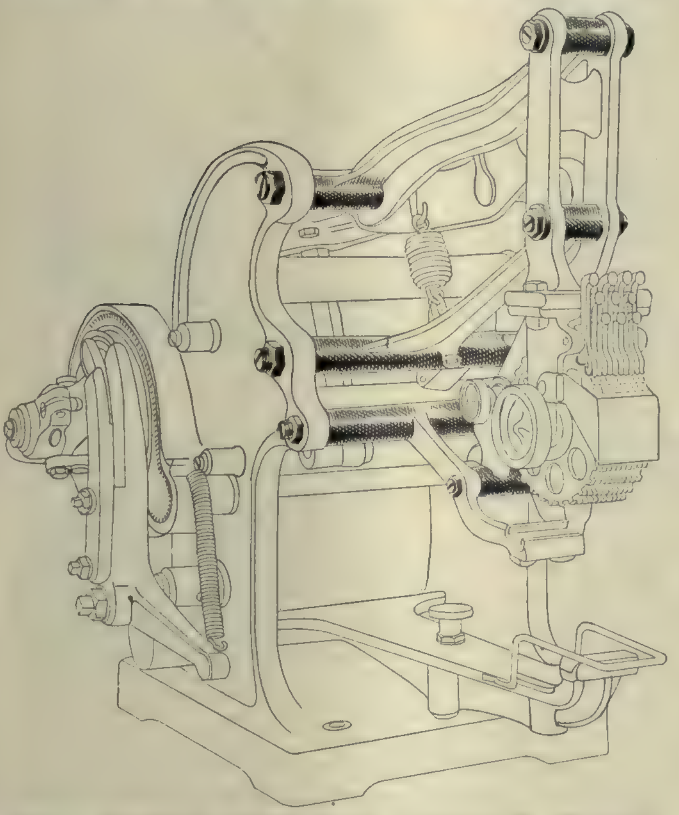


FIG. 1. MACHINE USING MANY CONE-POINT BEARINGS

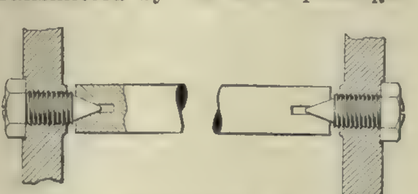


FIG. 2. CONE-POINT BEARINGS

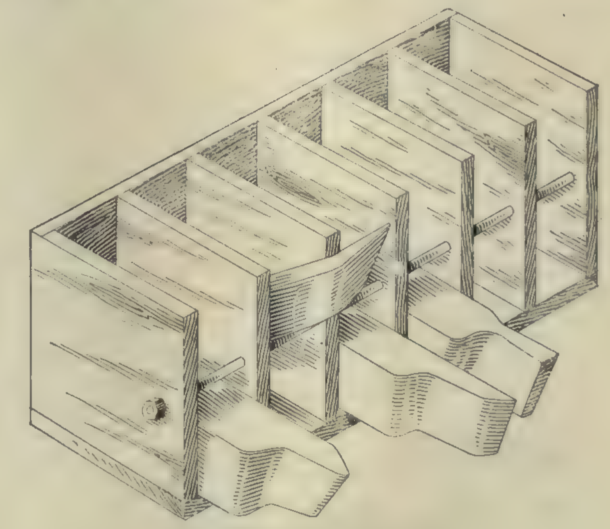
It can be seen that the saving in manufacturing costs is great. The use of these bearings eliminates the necessity of finishing any of these levers on the ends or the side-frame bosses. Plenty of clearance is allowed between the levers and side frames, and no drilling of long holes is necessary. The assembling proposition is exceedingly simple. The levers must be in absolute alignment to insure easy running, and this is quickly accomplished by adjusting the cone-point screws on either side. There is absolutely no fitting. Another feature is the ease with which compensation for wear can be made.

Lathe-Tool Holder

By William Forray

The accompanying sketch will show how, at a small expense, time wasting can be avoided in "hunting up" lathe tools that very often lie buried in chips of heavy machine work.

The fixture consists of a wooden box of suitable size with one side removed, and partitions held together by a $\frac{3}{16}$-in. rod.



LATHE-TOOL HOLDER

The tools are placed at the bottom, but those being used are placed on the rod and can easily be taken out. The holder can be mounted on the lathe bed or bench by suitable means.

Press Tools Designed for a Sheet-Steel Hinge Part

By Hugo F. Pusep

The manufacturing in large quantities of one of the components of a special hinge used in the making of metal furniture necessitated the designing and building of a set of interesting press tools.

The piece as it appears when completed is shown at *C*, Fig. 1, while *A* and *B* represent the preceding operations in their order. These pieces are made of No. 16 gage (0.0625-in.) sheet steel 1½ in. wide. Altogether, three operations are necessary for producing the finished piece from the strip stock.

In Fig. 2 are shown the first-operation punch and die, which pierce the six holes and cut off the blank from 1½-in. strip steel. In appearance the punch and die do not differ materially from any similar progressive die, although a few points about the construction might be interesting.

The die shoe *A* and the punch holder *B* are of cast iron. The stock is fed into the die under the stripper *C* from the right till the end of the stock extends a little over the cutting edge *D* of the die. The punch when it descends pierces the six $\frac{9}{64}$-in. holes, at the same time trimming the end of the strip. After this the stock is fed forward till it strikes the stop *E*, which is set the correct distance from the cutting edge *D* and is secured by two capscrews working in elongated slots, to allow for adjustment. Now a finished blank will drop through the opening *F* of the die shoe at each stroke of the press, the operator merely feeding the strip against the stop on the upstroke.

To make a die of this kind work successfully, it is necessary that the cutting-off punch *G* be longer than the piercing punch *H*, so that the blank is cut off the strip before the piercing punches come in contact with it, thus prolonging the life of the small piercing punches; it is also essential to make the stock guide slot in the stripper no wider than is necessary for the full sliding of the stock. As will be observed, the cutting-off punch *G* has a portion *I* cut out. This is for the purpose of providing room for the machine-steel punch plate *J*, which along with the cutting-off punch is secured by fillister-head screws and dowel pins to the punch holder *B*.

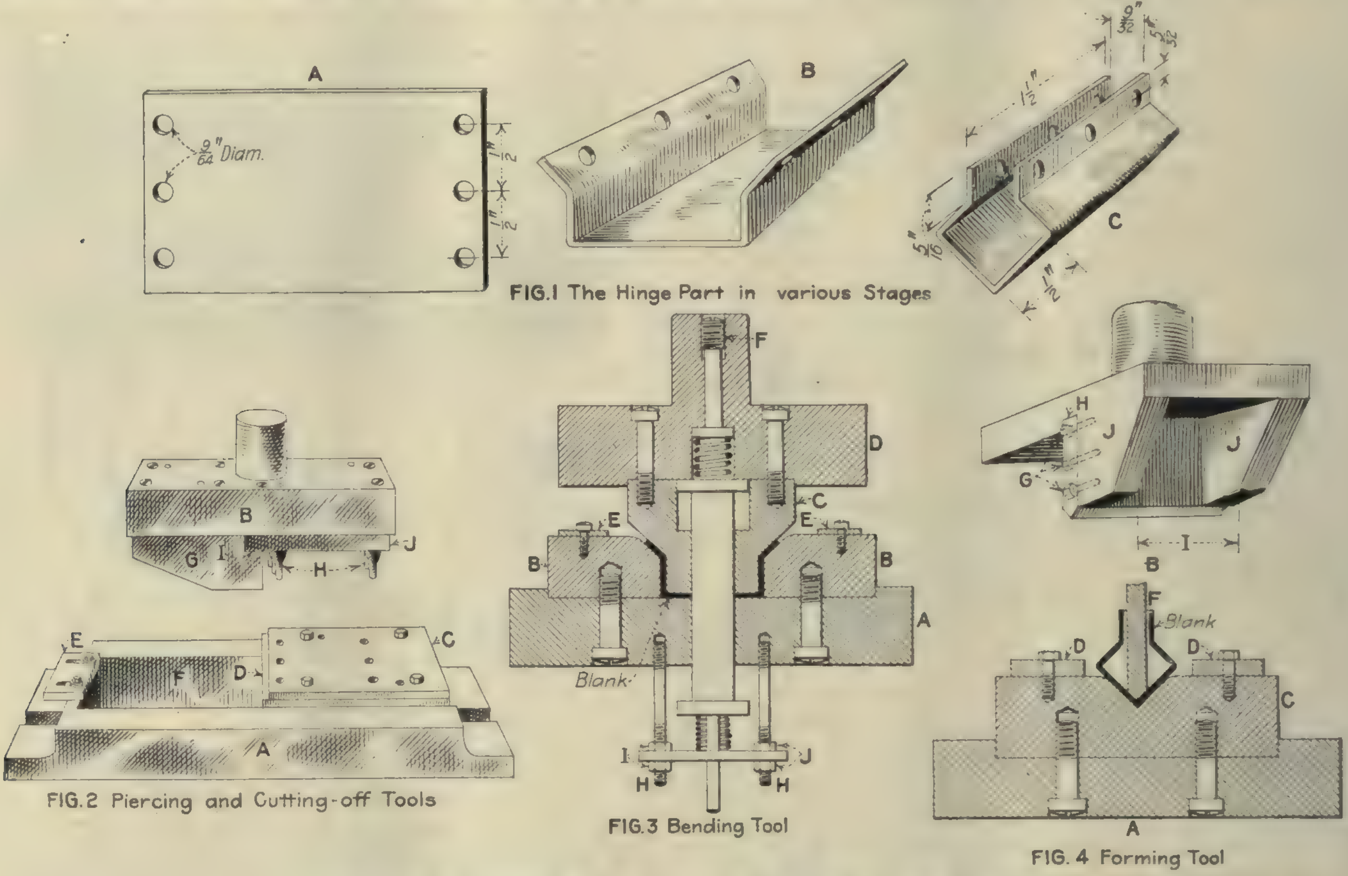


FIG. 1 The Hinge Part in various Stages

FIG. 2 Piercing and Cutting-off Tools

FIG. 3 Bending Tool

FIG. 4 Forming Tool

FIGS. 1 TO 4. PRESS TOOLS FOR A SHEET-STEEL HINGE PART

Fig. 1—The hinge part in various stages. Fig. 2—Piercing and cutting-off tools. Fig. 3—Bending tools. Fig. 4—Forming tools

Fig. 3 shows a sectional view of the second-operation punch and die, which form the blank as at *B*, Fig. 1. The cast-iron die shoe *A*, Fig. 3, has two hardened tool-steel forming blocks *B* mounted upon it and held by four fillister-head screws through the die shoe. The forming punch *C*, of hardened tool steel, is secured to the cast-iron punch holder *D* by four screws. The stops *E* locate the blank centrally and sidewise over the die. Spring knock-out pins are provided for both the punch and the die. The right tension for the punch knock-out spring can be secured by adjusting the screws *F*, while the knock-out spring and pin in the die have means for adjustment through the screws *H* and the nuts *I* and *J*.

The third-operation punch and die are illustrated in Fig. 4. The sectional view at *A* shows the simplicity of construction of these tools. The hardened tool-steel die block *C* is mounted on a cast-iron die shoe and held with screws, as is clearly shown. Gage stops *D* locate the blank in correct relation to the V-form of the die. The forming punch *F*, which is of necessity very slender and therefore subject to breakage, had to be reinforced without interfering in any way with the die or the work. The way in which this was accomplished is clearly shown at *B*, Fig. 4. The forming punch rests in the slot *H* and is secured to the webs *J* of the punch holder by six screws, as shown by the dotted lines *G*. The distance *I* is ample to clear the width of the die block, so that there is no interference.

By using this method of mounting very thin forming punches, the danger of bending or breaking is eliminated altogether; and the replacing of the old punches is also very much simplified.

The average production time on these press tools was as follows: 3000 blanks per hour for the first operation and 1700 per hour for the second and third operations. A No. 5 Niagara inclinable power press, running at 100 r.p.m., was used for all the operations.

Editorials

In Justice to the Ordnance Department

THE *American Machinist* has held that in a country devoted to peaceful pursuits, such as ours has been for many years, the creation of a vast military machine capable of contending with the German product of 20 years of effort must depend most largely upon our civilian industries and our civilian engineers who, through training and experience, are skilled in handling large-scale production.

And even to those familiar with production on the greatest scale heretofore imagined, the present task of munition manufacture is so stupendous as to be almost bewildering. It is a gigantic task that will require the utmost of human ability, ingenuity and effort.

The realization of the enormousness of this task and of the necessity of devoting to it the best we have is the first step toward its accomplishment, and this step has now been taken.

For a number of weeks the Ordnance Department at Washington has been drawing from the various industries of the United States civilian experts who will head the various departments where civilian industrial experience can relieve the burden from the shoulders of our military technical experts. What these men have already been able to accomplish gives rise to the belief that our greatest war problem is rapidly nearing a solution.

Under the present system that we have adopted, it is necessary to appoint these civilians to military office in order that they shall have the necessary authority to get things done. The necessity for this is to be regretted, but in view of the greater necessity of quick accomplishment at this time it becomes an unimportant detail. The main thing is that the so-called red tape is being rapidly done away with and an organization perfected that will be the keystone in the great national industrial war structure.

* * *

Any attempt to lay a finger upon the individual cause of delays will be in vain. Coming back as it does in each case to our general condition of unpreparedness, it is reflected upon all the citizens of the United States who, contrary to the preaching of the War Department and certain others who saw beyond the horizon, were content to remain in a state of comfortable but false security. We *could* have been prepared, if you and I and all the rest of us had been in favor of preparedness. For years we have regarded our War Department and our arsenals as more or less ornamental and unnecessary institutions. For years Congress has refused to appropriate sufficient to do more than barely keep alive a meager military structure. At present, salaries paid commissioned officers are entirely inadequate to attract those who place a strictly mercenary value upon their services to their country.

For years this great country has maintained in its Ordnance Department a handful of men provided with sadly insufficient funds. It is inevitable under these conditions that sudden demand for a thousand-fold expansion should cause confusion. These men are doing now all that it is physically possible for human endurance to do. There is no question in most cases of their ability in military technology. The appropriations given them and the limitations set upon them made it impossible for them to be expert in manufacturing methods in addition to military technology.

* * *

There are two kinds of criticism, constructive and destructive. Each is wholesome when applied in its proper place and applied with fairness of mind. At a time like the present—a national crisis—criticism must be constructive if it is to be of national value.

Most of the men of the Ordance Department realize that this is not a one-man war nor a departmental war. Delays will arise and when they are serious will get to the attention of the public—and it is right that they should. Those immediately responsible for such delays must expect constructive criticism. But it is not right for you and me to shift our share of the responsibility upon the shoulders of individuals who are as patriotic as any of us, and who work harder than most of us.

* * *

The *American Machinist* has always stood for truth and for constructive criticism. We enjoy commending and dislike condemning. And so it gives us pleasure to tell our readers of the recent promising developments toward effective coöperation between the War Department and industry.

Standard Cost Methods the First Step Toward Price Regulation

RECENTLY there arose in Washington a controversy of grave importance to everyone furnishing material or executing contracts for the Federal Government. It has been apparent for some months that a marked difference of opinion has been growing concerning what should be considered the true cost of materials or services. Different departments of the Government have not agreed concerning this, as was shown some weeks ago when a standard price for coal approved by one department was peremptorily rejected by another. Inasmuch as a large amount of work is being done for the Government on the basis of cost plus a percentage for profit or is being done under compulsion by commandeering, the price to be fixed later by the Government, this subject of true cost has suddenly become one affecting the entire country. A large part of our population is now engaged in work for the Government, and the success or failure of those responsible for this work will depend upon whether or not the Government decides to adopt those views of cost which are held by men engaged in successful business.

The surprising feature of this situation is the fact that Congress stated very clearly in Section 302 of the income-tax law of Sept. 8, 1916, what the true cost of a manufactured product is. The purpose of Congress at that time was to establish the net income of a manufacturing corporation which should be taxed. Manifestly, it would insert in that statement of cost nothing that was questionable, for the larger the cost is fixed under the terms of the law the smaller is the income subject to taxation. Since that time manufacturers have sometimes written into their contracts with the Government for work done on a cost plus percentage basis the statement in the income-tax law concerning costs. This was done in contracts between the Government and small-arms manufacturers placed in July, and it is these contracts that were recently under criticism.

The trouble arises over the subject of interest. In the law it is stated that costs shall include "interest paid within the taxable year on debts or loans contracted to meet the needs of the business and the proceeds of which have been actually used to meet such needs." In the contracts this wording was changed to read: "A reasonable rate of interest on a proper proportion of the investment in plant, facilities, inventory and working capital not owned or provided by the Government." Most large manufacturing companies have an outstanding bonded indebtedness incurred to provide buildings and equipment for carrying on this work. The interest charges on this indebtedness are admitted in the income-tax law to be a part of the cost of manufacturing, but certain members of Congress are strongly disposed to hold that such interest charges should not be included as part of the cost.

The trouble is unquestionably due to the fact that there has never been a clear, concise statement of what must be considered the true cost of carrying on work. There have been innumerable discursive discussions of the subject, doubtless of much interest to economists, but certainly not likely to appeal to Congressmen in search of definite, concise information. A further cause of the trouble lies in the fact that there is a certain group of economists which insists that costs must include a certain interest on the capital engaged in the work. They hold that if capital is invested in high-grade bonds it will earn a certain amount of interest and it is not until that interest is earned that true profits begin to accrue.

It is clear to those who have followed this recent controversy that both sides are acting in good faith. The difference of opinion was bound to arise, and now that it has arisen it should be settled immediately. The United States will make many more contracts on a cost plus percentage basis, for that system of contracting is far superior to any other for emergency work.

Moving Bridgeport to France

SOME things are too vast for the human mind to conceive. It is impossible, for example, to visualize the distance between the earth and the sun or to form an adequate conception of a war bond issue. It is equally impossible for any one man, however experienced he may have been in seeing things done on a large scale, to grasp what present war means to industrial activity.

Lord Northcliffe raised one corner of the curtain in a recent address when he said that he had recently been in *one* of the munition plants of Great Britain and that this plant covered an area three miles wide and nine miles long. He raised another portion of the curtain and gave us a glimpse of industrial war activities when he said that Great Britain had found it necessary to establish in France, for the quick handling of immediate repairs to equipment, industrial centers that would compare in size with our own City of Bridgeport.

We will have to establish American Bridgeports in France for the purpose of taking care of our own ordnance and equipment, for obviously we cannot depend upon the already established British plants for this purpose; nor can we conceive the possibility of sending our equipment back to America for attention. As a matter of fact, plans are now well under way in Washington for the establishing of the first American industrial center of this nature abroad.

It is well for us who build machinery to have this curtain of ignorance regarding the size of the job we have tackled lifted occasionally so that our conception of the task ahead of us may be more nearly a true one, and so that we may realize the amount of effort necessary and take steps to apply it. Here are a few facts from the report of the Rt. Hon. Christopher Addison, of the British Ministry of Munitions, which perhaps will by comparison with what England has accomplished help us to obtain a proper perspective.

There are 40,000 people on the munitions-inspection staff in Great Britain. There is an additional staff of British inspectors in the United States numbering 8000. In times of peace we of America have employed in our arsenals some 5000 workers altogether. Here we find in Great Britain *five times as many inspectors* as we have had arsenal employees. In the Woolwich arsenal, England, there are now over 73,500 employees, of whom 25,000 are women. In Canada alone there are 200,000 people working under the Imperial Munitions Board.

One storehouse for shells in a shell-filling factory in England covers nine and one-half acres.

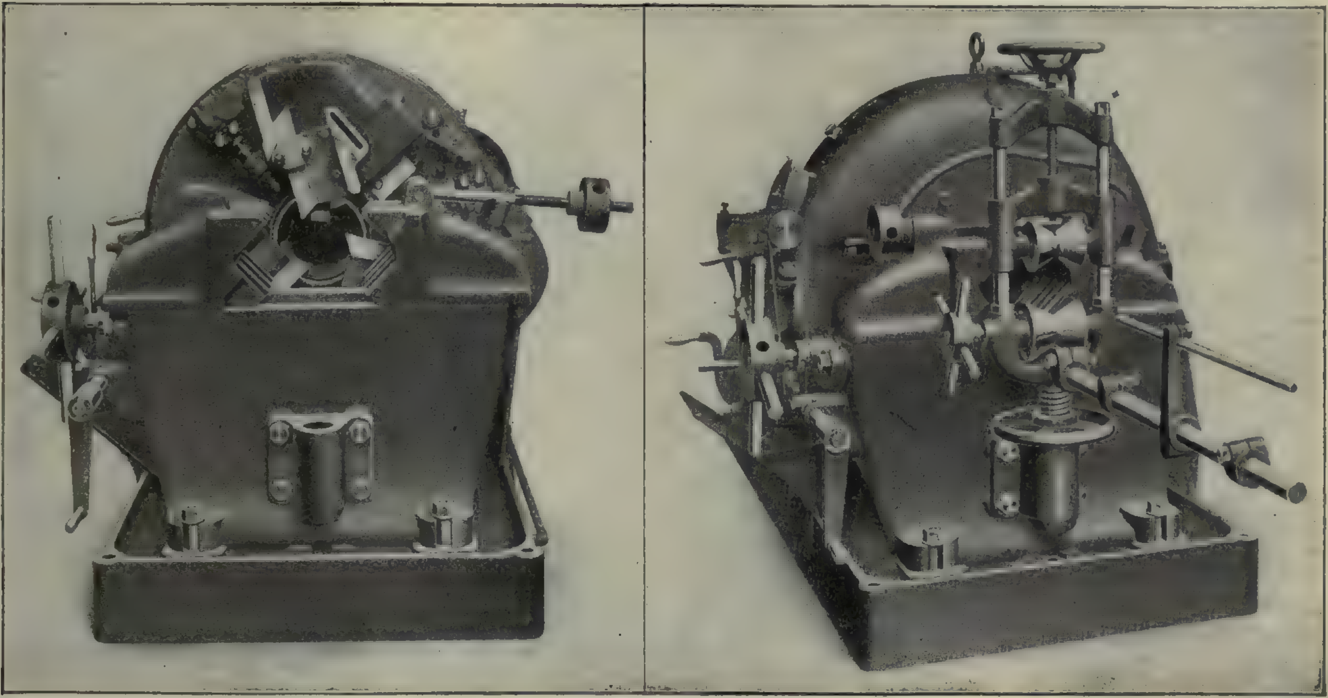
In the matter of machine tools, under Mr. Herbert and his Advisory Committee the machine-tool clearing house was recently established, through which idle and insufficiently used machinery is diverted to a better use. During the past seven months, 42,638 machines have been released. The value of these is estimated roughly at $15,000,000. More than sixty technical schools and colleges in Great Britain are used in training women for specialized jobs in industry.

Canteens have been established for the feeding of industrial workers and at present supply meals to 810,000 workers daily. At the Woolwich arsenal before mentioned, thirty-one canteens were necessary to take care of the provisioning of those who came from long distances.

In the absence of any possibility of presenting a complete picture of what war means to industry, these little examples give us an occasional glimpse beneath the curtain.

Taylor Eight-Inch Cutting-Off Machine

The 8-in. cutting-off machine illustrated has been recently constructed by Charles Taylor, Ltd., Birmingham, Eng., and, so it is claimed, will cut through a nickel-steel bar at the rate of an inch per minute. The machine is equipped with an all-geared headstock that carries the cutter head. The work is held in a self-centering vise with hardened-steel jaws of such construction that a variety of sizes of stock may be handled without making adjustments. Three cutting edges are used, the cutters being revolved while the work remains stationary.



TAYLOR EIGHT-INCH CUTTING-OFF MACHINE

Weight, 8000 lb.; floor space, 4¾ x 7 ft.; driving pulley, 5½ x 16 in.; horsepower required, 9

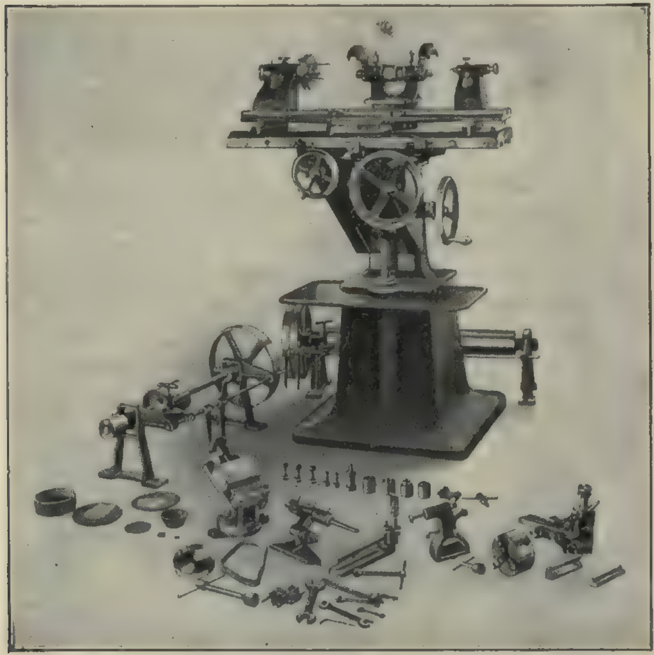
A balancing attachment is incorporated, which equalizes the power applied to each cutter. The cutters are offset so that each takes a cut slightly thinner than the groove in which it runs. This feature is claimed to effectually prevent clogging. An automatic throw-out stops the feed as soon as the piece being cut is severed from the main bar. Adjustable stops are incorporated so that in operating the only necessary manual labor is to feed new lengths of bar and start the feed. The illustrations show the front and rear of the machine.

"Wisconsin" Universal Tool Grinder

The universal tool grinder shown in the illustration is adapted for tool, cutter, cylindrical, internal and surface grinding. The base is of the cabinet type, with a door at the rear to provide for the storage of tools and fixtures. A shelf is cast at the front of the base for holding tools while operating the machine. The knee is also of box section and is entirely closed except for the opening at the bottom, through which the elevating screw passes. It has a T-slot in one side for carrying the crossfeed stop, which is provided with screws for fine adjustment.

The subtable is the full length of the table and has a T-slot in the front face for securing stops for the table movement. The table swivels 90 deg. each way on the subtable and is supported by a large cylindrical bearing. The graduations on the outside of this bearing allow the table to be set in terms of degrees of angle, while graduations at the end allow for setting for a certain taper per foot of length. The spindle is of tool steel and runs in bronze bearings provided with suitable adjustment for wear. The head swivels on top of the column in either direction and is graduated in degrees and provided with a three-point-bearing clamping device that locks the spindle firmly and in position by means of a single handle. An internal-grinding attachment is also provided which is bolted to the spindle head and is adjustable to give proper belt tension. A universal vise is among the attachments. It is graduated in degrees and can be made to swivel in any direction.

The equipment includes machine countershaft, drum countershaft, three-jaw chuck, gear-cutter grinding attachment, internal-grinding attachment, steadyrest, wrenches, T-slot bolts, grinding wheels, adjustable dog, tooth rest, spindle extension and a cabinet for extra parts. The machine is the product of the Dauber-Kratsch Co., Oshkosh, Wis.; and the E. L. Essley Machine Co., 551-557 Washington Boulevard, Chicago, Ill., are the sole sales agents.



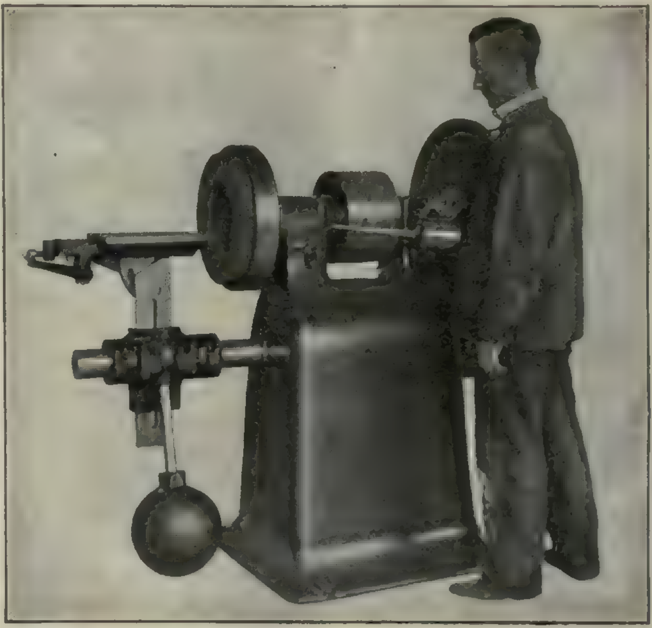
WISCONSIN UNIVERSAL TOOL GRINDER

Table surface, 5 x 36 in.; longitudinal table movement, 20 in.; transverse table movement, 8 in.; vertical table movement, 9 in.; maximum distance center of wheel to top of table, 8½ in.; swing on centers, 10 in.; maximum distance between centers, 22 in.; dead center in headstock, No. 3 Morse taper; height of spindle from floor, 48 in.; opening of universal vise, 2¼ in.; width of vise jaws, 4⅝ in.; chuck, 4-in. 3-jaw universal; depth of internal grinding permitted, 4 in.; capacity of gear-cutting attachment, 1⅜ to 8½ in.; capacity of steadyrest, 1½ in.; spindle speed, 3200 r.p.m.; belt width, 1½ in.; weight, 1350 lb.; floor space, 44 x 64 in.

Besly Disk Grinder

The illustration shows the No. 17 grinder that is now being manufactured by Charles H. Besly & Co., Chicago, Ill., and Beloit, Wis. The machine is a combination disk and ring grinder, the chief features of which are the type of bearings used and the lubrication system. Oil rings are provided together with large oil wells. It is claimed that this type of construction makes a bearing that is practically dustproof and gritproof.

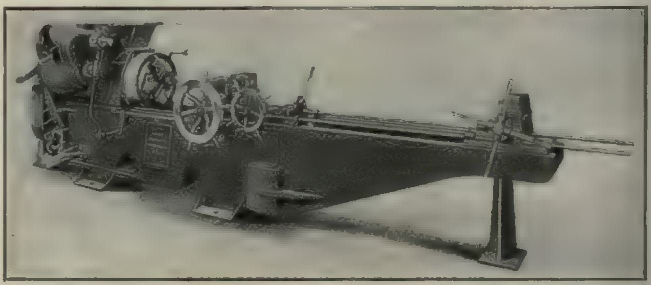
The bronze bushings are split, inserted in place and are renewable. End thrust is carried on hardened and ground tool-steel collars that bear against the flanged ends of the right bearing bushing. End play is taken up by means of an adjusting collar, threaded on the spindle and located under the rim of the spindle pulley. It is claimed that the grinder may be safely operated with all end play taken up in the spindle, as the bushing that carries the end thrust is provided with clearance to compensate for expansion in the bushing.



COMBINATION RING AND DISK GRINDER

Landis Threading Machine

The illustration shows a threading machine that has recently been built for work on hollow stay-bolt tubes. The machine is equipped with an auxiliary bed that is attached to the main bed and supports a carriage fitted with threaded grips used for timing the threads on the ends of the tube and also for supporting the tubes. The lead screw insures the thread being started correctly and a pitch indicator serves to indicate the correct position for engaging the lead-screw nut. The machine is shown arranged for an alternating-current constant-speed motor with mechanical speed-change box and a silent chain and sprocket drive.



LANDIS STAY-TUBE THREADING MACHINE

The method adopted to insure the continuity of the threads on both ends of the tube is as follows: The tubes are all threaded on one end by gripping in the vise of the regular carriage, and a master tube having continuous threads is placed in the machine. The chasers are then closed down on the threaded portion, and the loose threaded grips of the auxiliary carriage are adjusted endwise to fit the thread on the master tube. These grips are then securely fastened in the auxiliary-carriage vise jaws, the lead-screw nut of the main carriage is thrown in, and the tube is gripped in the regular vise of the main carriage. The master stay tube may now be removed, and the tubes that are to be finished are held in the threaded grips of the auxiliary carriage. The lead-screw nut is engaged when the pitch indicator shows the correct position, and the threads will be cut continuous with those on the opposite end.

The Landis Machine Co., Waynesboro, Penn., is the manufacturer.

Steel-Art Chucks and Lathe Dogs

The Steel-Art Tool Co., Elgin, Ill., is now marketing a line of quick-change keyless drill chucks and screwless safety lathe dogs similar to those shown in the illustrations. Fig. 1 shows the drill chuck, which is made in six sizes to accommodate drills up to 1 in. in diameter. It is a strictly hand-operated chuck and permits the changing of drills while the machine is in operation without danger to the operator. The chuck is always open to its full capacity, but can be reduced instantly to any size within its range by holding the knurled sleeve, the gripping being done by three tool-steel jaws that are hardened and ground to size.

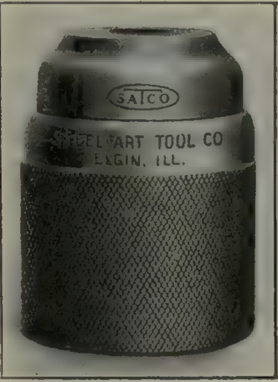


FIG. 1. DRILL CHUCK

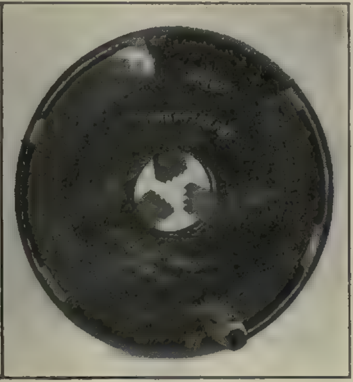


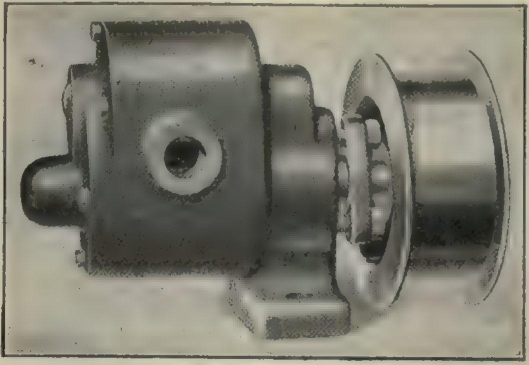
FIG. 2. LATHE DOG

Fig. 2 shows the screwless lathe dog. It is made in seven sizes, which cover all sizes of work up to 8 in. in diameter. The device may be put on and removed without the use of keys, wrenches or screws of any kind and is claimed to admit of a great saving of time where repeat work is being handled, as well as insuring safety to the workman.

"Roco" Circulating Pump

The pump shown in the illustration has recently made its appearance on the market for the purpose of circulating lubricant and other liquids. It is claimed that the construction of the pump adds life, eliminates priming and makes the use of relief valves unnecessary. Another feature claimed for the pump is that it will deliver either a large volume of liquid at low pressure or at a pressure of from 20 to 60 lb. per sq.in. The pump is made in four sizes with capacities per minute at 100 r.p.m. of 1, 1.6, 3 and 8 quarts.

The gears, instead of having their end surfaces in the same plane, are so placed that one gear extends past the other. This arrangement makes it possible to cover one end of each gear with a nonturning spring-controlled piston, which presses against the end of the gear and pushes it against the opposite surface of the body. This makes a tight fit at the end of the gears and takes up end wear.



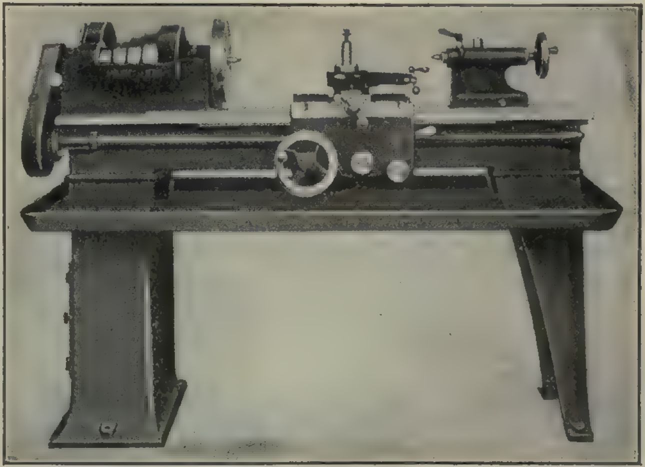
GEAR CIRCULATING PUMP

These pumps are the product of C. F. Roper & Co., Hopedale, Mass.

"Hercules" 12-Inch Engine Lathe

The 12-in. screw-cutting engine lathe illustrated is one of the late products of the Himoff Machine Co., Astoria, N. Y. It is fitted with floor legs or bench legs or is mounted on an oil pan and may be had with either belt or direct-connected motor drive.

The construction of the headstock is such that the under side of the cone pulley and the back gears are entirely inclosed. The cone pulley is finished both inside and out and is balanced to insure smooth running at high speeds. A crucible-steel forging is used for the spindle, which is ground to size and contains a 1-in. hole through its entire length. A chain oiling system



HIMOFF 12-INCH SCREW-CUTTING LATHE

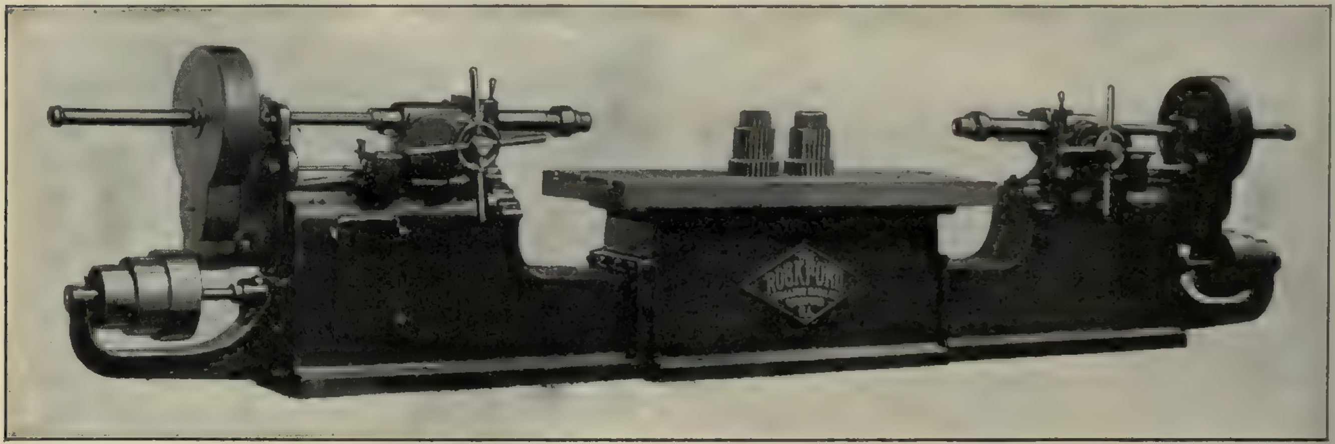
Swing over bed, 12¼ in.; swing over carriage slide, 7¼ in.; length of bed, 5 ft.; distance between centers, 30 in.; front spindle bearing, 1¾ x 4 in.; rear spindle bearing, 1⅜ x 3 in.; taper centers, Morse No. 2; diameter of hole through spindle, 1 in.; spindle nose threaded 1⅜ x 10; ratio of back gears, 8.52 to 1; diameter of lead screw, ⅞ in.; threads cut, 3 to 72; diameter of tailstock spindle, ⅞ in.; movement of tailstock spindle, 4¼ in.; opening in steadyrest, 3⅝ in.; length of carriage, 13½ in.; top slide movement of compound rest, 4 in.; diameter of faceplates, 6 and 10 in.; size of tool, 1⅛ x ⅝ in.; weight, 760 lb.; horsepower required, 1 to 2 takes care of the lubrication. An adjustable nut and a hardened-steel washer carry the thrust at the rear end. The machine is regularly furnished with gears for cutting threads from 3 to 72, including 11½, but can be furnished with a metric lead screw if so desired.

A standard compound rest is fitted to the cross-slide, and a European style toolpost can be furnished in place of the regular one without extra charge. The tailstock is provided with a side adjustment for taper turning. The carriage is gibbed front and rear and is guided with a large V, while the headstock and tailstock are guided by smaller V's placed at a lower level. Semi-steel is used for the bed casting. A taper attachment is placed at the rear of the carriage and is available for the full length of the bed. If desired, the machine can be furnished with an automatic draw-in chuck.

Rockford Horizontal Boring and Drilling Machine

The horizontal boring and drilling machine illustrated has recently been placed on the market by the Rockford Drilling Machine Co., Rockford, Ill. It is a single-purpose machine particularly adapted for repetition work on such parts as crank cases, transmission cases, axles, gun forgings and machine parts. It is built to customer's specifications as to spindle height, length of table and distance between spindle ends. It is supplied with any reasonable number of spindles desired, which may be parallel, offset or at right angles.

Bearings are of phosphor bronze and are interchangeable. The drive is through a three-step cone and a 4-in. belt, each spindle having an entirely separate speed control and being furnished with its own tight and loose pulley countershaft. Speed changes necessary beyond those furnished by the three-step cone may be secured by means of gears, which are readily interchanged. No bevel gears are used on the drive. The feed is taken from the spindle, and four changes are available. Forged high-carbon steel is used for the spindle, which is fitted with two ball thrust bearings. It is also equipped for a No. 4 Morse taper and is slotted across the end for heavy boring and facing heads. Hand traverse of the spindles is incorporated.

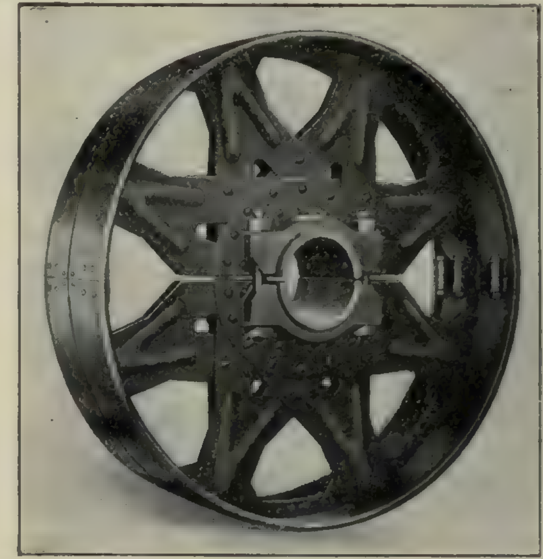


ROCKFORD HORIZONTAL DRILLING AND BORING MACHINE

Capacity with high-speed drills in steel, up to 2⅜ in.; distance from spindle to table and between spindles, to suit customer's specifications; length of feed, 20 in.; diameter of spindle sleeve, 3⅜ in.; Morse taper in spindle, No. 5; width of rack, 2 in.; diameter of spindle-driving gear, 18 in.; size of regular table, 24 x 72 in.; height of table from floor, 30 in.; feed changes, four, 0.010, 0.015, 0.022 and 0.030 in. per revolution; driving pulleys on countershaft, 14 x 6¾ in.; speed of countershaft, 500 r.p.m.; gear ratio between drive and spindle, 5 to 1

American Split Steel Pulleys

The special heavy-duty split steel pulley illustrated is one that is now being marketed by the American Pulley Co., 4200 Wissahickon Ave., Philadelphia, Penn. Pulleys of this type can be furnished from 36 to 84 in. in diameter and with either a 6- or an 8½-in. bore. They are particularly intended for driving drop hammers or other machinery subject to heavy intermittent loads, such as air compressors, rock breakers, crushing rolls, etc.

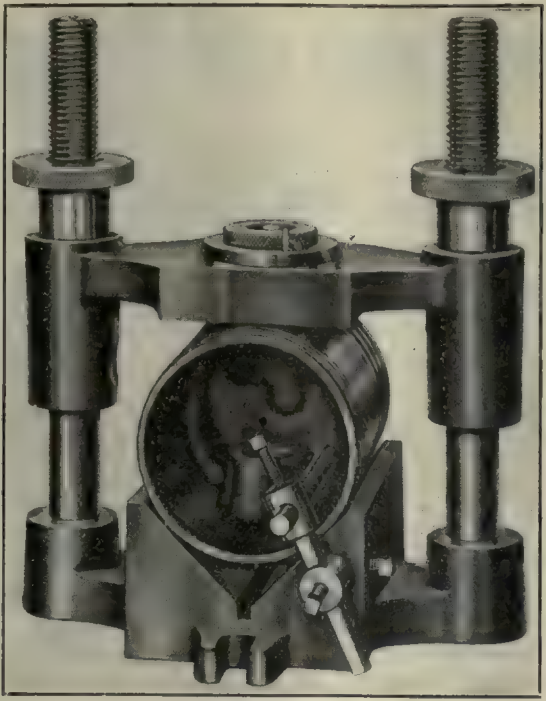


HEAVY-DUTY PRESSED-STEEL SPLIT PULLEY

Schmidt Piston-Boring Jig

For the purpose of crossboring and reaming pistons for the insertion of the wristpin, the B. L. Schmidt Co., Davenport, Iowa, has recently placed on the market the jig shown in the accompanying illustration. As may be seen, it consists of a V-block to which are attached two uprights serving as guides for the sliding yoke that carries the guide bushings.

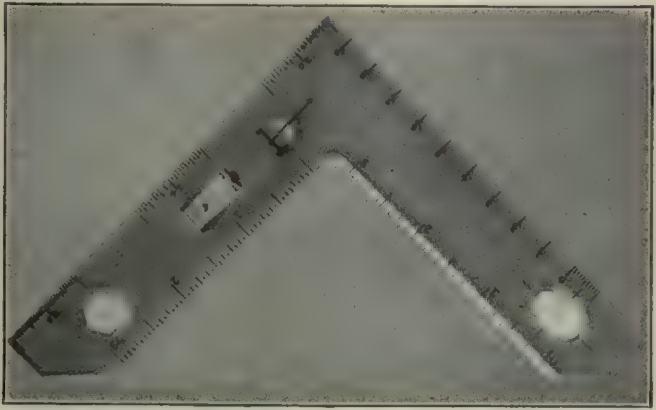
The upper ends of the two uprights are threaded, and the clamping nuts are knurled to permit ease of operation. A gage is attached to one end of the V-block for setting the piston to the proper position. The V-block is also provided with two lugs or ears for clamping to the machine table. The device is fitted with any desired size of slip bushings and is adjustable to all sizes of pistons up to 6 in. in diameter, which is the distance between the uprights.



PISTON CROSSBORING JIG

Ware Draftsman's Triangle

The manufacturer of the graduated pick-up angle square shown in the illustration is R. B. Ware, 101 Northhampton Ave., Springfield, Mass. This square is of the 45-deg. type, but it is also manufactured with the corners cut at 30- and 60-deg. angles. A number of sizes are made. The elliptical hole at one corner is intended for rounding the ends of shafts or other such work on a drawing. With the two corners of the square resting on the T-square, the sides of the hexagonal hole in the corner give the usual 15-deg. slant for lettering. With the square placed with its side against the T-square, the sides of the hexagonal hole are at 60 deg. and may be used conveniently for drawing in screw threads.

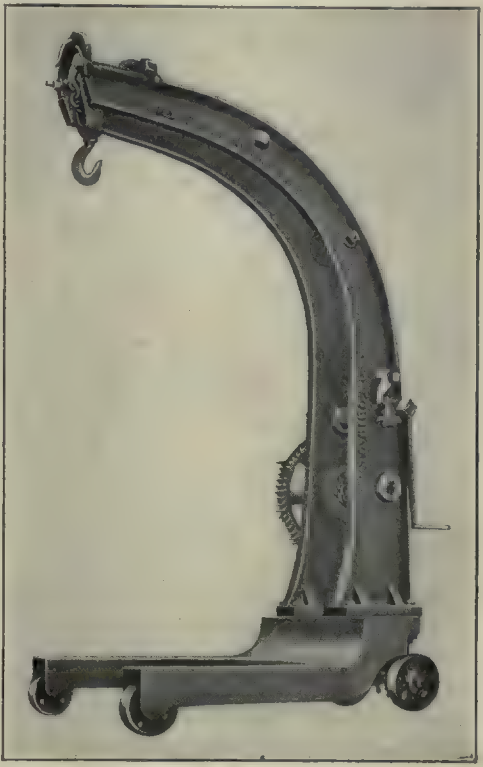


WARE DRAFTSMAN'S SQUARE

As regularly furnished, the beveled inside edge of the square is graduated in sixteenths of an inch, while twentieths, twenty-fourths, twenty-eighths and metric measurements are graduated on the outside edges. Another feature of the square is the knuckle-jointed handle, which is operated by a small music-wire spring and which folds flat inside the limits of the square when not in use.

Canton Portable Crane

The portable crane illustrated is one that is now being marketed by the Canton Foundry and Machine Co., Canton, Ohio. Its capacity is 4000 lb. The base casting is of steel, while the uprights are of semi-steel reinforced with a wrought-iron band. The chain is hand forged and tested. Roller bearings are used in the wheel, and the axle, fork and yoke are machined from drop forgings. The over-all dimensions of the crane are such that it may be readily moved into any box-car.



CANTON PORTABLE CRANE

Total height, 6 ft. 6 in.; distance from floor to hook, 5 ft. 4 in.; overhang, 2 ft. 6 in.; outside width of bed, 2 ft. 8 in.; inside width of bed, 2 ft. 1 in.; length of bed, 3 ft. 2 in.; height of bed, 6¾ in.; weight, 740 lb.; capacity, 4000 lb.

Lathe Design Suggestion

By A. H. Halladay

I have often thought that it would be a great convenience to have lathes so arranged that one turn of the handle would move the carriage 1 in. on the shears. In cutting threads, one could stop the lathe with the handle straight up, throw out the nut and turn the handle the number of turns to correspond to the length of thread to be cut, then throw in the nut and go ahead. I can see no reason why lathes could not be so arranged.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Hotel Powhatan, Washington, D. C., Sept. 29, 1917—One of the hopeful signs of our realization that we are at war, that real and herculean tasks must be accomplished, is to be found in the Aircraft Production Board and the way it is going about the work in hand. It is far different from any other branch of the service, because it means the development of a new industry, an industry which has hardly been born, so far as its being a manufacturing proposition is concerned.

THE SMALL AIRPLANE BUILDERS

Those who have followed the struggles and reorganizations of the builders of airplanes know that, while there are numerous shops which advertise in the aviation journals, for the most part the advertisements appeared more frequently than planes came out of the factories. But even this small capacity, and it was smaller than most care to admit, was not overlooked; advantage was taken of their experience, and all who were at all possible were given orders for all the machines they could make.

This, however, was only a beginning, for if we are to win in the air, as we are now planning, we must have planes by the thousands, and the additional capacity had to be developed from new sources. One new plant with a floor space of 275,000 sq.ft. was immediately available, and another huge woodworking establishment with experience on fine automobile bodies was induced to turn its attention to airplanes. Should it become necessary, another large plant, one of the largest woodworking plants in the country, stands ready to go into the work at almost a minute's notice.

AUTOMOBILE PLANTS FAVORED

Some criticism has been made to the effect that the automobile plants were unduly favored in this work, but a little consideration will show the very good reasons behind the action. Entirely aside from the fact that men responsible for large undertakings must select men and plants that they know can handle the work, where else can we find plants in any industry with the modern equipment and organization for large manufacture equal to that in the automobile shops? Is it not the logical place to go for such work, especially in the manufacture of high-grade airplane engines? England, France, Italy and Germany all utilize their automobile industry in this way, and it is the wise thing to do.

Training machines have been standardized, only two machines being used for this purpose. Each has been developed to use a different engine; and while it would have been preferable to have but one type of training engine, it was deemed better to avoid the delays due to changes and to build training machines of each type. By assigning only machines of one type to each school, the problem of spare parts will be kept at its lowest point, and no trouble should be experienced from this source.

When it comes to the engines for the scouting, reconnoissance and bombing machines, it is hoped and believed that the new U. S. A., or Liberty, engine will prove entirely satisfactory. But although tests have shown these engines to be unusually light and powerful and without any "bugs" as far as the tests have gone, the Aircraft Board is not putting all its eggs into any one basket. Hispano-Suiza, Gnome, Sunbeam and a few other well-known high-grade engines will be made in fairly large numbers so as to be able to satisfy any demands of the army aviators, whether well founded or not; for there are fashions in airplanes, just as in automobiles, machine tools and milady's bonnets. And the board wishes to be in position to supply any type of engine that may be called for. The Gnome engine is one of the stumbling blocks at present, although it is being built very successfully by one firm in this country. It is quite probable that any shop with a legitimate reason for thinking it can build Gnome engines would receive careful attention.

The lumber has all been contracted for at a fixed price, and the Government is ready to assist any maker to get his materials as far as possible. The smaller parts are being contracted for by the builders of the planes and engines, although this plan may be changed, should it seem best. The watchword is "production," and no hard-and-fast rules will be allowed to stand in the way of getting machines out in large quantities.

SPLITTING CONTRACTS

There is criticism in some quarters because contracts have not been split up so as to give more shops a part of the work. But it should be remembered that we are not playing politics (or should not be at least), but a much more serious game—war. Nothing should stand in the way of getting out airplanes in large numbers. Splitting contracts involves more inspection, more gages, more chances of error and a higher cost, unless the contract is beyond the capacity of any one shop. The Pacific Coast might well build the machines for the school at San Diego, but it would be folly to build airplanes in California or Washington to be shipped east over the Rockies and the miles in between.

There is one important point to be remembered in connection with the aircraft work: The board is largely composed of business men who have been brought up in our best-organized industry, that of the automobile, and they understand how to secure production on a large scale. Many of them are wearing uniforms as well as handles on their names, but that is because the army system of this and most countries makes it the only way to be recognized as having any authority. However, they are military only in title and remain business men and engineers just the same.

INSTRUMENT INSPECTION

One of the noticeable results is the reorganization that is going on in the inspection of instruments for aircraft, which comes under the auspices of the Signal Corps so far as the army airplanes is concerned. The navy still remains a separate institution. Instead of having a different ruling as to the inspection of compasses and other instruments for each lot that was ordered, as has been done at various times, this work is being centralized under one head and in a very practical manner. The inspection is to be divided into districts, and work in that district is to be inspected at the maker's factory, wherever possible, so as to expedite shipment. Where the output is large enough to warrant a resident inspector, this will be the method followed. In other cases it may be necessary to have an inspector visit a plant periodically or to have the work sent to the inspector in a few cases. But there will be no vacillation or shifting of orders, and it is the intention to use good, ordinary common sense so far as it can be secured, instead of the "reject everything possible" attitude that has been followed in too many cases.

This is a particularly gratifying outcome of what threatened to be a disagreeable situation in which it was attempted to redesign instruments that have proved satisfactory enough to be used exclusively by England, France and Italy, in the desire to have a different standard. This attempt fortunately has been sidetracked by the practical men who are on the job. As a result, certain specifications, which called for constructions that were abandoned by the best makers several years ago, have been quietly laid on the shelf.

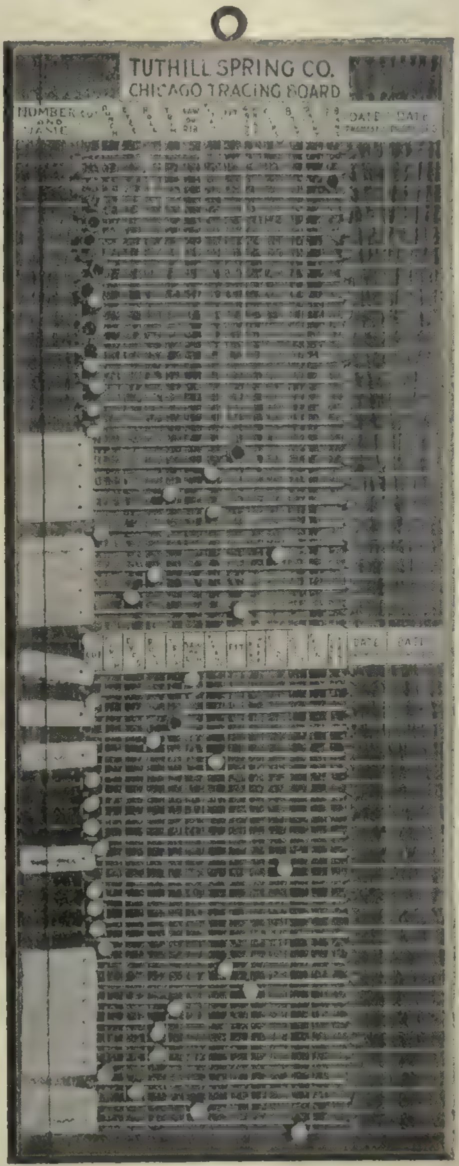
CANADIAN INSPECTORS

It is indeed pleasing to be able to write so optimistically on this subject, and particularly as it shows what can be accomplished when the modern production engineer is allowed to handle matters of this kind. In this same connection, we should pause long enough to congratulate Canada on the good engineering discrimination exercised by most of the inspectors and those who place orders for aircraft supplies. They are very businesslike in every way. They look over an instrument, test it to see if it answers their requirements, and order in such quantities as may be needed. They have learned to take a standard product that answers the purpose instead of demanding sundry changes in design, which do not affect the functioning of the instrument in the least, simply to conform with their notions or to have their earmark on the piece. As a result they get prompt attention and good service at a fair price. FRED H. COLVIN.

Job-Tracing Board

BY W. S. SWANN

Keeping tabs on orders so that delays are noticed, the causes discovered and deliveries made on schedule time is a problem common with all manufacturers. The Tuthill Spring Co., of Chicago, formerly kept track of the progress of orders through its plant by a card-index system. Each day the exact location of each job was noted on a card, and the superintendent or shipping clerk, by fingering through the cards, was able to keep posted on just what was taking place.



A JOB-TRACING BOARD

However, a company engineer devised a better way, and the tracing board shown is the result. The one illustrated is used in tracing Chicago orders. Each day the entry clerk, in much shorter time than was required to make the card records, can bring his tracing board up to date. The merest glance tells the superintendent or anyone else interested the exact status of each job. In use, the job cards are placed at the left, and the progress of the work is successively shown by means of tabs or buttons slid along the crosswires and stopped in the proper columns.

Personals

Donald A. Baker, consulting engineer, is now located at 308 Vanderbilt Avenue Building, New York City.

J. D. Rauch has been appointed manager of factory sales of the Wayne Oil Tank and Pump Co., Fort Wayne, Ind.

G. H. Sheuberger has been appointed works and safety engineer for the Goulds Manufacturing Co., Seneca Falls, N. Y.

W. S. Griffith, formerly with the Heald Machine Co., Worcester, Mass., has taken a position as manager of the Worcester Machine Screw Works, 25 Bartlett St., Worcester, Mass.

J. H. Beall, formerly manager of factory sales for the Wayne Oil Tank and Pump Co., Fort Wayne, Ind., has been appointed manager of a new branch office of the concern, located at Cleveland, Ohio.

John H. Barker has established himself in business at 95 Liberty St., New York City. He will solicit orders for complete electrical equipment of factories. Mr. Baker was formerly sales manager, of the Deal Manufacturing Co., Elizabeth, N. J.

J. H. Coffey, who has been with Pratt & Whitney Co. for fifty years, was presented by the company with a purse containing $250 in gold. Mr. Coffey entered the service of the company at the age of 19, serving three years as a blacksmith's apprentice, 26 years as journeyman and 21 years as foreman of the department.

Obituary

Russell Dale, sales manager of the Rich Tool Co., Chicago, Ill., was murdered on Sept. 22. Mr. Dale was well known in the machine-construction and metalworking field, having been sales manager for the Rich Tool Co. for the past five years. For a number of years previous, he was Chicago manager for the Carpenter Steel Co. He was 43 years old.

Business Items

The Columbia Steel and Shaft Co., Pittsburgh, Penn., has established a branch sales office in New York City, at 295 Broadway. The office will be in charge of Tracy F. Manville.

The Wayne Oil Tank and Pump Co., Fort Wayne, Ind., has just completed three additions, which will double the floor space. Additional land has recently been purchased immediately west of the main office building.

The Long & Allstatter Co., Hamilton, Ohio, has recently increased its line by taking over the manufacture and sale of lever shears, commonly known as alligator shears, formerly manufactured by Thomas Carlin's Sons Co., of Pittsburgh, Penn.

The Blevney Machine Co. has taken over through direct purchase all patterns, patents and the good will of John C. Blevney, manufacturer of grinding, polishing and finishing machinery and friction clutches. The new company has purchased a factory in Greenfield, Mass., to which it intends to move from its plant in Newark, N. J., soon after the first of October.

Trade Catalogs

Reversing Tapping Attachment. Bicknell-Thomas Co., Greenfield, Mass. Circular. Illustrated.

Engine Lathes. South Bend Lathe Works, South Bend, Ind. Spanish catalog. Pp. 48; 6 x 9 in.; illustrated.

Friction Tap Chucks and Tapping Attachments. Bicknell-Thomas Co., Greenfield, Mass. Circular. Illustrated.

Moback Plain and Swivel Milling Machine Vises. The Moback Tool and Machine Co., Boston, Mass. Circular. Illustrated.

Thread Lead Indicators for External and Internal Threads. Bicknell-Thomas Co., Greenfield, Mass. Circular. Illustrated.

Volute Centrifugal Pumps. Worthington Pump and Machinery Corporation, 115 Broadway, New York. Bulletin W-600-A. Pp. 32; 6 x 9 in.; illustrated.

Metal Racks, etc. for Factories, Foundries, etc. Manufacturing Equipment and Engineering Co., Boston, Mass. Catalog. Pp. 16; 6 x 9 in.; illustrated.

Economy Furnaces and Equipment for Heat Treating Metals. Economy Furnace Co., Chicopee, Mass. Catalog. Pp. 32; 6 x 9 in.; illustrated. These furnaces are for either gas or oil fuel.

The "Friendly Touch." The Black and Decker Manufacturing Co., 109-115 South Calvert St., Baltimore, Md. This is the title of a booklet describing the "Lectro-flater," an air-compressing unit for garage service.

Forging Machine Talk No. 27. National Machinery Co., Tiffin, Ohio. This is a reprint of a paper on "Laws Governing Forging-Machine Die Design," by E. R. Frost, read before the American Drop Forge Association at Cleveland.

Woodworking Machinery. Oliver Machinery Co., Grand Rapids, Mich. Catalog No. 20. Pp. 304; 6 x 9 in.; illustrated. In addition to complete line of woodworking machinery, engine and turret lathes for metalworkers are shown.

"New Britain" Pressed Steel Bench Legs. New Britain Machine Co., New Britain, Conn. Bulletin. Pp. 8; 8½ x 11 in.; illustrated. Tells the advantages of these bench legs and shows several methods of planking the different types.

Emery Wheels. American Emery Wheel Works, Providence, R. I. Table of grinding-wheel speeds, and grades and grains of wheels recommended for use on various materials. The table is arranged in a celluloid case measuring 2⅞ x 5¼ in., in which are slots allowing different figures to be quickly read.

New Publications

The Application of Efficiency Principles—By George H. Shepard. Three hundred and sixty-eight 5 x 8½-in. pages; illustrated with numerous diagrams and charts; cloth binding. Published by the Engineering Magazine Co., New York City.

This recent addition to the literature applying to shop management forms a useful connecting link between the existing broad statements of principles of management and the other extreme—specific cases of mere application. It is a book that deals with the application rather than the statement of principles, but gives as general a treatment of application as can be made concrete and practical.

Emerson's efficiency principles form the basis for a number of chapters. Methods of applying these principles in practical and effective ways in the average shop are detailed in a clear explanatory style that does not attempt to confuse the reader as do apparently many authors in treating of management.

There are 18 chapters in this book, some of the more interesting being Chapter 2, which treats of piecework and rate cutting and the troubles that ensue without fair standards; Chapter 9, the adaptation of conditions and work to each other; Chapter 12, the fair deal; Chapter 17, estimating financial results; and Chapter 18, the selection of the point of attack.

This book has been written by an author who knows his subject, and it should be in the hands of those who desire to transform ideal efficiency principles into practical working means.

Modern Machine Shop Construction, Equipment and Management—By Oscar E. Perrigo. Second edition revised and enlarged. Three hundred and eighty-four 6 x 9-in. pages; 219 illustrations; cloth binding. Published by the Norman W. Henley Publishing Co., New York City. Price, $5.

This book is a revision of the original work under the same title, first published in 1905. Four entirely new chapters have been added for the special use of managers, accountants and shop men.

The author, in his preface, gives as his object in publishing this book the desire to produce a work suitable for the everyday use of the architects who design, the manufacturers who build, the engineers who plan and equip, the superintendents who organize and direct; and for the information of every stockholder, officer, accountant, clerk, superintendent, foreman and workman of the modern machine shops and manufacturing plants of industrial America. This is a fairly large contract to be undertaken in 384 pages, and as the necessary result the treatment is rather general.

The book is divided into three sections, the first with 15 chapters on machine-shop construction, the second with 32 chapters on machine-shop management and the third containing the additional chapters to the second and revised edition. These are entitled: Increasing the Efficiency of Machines, Increasing the Efficiency of Men, The Relation of the Overhead Burden to the Flat Cost, and Manufacturing-Costs Systems.

The author, in his preface to this book, states that he has enjoyed over 20 years of successful management of shops and factories without having in a single instance encountered "labor troubles." This statement will be of interest to American shop executives who, as a rule, do not lead lives altogether free from trouble of this nature.

This book will be of interest to those desiring a general treatment of the subjects covered, but would have been more valuable had the revision been more thorough and the examples cited been brought up to date.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

The annual congress of purchasing agents, under the auspices of the national association, will be held at Pittsburgh, Oct. 9 to 11. The program includes business sessions for the mornings and visitation and inspection of industrial works during the afternoons. Special features are: Tour of Pittsburgh's principal business districts by automobile during the late afternoon of the first day, and cabaret dinner in the evening, to be held at one of the country clubs. The banquet will be held at the Convention Hotel the evening of the second day, Oct. 10, with speakers of national prominence. All purchasing agents and others interested are welcome and expected to attend and participate in the activities of the convention. Special arrangements are planned for the entertainment of the ladies.

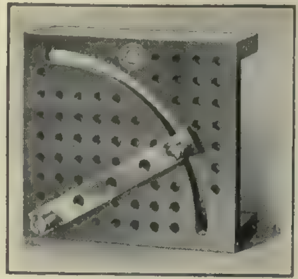
The National Machine Tool Builders Association will hold its sixteenth annual convention at the Hotel Astor, New York City, on Tuesday and Wednesday, Oct. 30 and 31.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Sine Bar

Slocum, Avram & Slocum Laboratories, Inc., 531-537 West 21st St., New York City

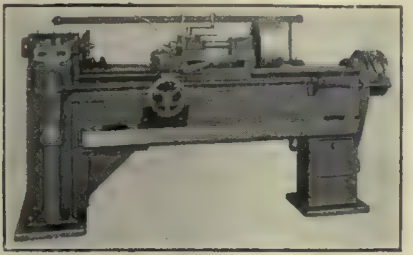


"American Machinist," Sept. 27, 1917

Has but one point of adjustment, one button being fixed and acting as a fulcrum so that the bar can be set at any predetermined angle by moving it to the proper location as determined by the second button and locking it with the screw that slides in the curved slot. After the bar is set, the work may be clamped directly to the angle plate and machined in this position. The bar, buttons and studs are of tool steel, hardened, ground and lapped to size

Worm-Hobbing Machine

Moline Tool Co., Moline, Ill.

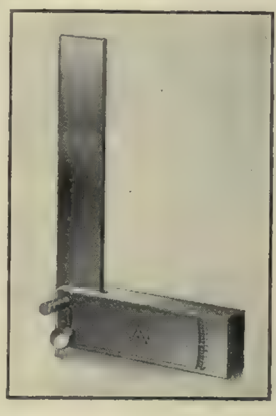


"American Machinist," Sept. 20, 1917

Maximum length of thread, 6 in.; maximum distance between centers, 56 in.; pitch cut, up to 8 right or left; maximum diameter of work, 13 in.; ratio of reverse, 2 to 1; speed of countershaft, 350 r.p.m.; diameter of hob pulley, 12 in.; diameter of countershaft drum, 4 in.; diameter of pulley, 13 in.; floor space, 96 x 36 in.; weight, 4300 pounds

Square, Indicating

Slocum, Avram & Slocum Laboratories, Inc., 531-537 West 21st St., New York City

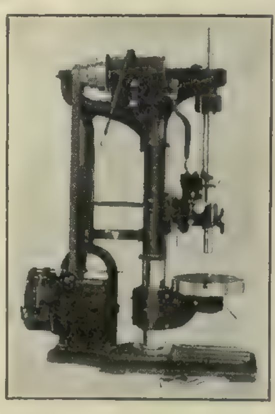


"American Machinist," Sept. 27, 1917

An indicating square with which it is possible to read angles from 80 to 100 deg. Where it is desired to use the device as an ordinary square, the engaging pin that holds the blade firmly in position may be slipped into place. A setscrew is also provided for locking the blade at any desired angle within the limits of its travel. The entire mechanism is concealed to protect it from dirt, all parts being made of steel, hardened and ground to size

Drilling Machine, 25-In.

Weigel Machine Tool Co., Peru, Ind.

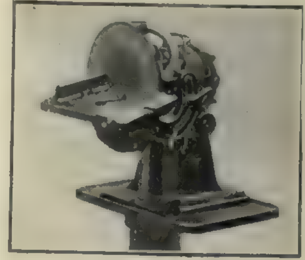


"American Machinist," Sept. 27, 1917

Extreme height, 9 ft. 9½ in.; distance from base to spindle, 47¼ in.; distance from table to spindle, 30½ in.; drills to center of 25⅝-in. circle; traverse of table of column, 13½ in.; traverse of head on column, 21 in.; traverse of spindle, 11 in.; diameter of table, 22 in.; diameter of column, 7½ in.; diameter of spindle sleeve, 2⅝ in.; diameter of spindle in sleeve, 1 1/16 in.; taper in spindle, Morse No. 4; bevel-gear ratio, 2½ to 1; feeds, eight, 0.004 to 0.0432 in. per revolution; speeds, eight, 15 to 400 r.p.m.

Grinding Machine, "Pioneer" Disk

Carter & Buchholz Co., Inc., Syracuse, N. Y.

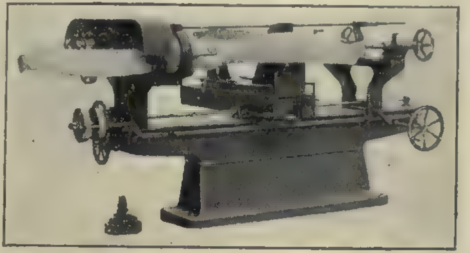


"American Machinist," Sept. 20, 1917

Swivel of table, 15 deg. up and 45 deg. down; horsepower of motor, 9-in. machine, ⅛; 15-in. machine, ½; size of table, 9-in. machine, 5 x 11½ in.; 15-in. machine, 7½ x 19 in.; rise and fall of table, 9-in. machine, 4½ in.; 15-in. machine, 7½ in.

Lathe, Airplane Propeller

Defiance Machine Works, Defiance, Ohio



"American Machinist," Sept. 27, 1917

May be used for propellers, struts or other similar work, which may be made either smaller or larger than the model by an adjustment of the tail center. Horsepower required, 6; floor space, 68 x 120 in.; domestic shipping weight, 4925 lb.; capacity, work up to 12 in. in diameter and 10 ft. 4 in. long

Truck, Electric Storage Battery

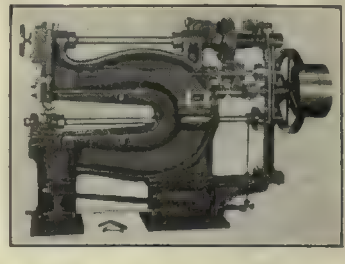
C. W. Hunt Co., West New Brighton, N. Y.

"American Machinist," Sept. 27, 1917

Wheels, cast steel; tires, front, 20 x 3½ in., rear, 10½ x 5 in.; height of platform, 11 in.; dimensions of platform, 60 x 37 in.; turning radius of outside wheels, 5 ft. 8 in.; drive, motors in wheels; wheelbase, 52⅜ in.; length over all, 106 in.; width over all, 37¾ in.; maximum speed, 7 miles per hour; capacity, 4000 lb.; grade negotiated with full load, 15 per cent.

Cutter for Sheet and Plate Metal (Gray's)

W. J. Savage Co., Inc., Knoxville, Tenn.



"American Machinist," Sept. 27, 1917

Adapted for cutting shapes usually done with a hammer and cold chisel, drilling, punching or the acetylene torch. Height, 70½ in.; length, 103 in.; width, 28½ in.; weight, 6000 lb.; strokes per minute, 80, 110 or 160; feed per stroke, ⅛ to ½ in.; length cut per minute, 10 to 80 in.; thickness of plate handled, up to ⅝ in.

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices which went into effect last week, will have little effect on the general market for some time. Present warehouse stocks—bought at the old mill price—will probably be sold out before the present warehouse prices to ordinary consumers are reduced, The Government prices are: Pig iron, $33 per gross ton; steel bars (Pittsburgh-Chicago), $2.90 per 100 lb.; shapes, $3; plates, $3.25.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Sept. 28, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	....	$47.00	$14.50
No. 2X Northern Foundry, Buffalo	....	53.00	19.75
No. 2 Northern Foundry, Chicago	....	55.00	19.00
*Bessemer, Pittsburgh	†$36.30	52.95	21.95
*Basic, Pittsburgh	33.00	50.95	18.95
No. 2X, Philadelphia	....	53.00	19.50
*No, 2, Valley	33.00	53.00	18.50
No. 2, Southern Cincinnati	....	49.90	17.40
Basic, Eastern Pennsylvania	45.00	50.00	19.75

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.
†Subject to revision.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Sept. 28, 1917	One Month Ago	One Year Ago	Sept. 28, 1917	One Year Ago	Sept. 28, 1917	One Year Ago
Structural shapes	$5.25	$5.25	$3.25	$5.00	$3.25	$5.00	$3.10
Soft steel bars	5.00	5.00	3.30	4.50	3.30	4.50	3.10
Soft steel bar shapes	5.00	5.00	3.25	4.50	3.25	4.50	3.10
Plates, ¼ to 1 in. thick	10.00	9.00	4.50	7.00	4.00	9.00@10	3.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Sept. 28, 1917	One Year Ago
Pitttsburgh, mill	$4.75	$2.60
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Sept 28, 1917	One Month Ago	One Year Ago	Sept 28, 1917	One Year Ago	Sept 28, 1917	One Year Ago
*No. 28 black	8.00	10.50	10.50	3.65	9.00	3.40	10.00	3.35
*No. 26 black	7.90	10.40	10.40	3.55	8.90	3.30	9.90	3.25
*No. 22 and 24 black	7.85	10.35	10.35	3.50	8.85	3.25	9.85	3.20
No. 18 and 20 black	7.80	10.30	10.30	4.45	9.20	3.20	9.80	3.15
No. 16 blue annealed	8.20	10.20	10.20	4.45	9.20	3.70	10.20	3.60
No. 14 blue annealed	8.10	10.10	10.10	4.35	9.10	3.60	10.10	3.50
No. 12 blue annealed	8.05	10.05	10.05	4.30	9.05	3.55	10.05	3.45
No. 10 blue annealed	8.00	10.00	10.00	4.25	9.00	3.50	10.00	3.40
*No. 28 galvanized	9.50	11.50	12.00	5.00	10.75	4.70	11.50	4.75
*No. 26 galvanized	9.20	11.20	11.70	4.70	19.45	4.40	11.20	4.45
No. 24 galvanized	9.05	11.05	11.55	4.55	10.30	4.25	11.05	4.30

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Sept. 28, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	45%
Cleveland	30%	40%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Sept. 28, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	15.30	6.30
Chicago	13.50	5.50

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*	
3/8, 11/32, 5/16, 1/4, 7/32, 3/16 No. 8, 5/32 and No. 10 1/8 No. 12 3/32, No. 14 and 1/16 No. 18 No. 20	21.00@30.00

*Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long	16.00
1/4 by 19 in. long	14.00
3/8 by 19 in long	12.00
1/2 by 21 in. long	12.00

*Special Welding Wire	
1/8	33.00
5/32	30.00
3/32	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Sept. 28, 1917	Cleveland Sept. 28, 1917	Chicago Sept. 28, 1917
Tire	5.00	5.00	4.50
Toe calk	5.70	5.50	4.75
Openhearth spring steel	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜	42%	15½%	¾ to 1½	33%	17%
½	46%	31½%			
LAP WELD					
2	42%	29½%	2	26%	12%
2½ to 6	45%	32½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	38%	20½%	¾ to 1½	33%	18%
½	43%	30½%			
¾ to 1½	47%	34½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4	43%	31½%	2¼ to 4	29%	17%
4½ to 6	42%	30½%	4½ to 6	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	38%	25%	38.8%	24.8%
3½ to 6 in. steel lap welded	18%	List+20	23%	39%	42.8%	27.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Sept. 28, 1917	One Month Ago	One Year Ago
Copper, lectrolytic	23.50*	26.00	29.00
Tin, in 5-ton lots	61.75	61.75	39.00
Lead	8.00	10.50	6.75
Spelter	8.50	8.00	8.50

*Nominal; no market until Government intentions are known.

ST. LOUIS

	Sept. 28, 1917	One Month Ago	One Year Ago
Lead	8.00	10.75	5.87½
Spelter	8.25	8.25	9.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Sept 28, 1917	One Month Ago	One Year Ago	Sept 28, 1917	One Year Ago	Sept 28, 1917	One Year Ago
Copper sheets, base	35.00	39.00	37.50	33.00	38.50	36.00	38.00
Copper wire (carload lots)	38.50	38.50	32.00	33.00	33.00	38.50	33.50
Brass pipe, base	43.00–45.00	43.00	46.50	41.00	45.00	44.00	45.00
Brass sheets	40.00	40.00	44.50	33.00	42.00	38.00	39.00
Solder ½ and ½ (case lots)	39.25	39.25	24.62½	39.50	24.75	39.25	24.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Sept. 28, 1917	One Year Ago
Mill	$29.00	$42.00
New York	35.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

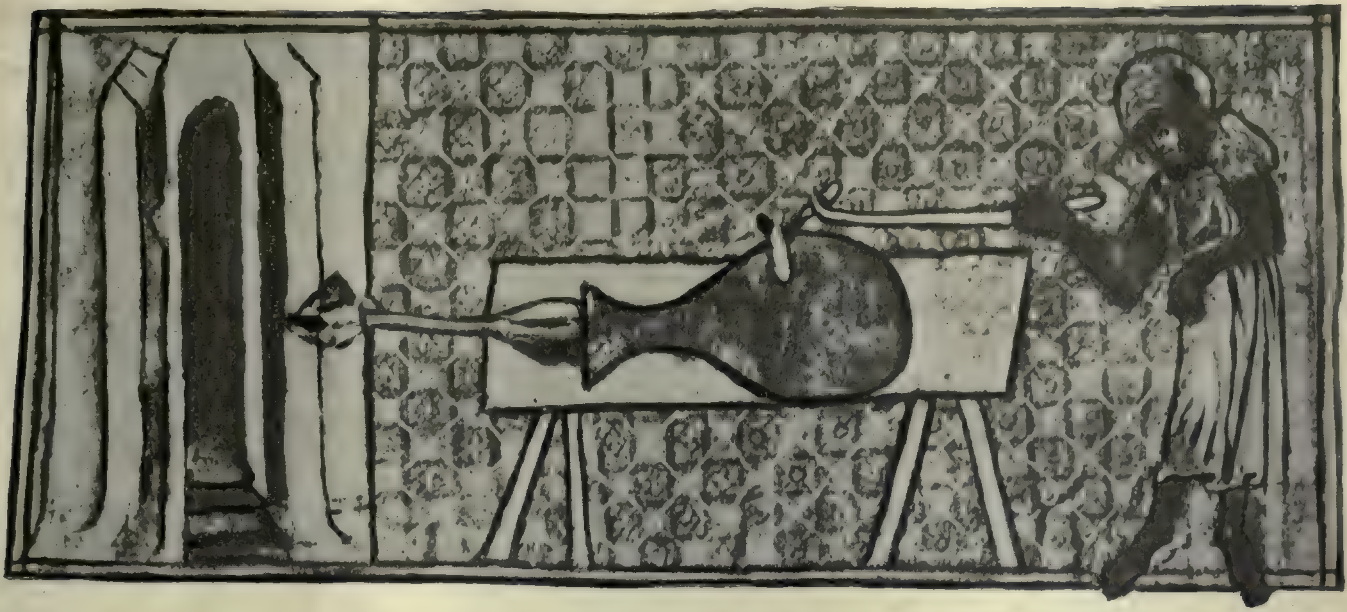
ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Sept. 28, 1917	One Year Ago	Sept. 28, 1917	One Year Ago
New York	21.00	17.00	21.50	18.00
Cleveland	23.00	16.75	23.25	17.50
Chicago	22.50	17.00	23.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Sept. 28, 1917	One Year Ago
New York	15.00	13.50
Cleveland	17.50	13.00
Chicago	16.00	13.50

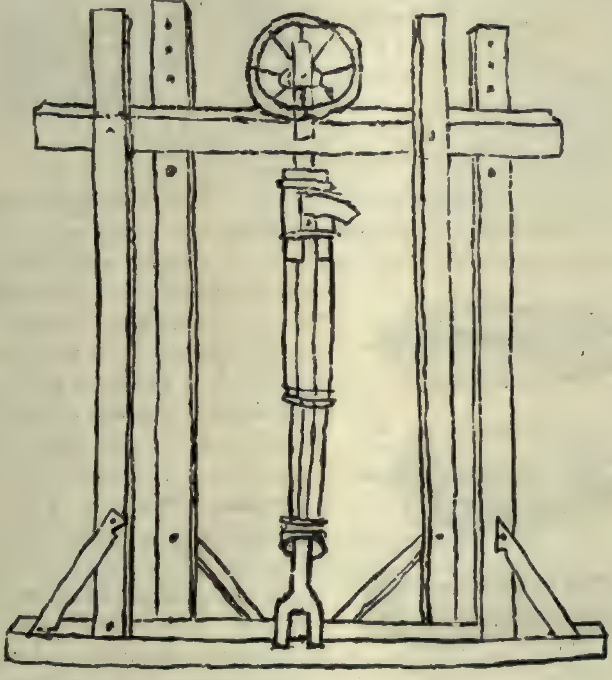


Cannon Making in Past Centuries

By H. H. Manchester

SYNOPSIS—*Modern cannon and field pieces, cannon and howitzers, are masterpieces of mechanical workmanship, but it is interesting to turn from these present-day products of arsenals and munition factories to the early handiwork of the thirteenth, fourteenth and fifteenth centuries.*

THERE are a number of illustrations of early cannon which aid us somewhat in comprehending their construction, but the historic pictures directly showing munition manufacture are remarkably rare. A reliable reference to the first cannon seems to be in the journal of the City of Ghent, which was begun in 1300. Under the date of 1313 there is an entry, a translation of which reads: "Item, in this year was the first discovery of the use of cannon by a monk in Germany." The monk mentioned was in all probability none other than Berthold Schwartz. Several cannon seem to have been imported into England in 1314 from Flanders, which was long a center of munition manufacture. The earliest picture



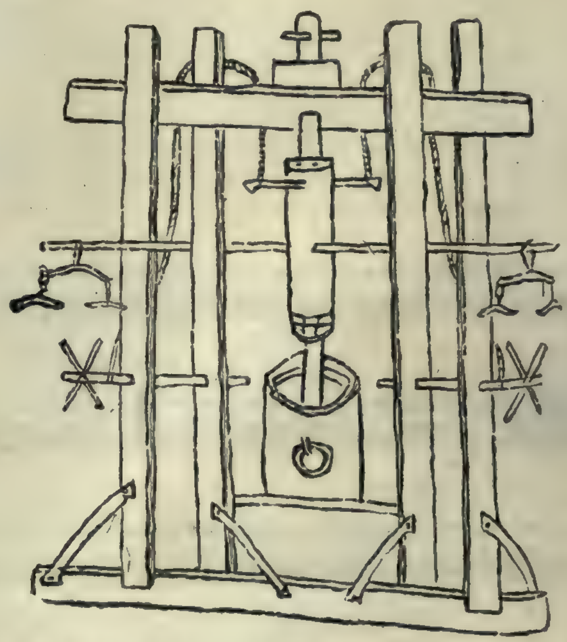


FIG. 1. SMALL SERPENTINE BEING BORED BY HAND ON A CRUDE BORING MACHINE, A. D. 1450

FIG. 2. BORING MACHINE FOR CANNON; POWER WAS PROVIDED BY HORSES OR OXEN; A. D. 1450

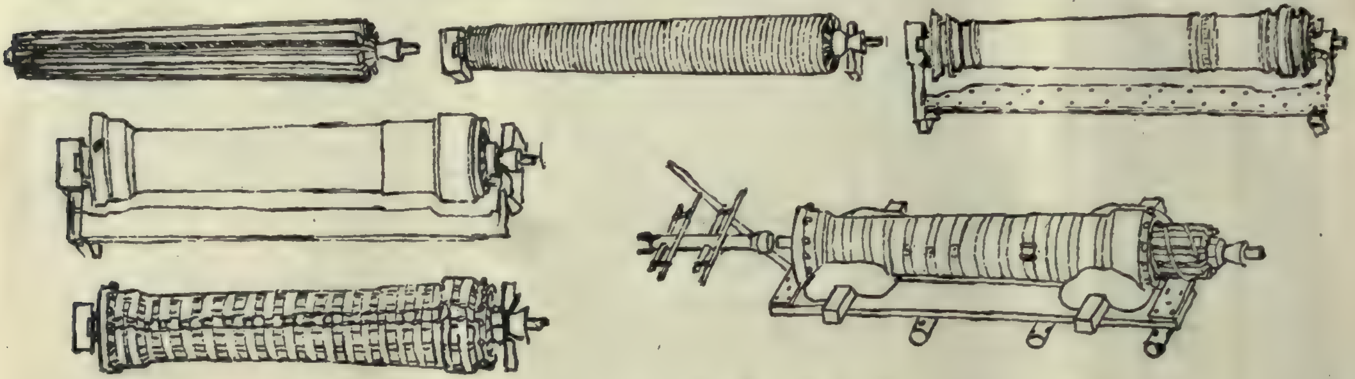


FIG. 3. PROCESS OF MOLDING CAST BRONZE CANNON IN A. D. 1500

of a cannon is on the lower border of the last page of an illuminated manuscript by Walter de Millemete, dated 1326 and entitled "De Officiis Regnum." It is now in the Christ's Church Library of Oxford. The cannon shown is like a petard, having the shape of a large vase or flagon, and is shooting a long dart against a door as shown in the title piece. The gun is simply lying unsecured on a rough wooden bench. It is being fired through a touch hole by a soldier in armor. From the shape, one would judge that this cannon was made of bronze and cast hollow in somewhat the same manner as a bell or rather a vase of the period. If so, it was cast around a clay core that was afterward broken out. Even at this date two types of large guns seem to have been known, as we read of both *"serpentines et canons"* at Metz in 1324. The distinction seems to be that some large guns were bombards or mortars comparatively short in length, but of large caliber, while the serpentines were long, but of small caliber. The serpentine was constructed of bars of wrought iron which were fitted together like the staves of a cask and then welded. They were held in position by rings of wrought iron which were driven or shrunk on like hoops. The bombards might be constructed in the same way, but were also cast; and if very short, they were sometimes made from stone. The range of the earliest cannon was hardly more than 100 yd., and the pictures suggest that the flight of the balls could easily be followed with the eye. The first mention of iron shot seems to be their use by the Florentines in 1326. The famous bombard of Ghent, manufactured about 1352, consisted as described of wrought-iron bars with wrought-iron rings shrunk on. Its length was 197 in., and the diameter of the bore 29 in. It weighed 13 tons and fired a granite ball weighing 700 lb. It is probable that the first serpentines were left unbored; but it was soon discovered that, if bored to fit the shot, less energy was wasted. Boring itself is mentioned as early as 1373. The earliest cannon were simply laid on the ground with the breech against wooden piles. Later, timber cradles were employed, and the Venetians, at least, used wheeled carriages for transporting small serpentines from place to place as early as 1376.

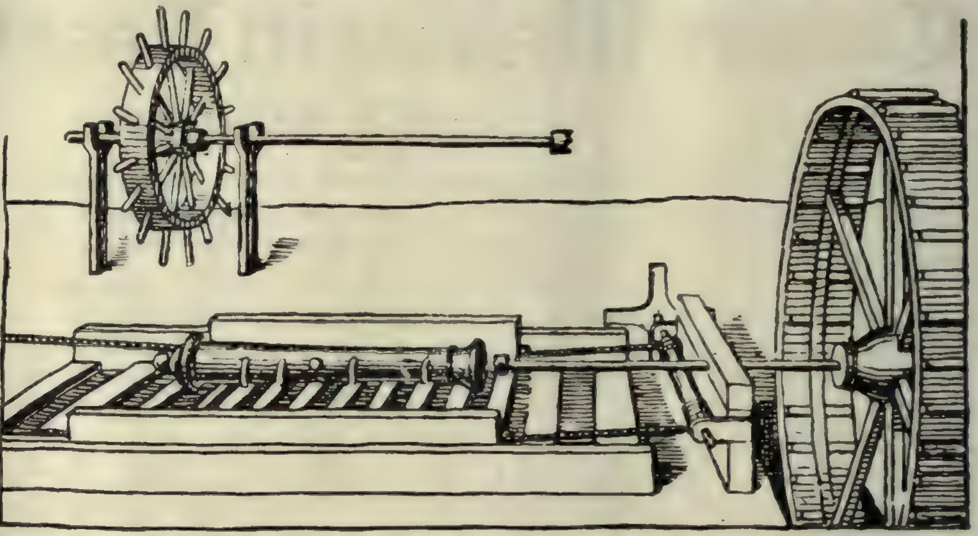


FIG. 6. BORING MILL OF 1540, WITH CANNON AND BORING TOOL IN POSITION

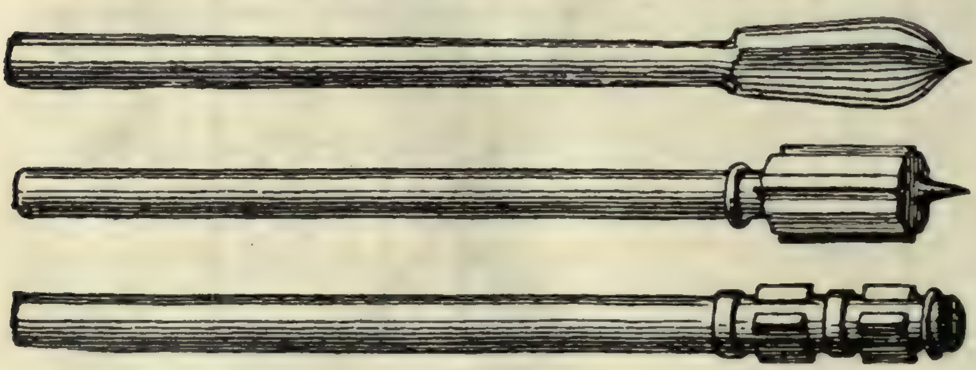


FIG. 7. BORING TOOLS OF 1540 WERE NOT ENTIRELY UNLIKE THOSE USED TODAY

In the fifteenth century we begin to find a few pictures of the manufacture of large guns. Two cuts showing the boring of cannon in 1450, from a manuscript written during the Hussite wars, have been published by the German National Museum. In both cases the cannon is set up vertically and is bored from the top. In one of them, which represents a small serpentine or possibly the barrel of a large hand gun, the boring is done by hand. This gun apparently consists of rods bound together by hoops.

In the other cut the cannon is of larger dimensions. The figure is very badly drawn, but it is evident that four horses were employed to turn the drill. In this case the cannon seems to be of one piece, and was probably cast.

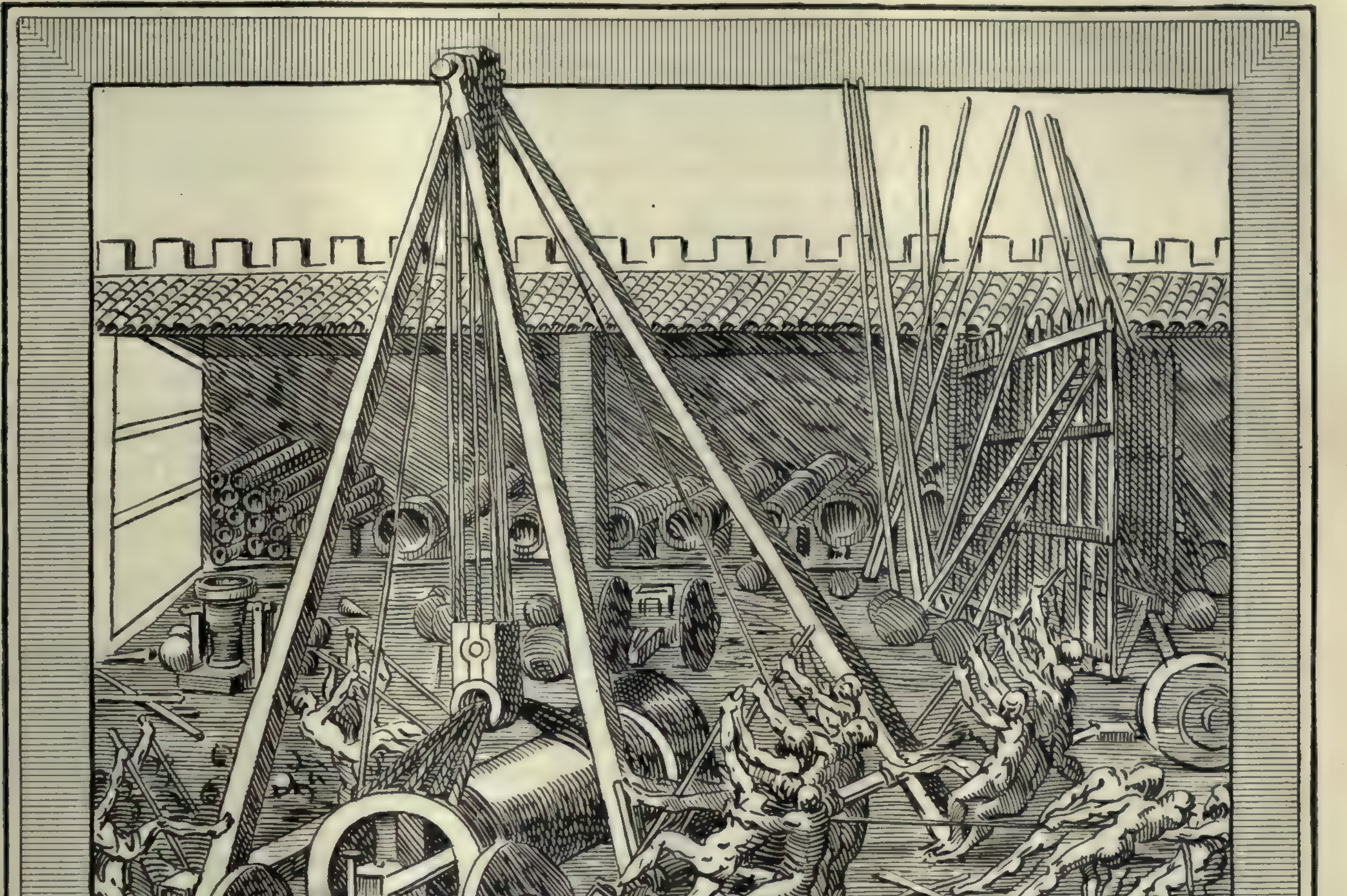


FIG. 4. YARD OF A CANNON FOUNDRY IN A. D. 1500; DRAWN BY LEONARDO DA VINCI

In each case the gun was hollow before the boring was commenced, and the drill took out merely a thin shaving of metal. The drill seems to have sunk into the metal of its own weight, although the fact that the neck pieces for the horses or oxen are pictured so high may imply that a certain downward pressure was exerted by the animals.

Several designs by Leonardo da Vinci illustrate the process of casting cannon about 1500. One of them is a series of cuts which is preserved in the "Codice Atlantico" and shows the process of molding at that time. In the cut the first figure shows a wooden spindle, which is later wound round with a straw rope, as seen in the second figure. The third figure illustrates how this was covered with clay and then turned with molds forced against it to produce a more finished shape. After the decorations were put on, this clay was well sprinkled with powdered charcoal so that nothing could stick to it. This mold was then thickly covered with clay, as is seen in the fourth cut, and this outer clay mold was securely bound with wide iron bands. The whole was then baked. When the straw rope had become soft, the spindle was knocked out and the rope drawn forth. The inner clay form was then broken out, leaving intact the mold for the outside of the cannon. This mold was placed vertically in the ground and the earth well packed around it, with a passageway left at the bottom for the molten metal.

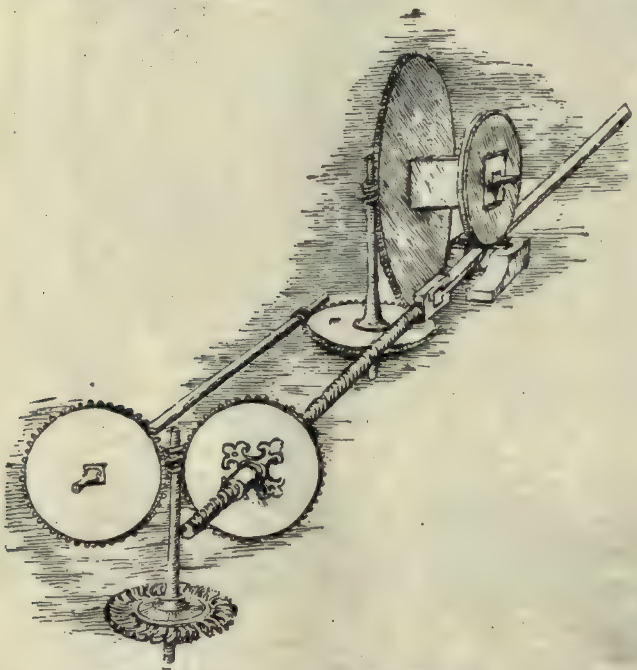


FIG. 5. TURBINE-DRIVEN ROLLING MACHINE DESIGNED BY DA VINCI FOR MAKING SERPENTINE STAVES

It had already been discovered that casting from the bottom kept the metal more nearly free from imperfections. In those days the cannon was cast hollow, for which purpose a core was let down into the center of the mold. The metal used was of course bronze, not steel.

Another drawing by Leonardo da Vinci, which is preserved in the Windsor Library, England, illustrates the yard of a cannon foundry. Naked men who by means of a crane are raising a cannon upon a wagon form the main part of the picture. In the foreground, however, is a cannon cradle on rollers. Various tools lie scattered about, and the background exhibits guns of both large and small bore.

Leonardo also designed machines to be run by turbines, for rolling and drawing the iron bars to be used in the manufacture of serpentines; but whether the machines were ever built is extremely doubtful.

The method of boring cannon employed in 1540 is illustrated by Biringucci. The cannon was fastened horizontally upon a cradle, and the drill was turned by a waterwheel. Hand power, however, as suggested by a figure at the top of the cut, was still sometimes employed. The cannon was drawn against the drill by ropes fastened to a roller, which was very slowly turned by the waterwheel. The guns were still cast hollow before boring, so that all that was required from the drill was to enlarge, straighten and smooth out the bore. But no bores made in this way were ever perfect.

Biringucci used three kinds of drills. The one at the top of the cut was a solid steel rod and drill, such as was used by him in boring the cannon "Leofonte." Such a steel rod and drill he calls "of the French type." The middle drill was a bronze rod with hardened-steel cutters. The lowest figure represents a wooden rod, in which were set eight well-hardened steel cutters, which were kept in place by three iron rings.

Efficiency in Special-Machinery Design

BY F. E. JOHNSON

Where the quantity of parts manufactured will warrant the expense, the special, single-purpose machine is a most important factor in the reduction of manufacturing costs.

Much of the trouble and difference of opinion regarding the correctness of design of machines of this class will be entirely eliminated if suggestions and ideas are solicited from those who are interested in the building of the machines. In this way, an understanding as to what will constitute the best machine for a certain purpose is arrived at before any work is started in the drawing room.

This coöperation will prove of undoubted advantage if the contemplated machine is new in type and there is no previous experience to serve as a guide. Quite often such a machine is started with a full-size or half-size layout that is a puzzle to the shop man who, because of his knowledge of the work that the machine is intended to do, is asked to give an opinion as to its practicality.

The maze of lines on a drawing for a machine of this kind may be clear enough to the designer and to those who have been in touch with it continually, but it will prove perplexing to the average man who is called on to give his opinion in the comparatively short space of time usually allowed for this purpose.

A better way is to start with a preliminary design, either one-eighth or one-quarter size, whichever is considered necessary, this drawing to show only enough lines to convey the general idea of the machine. This design may be submitted for criticism to those directly interested.

A discussion of the matter may change the entire scheme. This preliminary drawing is cheap to begin with and, being stripped of much detail, is readily understood.

Series for Executives

Patents and the Manufacturer

BY GLENN B. HARRIS

SYNOPSIS—*Many executives and manufacturers are considerably in the dark as to how a patent application should be handled to the best advantage and thereby secure the maximum amount of protection. The advice here given is based on long patent-law experience.*

THE connection between patents and manufacturers is a close and an intimate one. There is hardly a manufacturing industry in the country that is not in some manner concerned with a patent, either being based upon and operating under one, or having ownership or license covering some particular device, structure or specialty.

A patent is granted for a period of 17 years, and there are about 75,000 applications filed annually, of which number in the neighborhood of 40,000 pass to final issue and assume the form of patents. The remaining applications die a natural death, either for lack of prosecution, formal abandonment or on final rejection by the Examining Corps of the Patent Office for lack of patentability.

It is a difficult proposition to estimate the number of actions at law which are brought for alleged infringement of patents; but the number is large, and the percentage of patents sustained as valid is relatively small. Taking into consideration suits that are dismissed for lack of infringement, the number of patents that pass final muster in the courts is about 20 per cent. of the number litigated.

PATENT CLAIMS

THE claims of a patent are its fundamental and governing feature, and too much care cannot be exercised in their drafting. The average inventor is under the impression that the greater the number of elements contained in a claim the greater the protection; that is to say, if every part going to make up a complete mechanism, device or structure is mentioned, then the patent is strong and affords complete protection, while the reverse is the fact. The law is that if one element of a claim is omitted the patent is not infringed. It is therefore obvious that a claim containing anywhere from six to a dozen elements is more easily evaded than one containing three or four elements. Of these latter or short claims, it is possible to draw a series covering different parts of the mechanism, device or structure, while the omnibus claim or claims of many elements or parts is supposed to cover the latter in its entirety; and so it does, but if granted and it assumes the form of a patent, it is not worth the expenditure of money required in its procurement, as it is comparatively easy for a skilled mechanic to omit one or more elements of a claim or so to alter or change these elements that the same result is obtained and thus infringement avoided.

The claims to which particular reference is made are those applied to a mechanical construction, structure or device of any character. There are other forms of claims to which the rules heretofore given apply with equal force.

PROCESS AND METHOD PATENTS

CLAIMS for a process, as in the production of chemicals or, say, bessemer steel as examples, may be drawn to cover each step of the process contributing toward the final accomplishment or result. Every claim should be so drawn that it will cover some one part of the process which is essential to its completion. In this manner the process as a whole is completely protected; and if the process be new, the patent is valid and strong.

A method patent is designed to cover the different operations leading to the production of a finished mechanical article or device, as, for instance, in the manufacture of railroad rails numerous operations are necessary before the finished product is at hand. These different operations may be protected, but each operation or step should be complete in itself and tending directly toward the end in view.

The product of a process may be patented if new. In many instances the product *per se* is old, while the means employed to produce it are new and therefore patentable. This also applies with relation to a method patent. Take, for instance, the manufacture of steel rails; the rail turned out as the result of the method may be exactly the same as those produced by other methods, and in this case no patentability would lie; but should the rail possess some feature of advantage over others, then it, like the method, would be patentable.

If a manufacturer, or for that matter anyone, intends becoming interested in an invention, it is absolutely necessary for the protection and safeguarding of his investment that a thoroughly competent patent attorney be engaged in order that the specification and claims be drawn, not only in proper legal form, but in a manner to secure the protection to which the invention is entitled.

WHAT THE EXAMINERS GRANT

THE examiners in the Patent Office seldom grant everything asked for; and if the application goes through the office unscathed, it is safe to assume that all that might have been obtained was not asked for. The examination of an application for patent extends not only through the patents of this country, to which the invention pertains, but also among the patents of foreign countries; and it not infrequently happens that the application emerges from the fray tattered and torn and bearing but a slight resemblance to its original self. However, what has been allowed may be of great value as protection, and the means of preventing the unscrupulous from invading the rights of the patentee.

Before purchasing a patent, a shop-right license to manufacture under a patent or assuming the payment of royalties, it is essential that what is known as a validity search be instituted. This search is for the purpose of determining whether or not the claims of the patent would probably hold if suit for infringement were brought under it. The search is also for the purpose of determining the scope of the claims, and whether or not too much has been granted.

SEARCHING FOR THE VALIDITY

THE validity search should comprehend a review, not only of previously granted patents to which the invention pertains, but also those of any class analogous thereto, and should also include foreign patents and such publications as might possibly disclose the invention in its entirety or in part. This is just as necessary and essential as having the title to a piece of property searched before purchasing, and the attorney employed should possess a high degree of ability.

The writer has known of numerous companies predicated upon absolutely worthless patents. Owing to the fact that the purchaser did not possess even rudimentary knowledge of what a patent is or should be, large sums of money have been paid for patents the subject matter of which was absolutely open and free to the public; but the impress of the Patent Office seal was there, and this apparently was the magnet which separated the purchaser from his money.

In one instance with which the writer is thoroughly familiar, a company was formed with $1,000,000 capital, of which fully $500,000 was paid in cash. The basis of this organization was two patents, and no examination was made to ascertain their validity or comprehensiveness. As a matter of fact, while the claims might have been valid and so held by the courts in litigation, they were so narrowly drawn and loosely put together that their evasion was a comparatively easy matter.

Upon a supposed infringer appearing in the market, eminent patent counsel was consulted, with the result that the company was informed that its property, so far as patent protection was concerned, was worthless; and yet this same property formed the base for the large investment mentioned.

A suit was determined upon, however, as a means of intimidating intending purchasers of the alleged infringer's product and of hampering the marketing thereof. In instances where required, an indemnifying bond was given and a sale consummated.

After the taking of voluminous testimony and the expenditure of about $50,000 in the prosecution of the suit by the complainant, the case came to trial and was promptly thrown out of court, on the ground that the claims were so narrow and limited as not to be infringed. Validity in this case was not considered. An appeal was taken, and the same result followed.

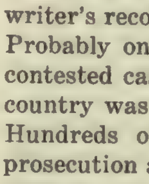
BUYING A WORTHLESS PATENT

IN ANOTHER instance a company owning an absolutely worthless patent, but which had been fairly successful in the introduction of the article, was approached and the sale of the patent suggested. A price of $15,000 was agreed upon, and the money was immediately paid. There was no investigation as to validity or scope, or even whether title to the property was with the vendors. The purchasers had bought something worth its weight in waste paper. Had competent patent counsel been consulted and a search instituted, this considerable sum of money would have been saved.

There are a number of similar instances within the writer's recollection of the purchase of worthless patents. Probably one of the most hotly, if not the most hotly, contested cases of patent litigation in this or any other country was that over the Bell patent on the telephone. Hundreds of thousands of dollars were spent in its prosecution and defense, and even the aid of the Government was invoked to procure its annulment; but all efforts were without avail. The patent was sustained, and Bell was victorious at all points. The reasons are: Bell's invention was new and meritorious, and he had the acumen to engage thoroughly competent patent counsel who drafted and succeeded in having granted a patent that was impregnable. Had the drawing of the specification and claims for the Bell application been intrusted to someone not well versed and skilled in the art, the result would probably have been the securing of something having no protective value.

If an invention possesses merit and is worthy of protection, give it all that protection which money will purchase for it in the way of competent service.

VALUE OF THE AVERAGE PATENT



A GREAT many investors in patent property are under the impression that its possession spells fortune, but this is not a fact. There are today in force probably 600,000 patents, and of this very large number very few have brought the inventor any return whatever. In most instances the patent is without any commercial value; and as a matter of fact, thousands of patents have been granted on churns, washing machines, rail fences and car couplers. In most cases the alleged inventions are freaks, but the inventor can never be persuaded of this fact and sees only fortune before him. Patents having considerable merit are permitted to lie dormant, due to lack of push on the part of the inventor or his inability to secure capital. Even with inventions of the most meritorious character this statement holds good, and it is safe to assume that not more than 10 per cent. of patents granted prove remunerative.

The percentage of failures to successes in new business enterprises is very great, and just as much hard work must be displayed in pushing a patented article as in making a success of any business venture. The patent, as a matter of fact, is of absolutely no value as a money producer. What it is supposed to cover may be ingenious, and it may be what the public wants, but it is a case of push, push, and then some more good strong pushes to land at the desired goal.

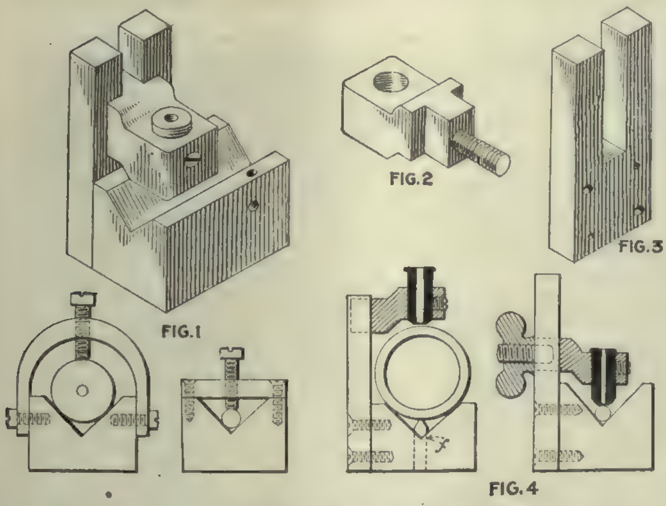
If your business proves successful and you are fortunate enough to possess a patent having good strong claims, your fortune is without doubt; but woe to the owner of weak patent property, which is supposed to protect a really valuable invention. Imitators will spring up like mushrooms, and the proud possessor of the red seal and blue ribbon will find himself left in the lurch.

Therefore, again the advice, secure the best patent counsel obtainable.

Drill-Centering Device for V-Blocks

By Harry P. Simmons

To make a quick and accurate job of drilling holes in small round stock such as may be required in the general work of the toolroom is not always an easy task. No matter how carefully the job may be laid off or how warily the drill may be coaxed to straddle the curved surface, the resulting hole is never a safe bet. The device illustrated by the accompanying sketches stops the uncertainty and saves much time besides. In reality, it is an attachment for a V-block about the size of the ordinary toolmakers' block sold by the Starrett and the Brown & Sharpe companies. The size described here was designed for the kit of the workman at the bench, but the field of usefulness could easily be enlarged. Made up on a little larger scale, it would be handy as a general toolroom fixture.



FIGS. 1 TO 4. V-BLOCK WITH BUSHING HOLDER AND CENTERING DEVICE

Fig. 1 is an isometric projection of the tool ready for use except for the clamp. Fig. 2 shows the bushing holder, which slides up and down between the parallel ways shown in Fig. 3. This piece is fastened to the V-block by screws and dowel pins. The hole in the bushing holder is central with the bottom of the V. The three pieces shown are made of machine steel, casehardened, and the hole for the bushing is lapped. The capacity is for stock from 1/16 to 1¼ in., and for holes from 1/16 to ¼ in. The outside diameter of the bushings is ⅜ in. They are a slip fit in the holder and are prevented from turning by a small setscrew tightened against a small flat, ground on the side. The holder is a close sliding fit between the ways and is clamped at any height by the thumb-screw at the back.

After the piece to be drilled is clamped down in the *V*, as is illustrated in Fig. 1, a bushing of the size desired is placed in the holder, which is then adjusted on the ways so as to bring the lower end of the bushing close to the work, thus dispensing with laying off or using care in centering. In slotting small cutter bars, for example, it is required that the bulk of stock be removed by drilling to leave the slots in shape for finishing with an end mill or the more primitive way—filing.

First, mark the center of the radius at one end of the slot and clamp the piece in position. Then with the V-block in place on the drill table or other flat plate, fasten a lathe dog or similar device on the free end of the work being drilled, so that the tail rests against the plate. This will keep the row of holes in line, and they can be so far overlapped that very little stock will be left, thus making a quick job in the finishing.

In connection with the slot drilling, it will be well to mention the sliding center point, which is placed at the bottom of the V, in the center line of the drill bushing. This center, having an angle somewhat sharper than a drill, is a close sliding fit so that it may be easily removed after the work is located and clamped in position. If a hole must be accurate in distance or angle with other parts, it can be marked and punched and this center point be brought up in the punch mark to locate it. The main use for the centering point, however, is to locate holes diametrically opposite in tubing or other work, as shown in the cross-section sketch, Fig. 4. In drilling small holes through work of comparatively large diameter where the stock is tough, it is better to drill halfway through, then turn the piece halfway over, locate it and finish from the opposite side.

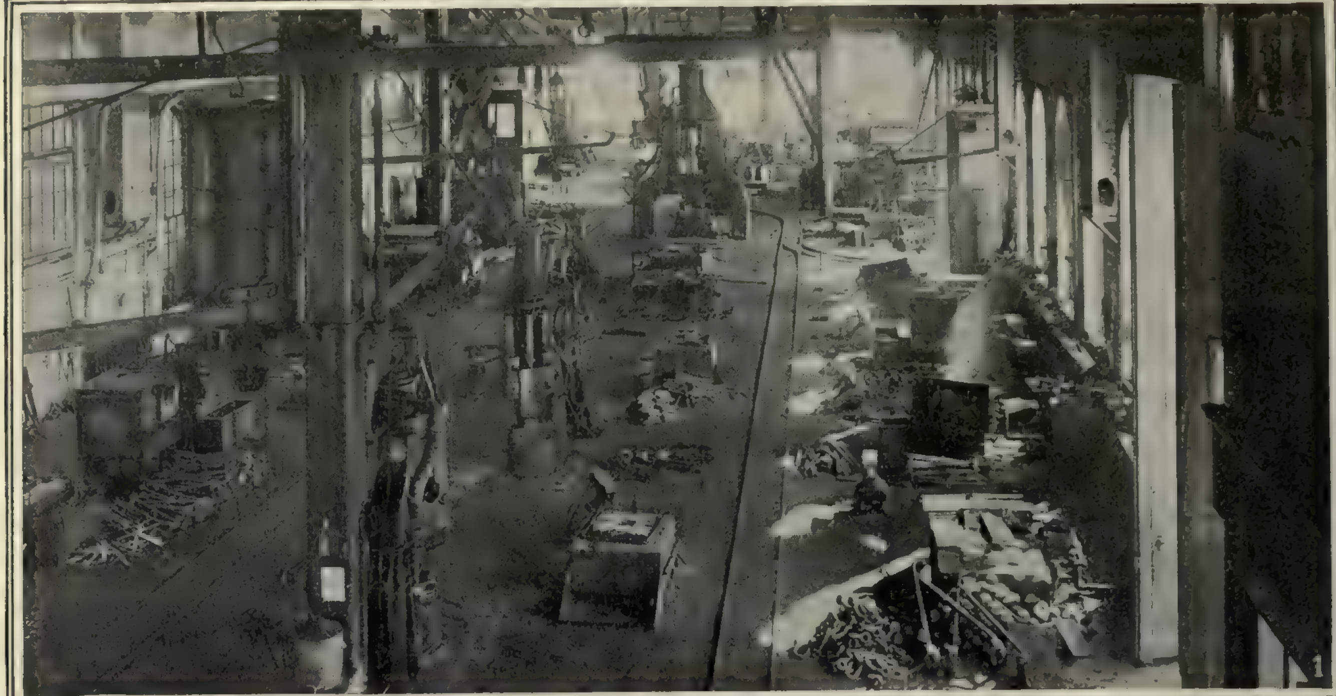
Bending Tubing

By George W. Dover

On page 121, F. B. Terry asks how to do a pipe-bending job. I should do it in the following manner:

Take two wheels and turn a semicircular groove equal to one-half the diameter of the tube, the wheel to be stationary as far as the fixed center is concerned, and revolve on a stud. The wheel is to be fitted to the contour of the inside bend of the tube. A wheel of the same diameter and construction should be yoked to the first wheel mentioned, their flanges contacting. When this is done, it will be observed that a hole is described having the same diameter as the outside of the tube.

Then with a lever connected to the end of the yoke, the outer wheel will swing on a radius prescribed by the greater circumference of the bend. With the lever, swing it one-half a revolution and you will wipe the tube into the central wheel and accomplish your end.



Mare Island Navy Yard

SPECIAL CORRESPONDENCE

THE shipsmith shop at Mare Island navy yard is illustrated by Fig. 1, which is a view looking south and showing the interior of the west wing of the department. Along the center of the wing will be noticed the heavy steam hammers for big forging operations, and at the sides the forges and furnaces. The arrangement of jib cranes for handling material and work is also distinctly brought out in the illustration.

In Fig. 2 is shown an interior view of the shipfitters' shop. Among other features of interest are some of the punches and shears in the equipment for working

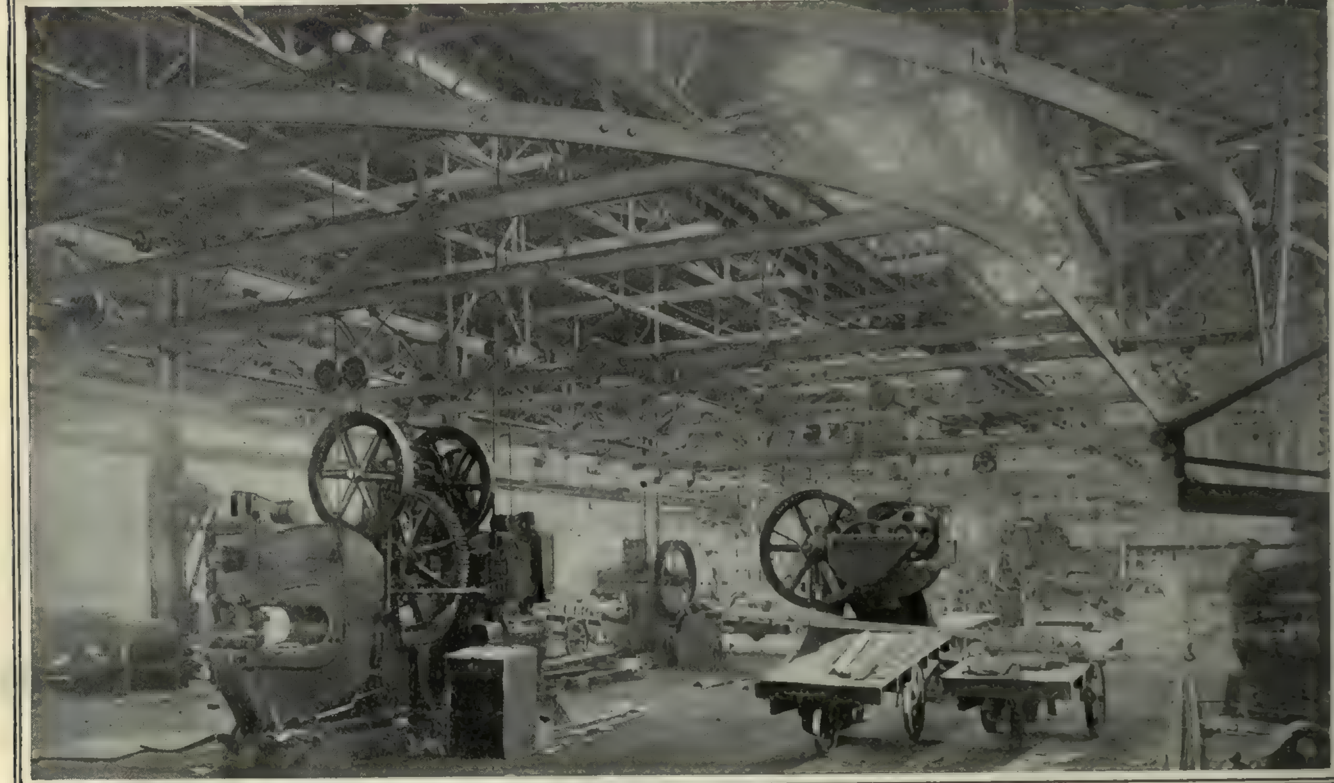


FIG. 2. EQUIPMENT IN THE SHIPFITTERS' SHOP, SHOWING A NUMBER OF PUNCHES AND SHEARS

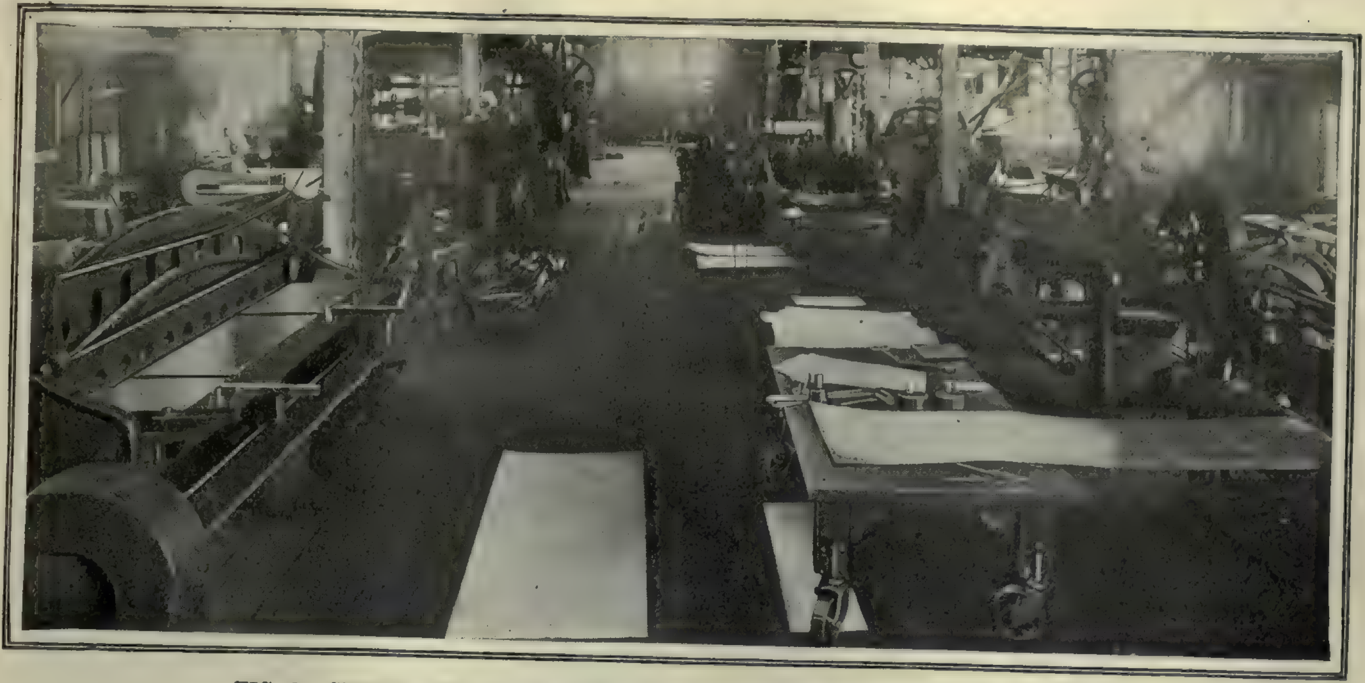


FIG. 3. SHEET-METAL SHOP, CONTAINING A LARGE VARIETY OF MACHINES

plates, angles, etc. Overhead will be seen a very complete installation of trolley rails, longitudinal, crosswise and curving, for facilitating the shifting of jobs of all kinds in and out of the tools and about the shop. The sheet-metal shop, where rolls, punches, shears, benders, formers, etc., are used for working up a variety of articles from sheet stock, is shown in Fig. 3. An interesting foundry illustration is presented in Fig. 4, which shows a loam mold and core for the casing of a big turbine engine. The method of supporting the core and of slinging the mold preparatory to setting in position is brought out clearly. This view is taken in foundry No. 1, which is devoted exclusively to gray-iron work. The No. 2 foundry

FIG. 12. EMERGENCY HOSPITAL

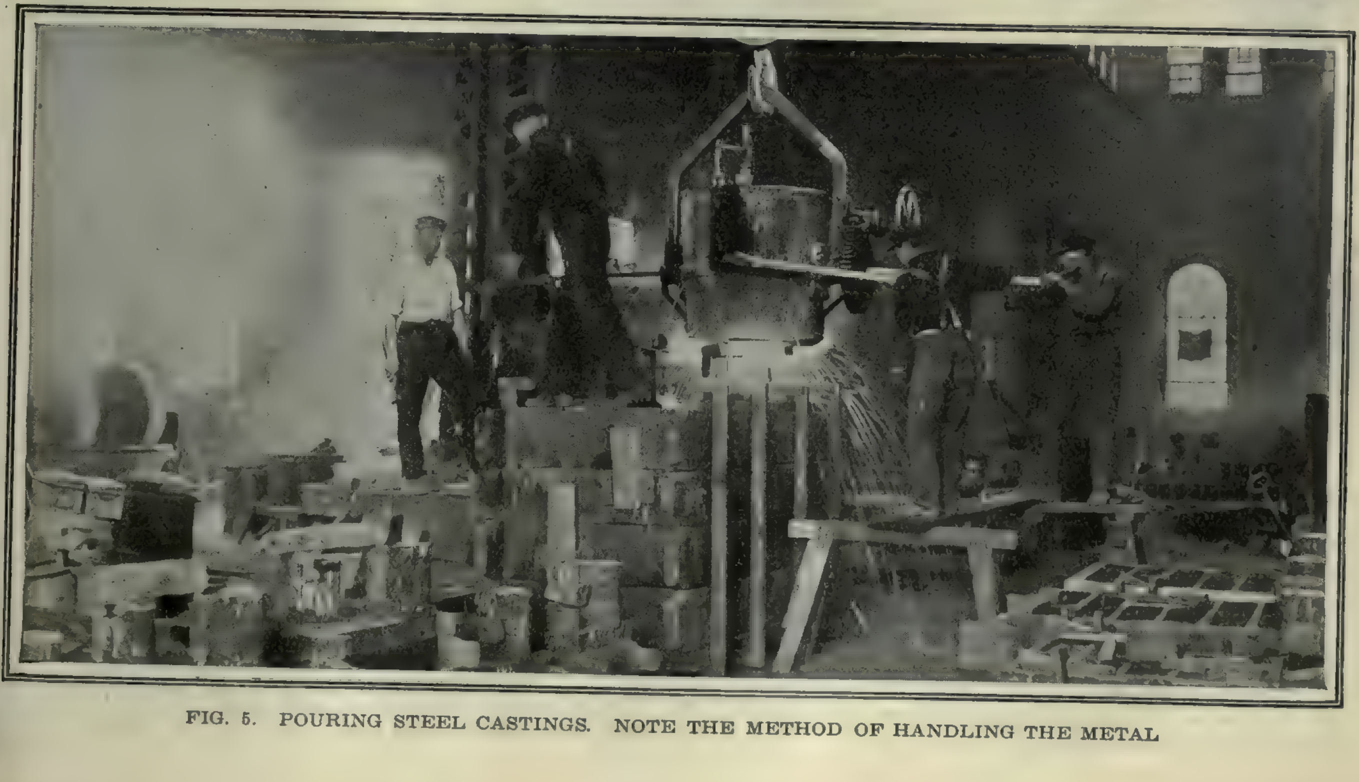


FIG. 5. POURING STEEL CASTINGS. NOTE THE METHOD OF HANDLING THE METAL

is for steel and brass castings, and a view showing the actual pouring of a steel casting in the latter foundry is reproduced in Fig. 5, where the process of handling the metal over the flasks is the principal feature of the engraving.

In building ships the lines of the vessel under construction must first be laid down, and templets must be made before actual construction begins. A view in the mold loft, showing full-size templets being laid out, is given in Fig. 6. It represents only a portion of the long loft floor where many men are kept at work on this preliminary operation that prepares the templets to which the ship plates and other members will be shaped in the metalworking shops.

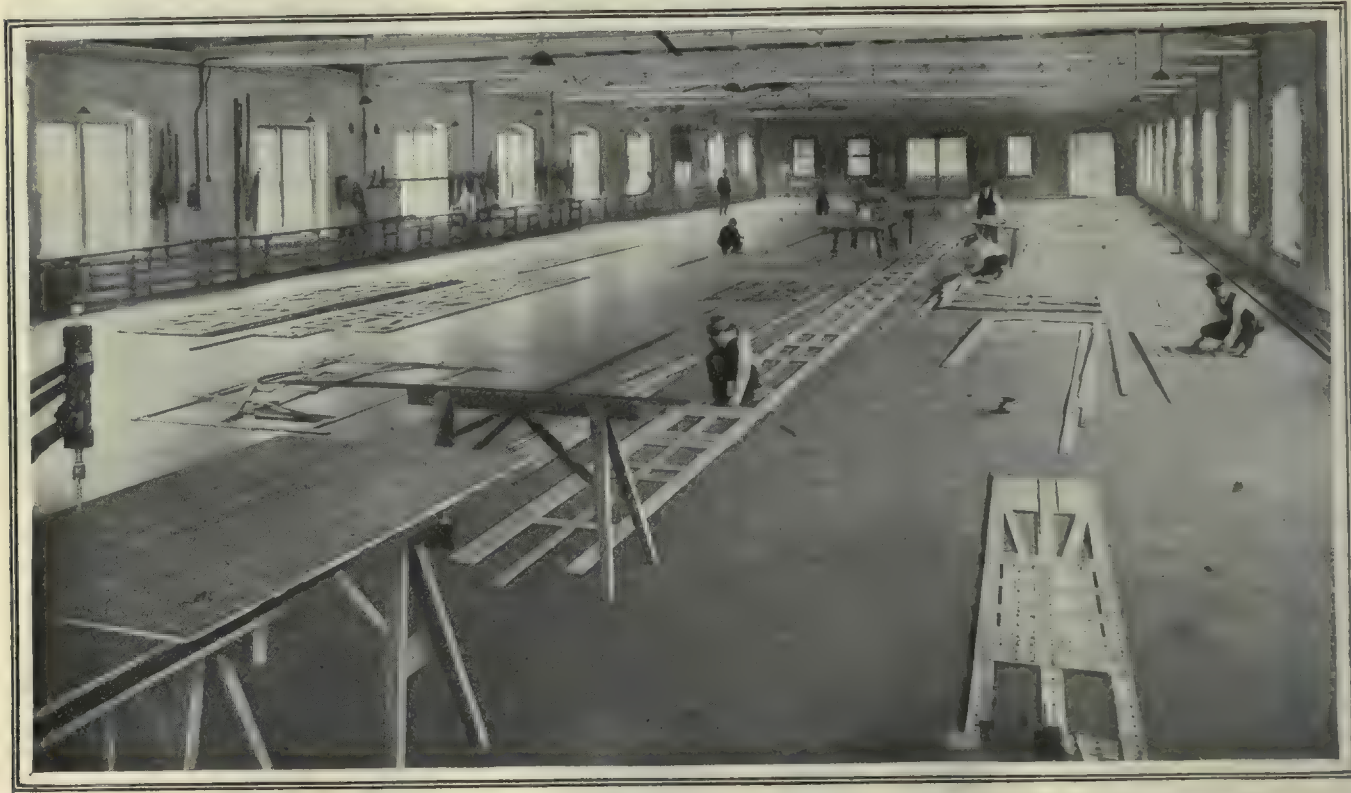


FIG. 6. MOLD LOFT FOR LAYING OUT WORK PRELIMINARY TO CONSTRUCTION OF VESSELS

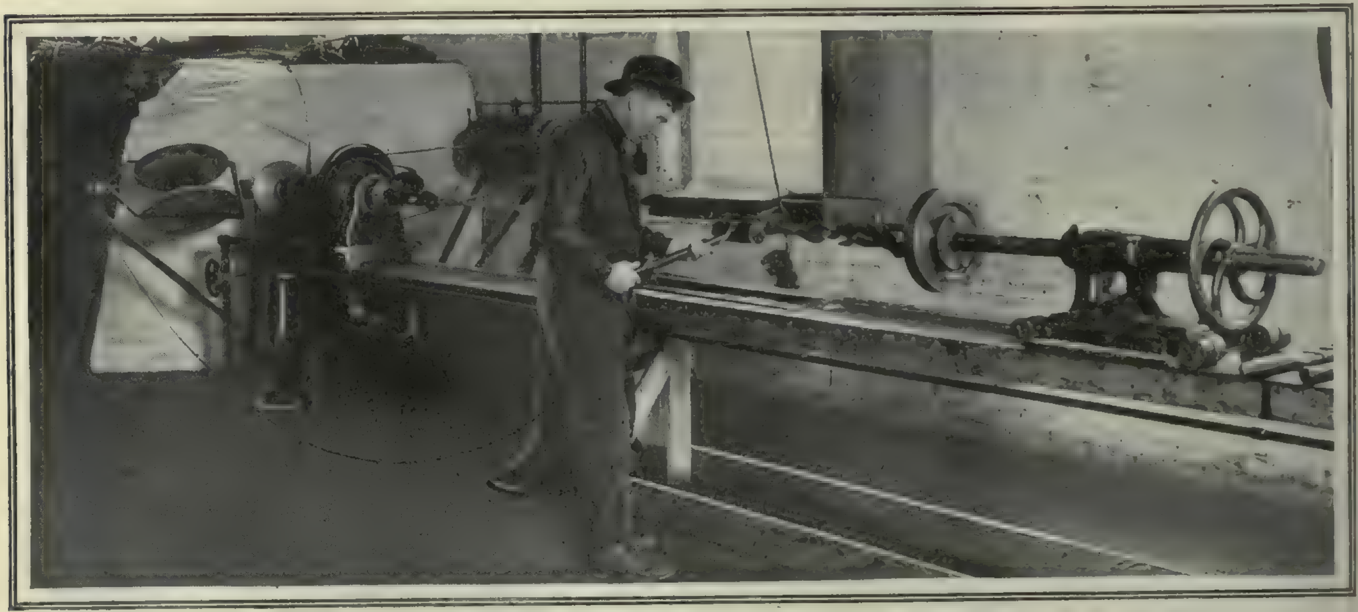


FIG. 8. MACHINE FOR SERVING WIRE ROPE IN A RAPID AND EFFICIENT MANNER

The joiners' shop is seen in Fig. 7. This department is equipped with a complete line of woodworking apparatus for the production of patterns, cases, furniture and an almost endless list of wooden articles.

An illustration of somewhat different character is Fig. 8, which shows the machine in the rigging loft for serving wire rope. In appearance this machine is like a lathe with long bed and suitable spindle and chuck attachments for securing the eye ends of the work. The process of serving consists in winding the rope from end to end so that it is covered completely by the strand that is wound tight about its surface.

Every ship carries of course a number of boats and launches. These are built in the shop illustrated by

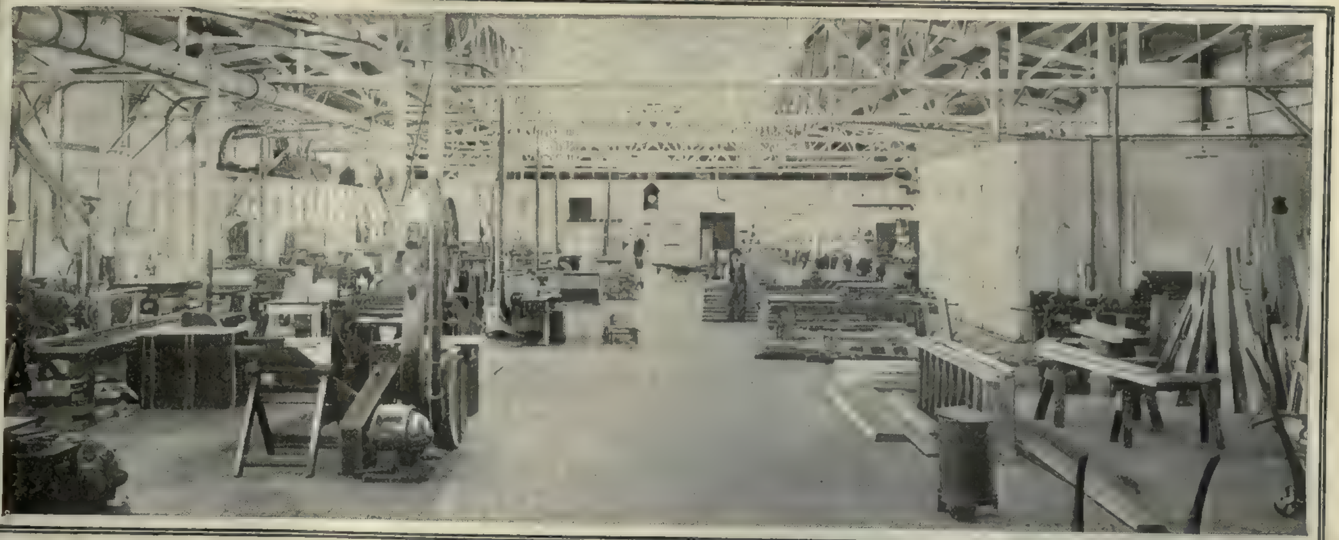


FIG. 7. VIEW SHOWING THE MAIN PART OF THE JOINERS' SHOP

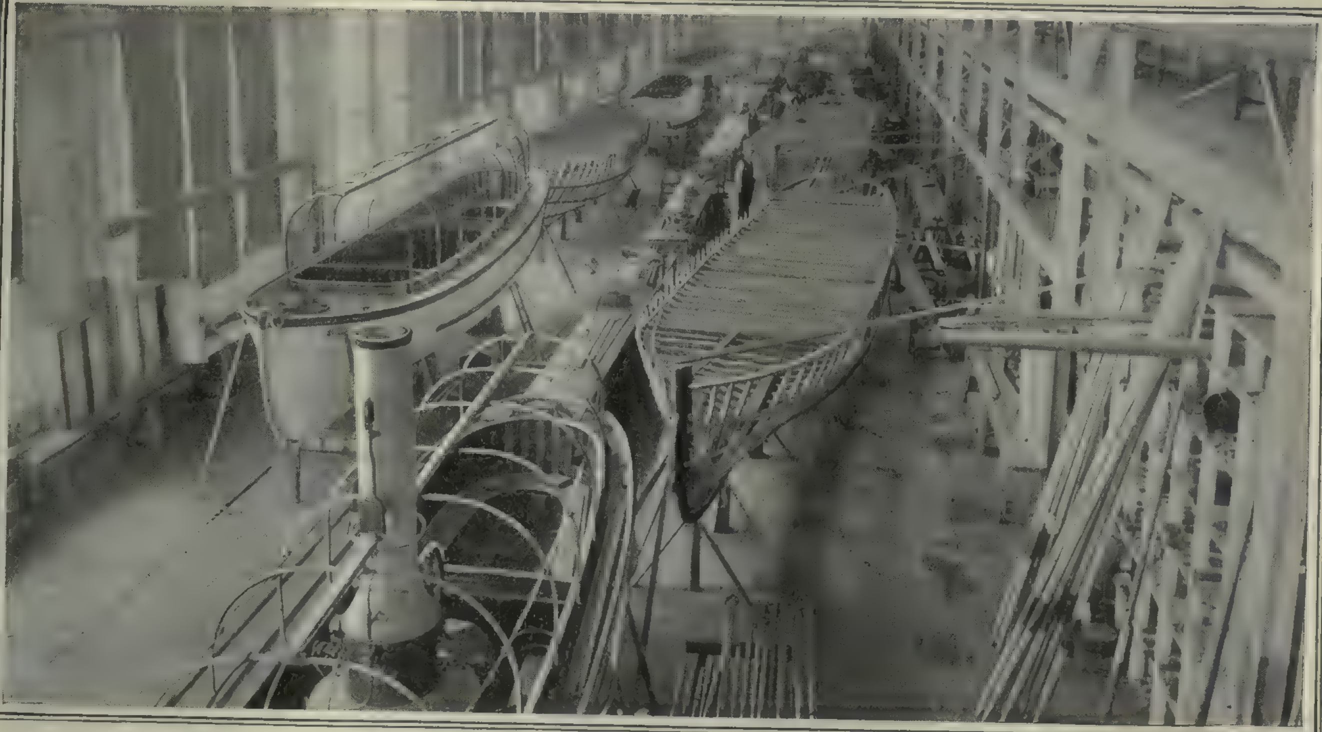


FIG. 9. PART OF BOAT BUILDERS' SHOP WHERE THE SHIPS' BOATS ARE MADE

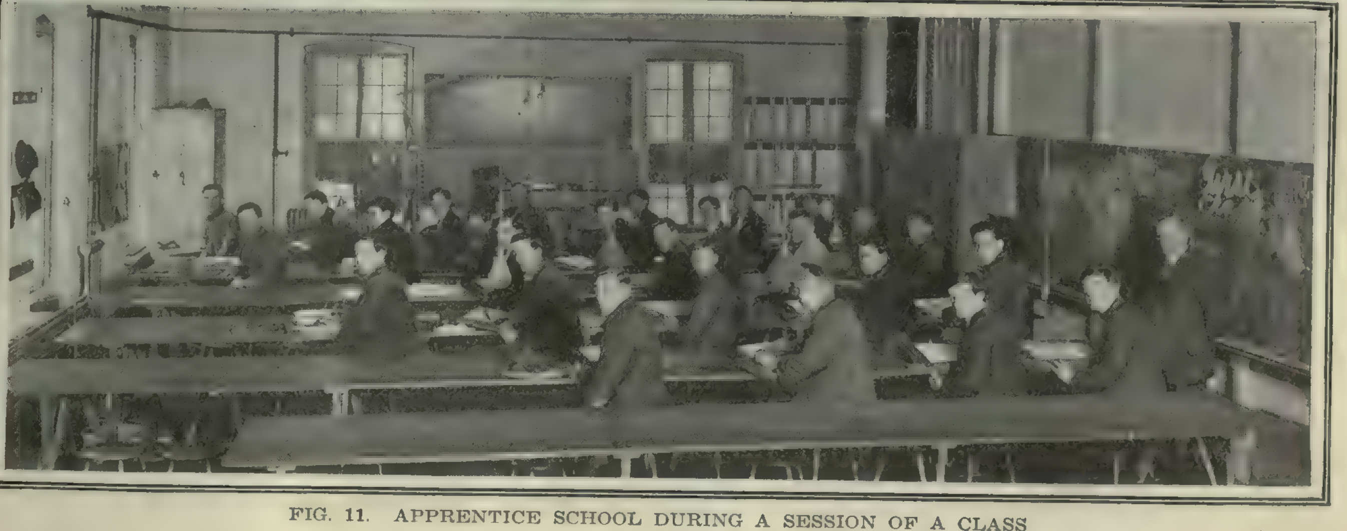


FIG. 11. APPRENTICE SCHOOL DURING A SESSION OF A CLASS

Figs. 9 and 10. In the first of these views several boats are seen in various stages of construction—some just started, others nearly completed. A number of boats all approaching a finished stage and about ready to leave the shop are shown in Fig. 10.

An apprentice school is maintained at the yard, and a view of this school with a class in session is given in Fig. 11. Besides the thorough schooling that the apprentice boys receive here, they are given systematic and progressive work in the shop departments, in the shipfitters' shops, in the iron and steel foundries, in the sheet-metal shop (where they make metal furniture and a varied line of apparatus), in the mold loft and so on. It may be stated in reference to this loft that the personnel is recruited from the best men of the shipfitters', joiners' and shipwright shops in addition to picked loftsmen themselves. Apprentices assigned to this department are naturally given every opportunity to benefit by the experience and observation possible on an unusually interesting class of operations.

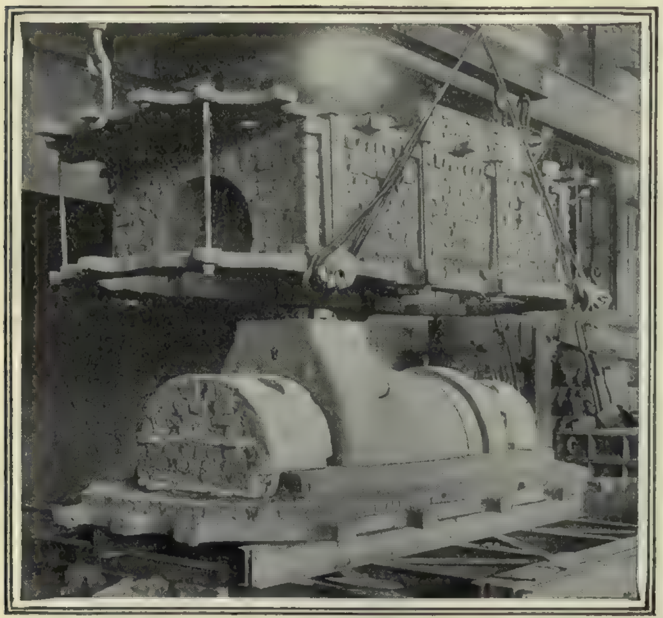


FIG. 4. MOLD AND CORE FOR TURBINE CASING

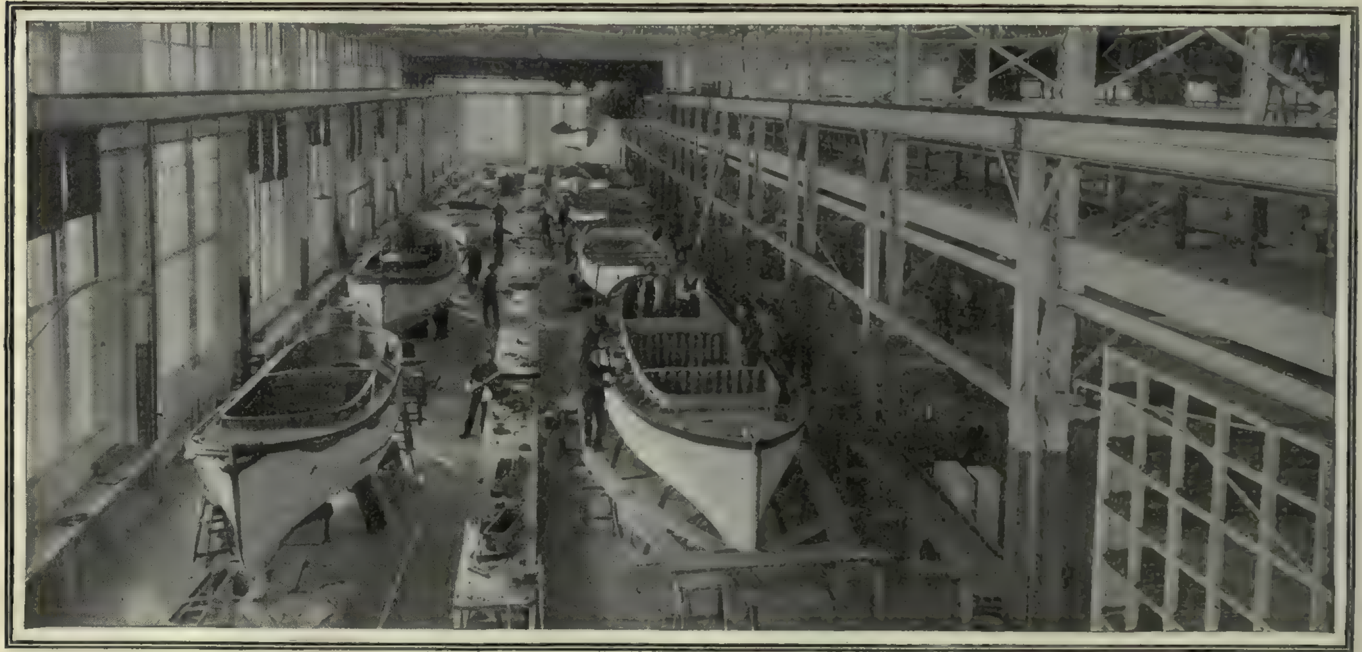


FIG. 10. BOAT BUILDERS' SHOP SHOWING WORK NEARING COMPLETION

The final view in this series, Fig. 12, illustrates the yard dispensary and emergency hospital. While every modern safeguard is adopted for the prevention of accidents, mishaps will occur at times; and in recognition of this fact the yard maintains the emergency hospital and dispensary for the protection of the employees. In this connection it should be stated that there is also an act in effect under which workmen are compensated for all loss of time incurred as a result of injuries.

Forging High-Speed Steel

BY F. GARBUTT

On page 871, Vol. 46, J. A. Raught complains of trouble with high-speed steel breaking off and showing a coarse grain after being drawn down under the steam hammer. Such trouble invariably arises either through the steel having been worked at too low a heat or not having been properly annealed after drawing down.

It is essential in the working of high-speed steel to get it to as high a heat as that particular brand will stand. Work it until it attains a bright red, then reheat. Never work it below a bright red.

If the steel to be drawn down is in long lengths, take a long heat; but never work it the full extent of the heat. Always leave a margin of at least 3 in. that is not touched by the hammer faces—that is, if the heat is 12 in. long, never work more than 9 in., as the last 3 in. is not quite as hot.

If short pieces, bar ends, etc., are being drawn down, it is possible to heat the pieces uniformly throughout. After all the pieces have been drawn to size, place them in a casehardening box, cover with bone or leather that has been repeatedly through the casehardening furnace, seal with fireclay, place in a cold or moderately heated furnace, damper the fire and leave to cool off.

Possibilities of Rapid Growth in Airplane Work

By FRED H. COLVIN

SYNOPSIS — *The article shows what can be done in getting production from a new plant when parts are standardized and the work put through in a systematic manner. It is particularly encouraging in view of the task which is before us—that of building airplanes in larger quantities than have ever been built before.*

WITH all parts standardized, it would be possible to turn out airplanes in much the same way as the modern automobile factories turn out their standard product, except that in this instance the quantity is not sufficient to allow of special machinery or of machinery of any kind for some of the more complicated metal shapes. These must be constructed more or less by hand, with the aid of forms, filing jigs and bending fixtures, and in some cases the old art of forming sheet metal with the mallet is called into play on the special shapes required. An example of this kind of work is the upper part of the hood, or casing, which fits over the engine, the sides of this hood being formed in graceful curves to accommodate some of the valve mechanism and other parts at the top of the engine. This forming is done quite easily with the sheet aluminum used, the sheet being clamped over a form and drawn to the desired form with a round-faced mallet. In a similar manner the gasoline pocket in the under sheet of the hood is drawn up quickly and in perfect contour, to insure that all the surplus gasoline drains away and does not accumulate and possibly cause trouble.

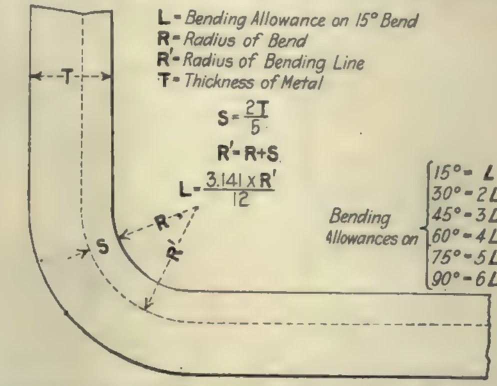
The fuselage is built up in the regular way except that special fittings have been devised for the turnbuckle connections at each fuselage strut. Ash is used for the longerons and spruce for the struts, as is common practice. The engine mounting is of laminated wood, with two strips of spruce in the center and a strip of ash top and bottom. Special mountings are provided for the tail skids which allow great latitude of movement with a minimum of breakage.

TABLE I. BENDING ALLOWANCE FOR SHEET METAL

Thickness	20, 22 B.W.G. $\frac{1}{32}$ Aver. T=0.03142						18 B.W.G. $\frac{3}{64}$ Aver. T=0.0479						16 B.W.G. $\frac{1}{16}$ Aver. T=0.0637					
Degrees	15	30	45	60	75	90	15	30	45	60	75	90	15	30	45	60	75	90
Radius																		
$\frac{1}{32}$	0.0115	0.023	0.0345	0.046	0.0575	0.069	0.0132	0.0264	0.0396	0.0528	0.066	0.0792	0.0149	0.0299	0.0449	0.0599	0.0749	0.0899
$\frac{1}{16}$	0.0196	0.0392	0.0588	0.0784	0.098	0.1176	0.0214	0.0428	0.0642	0.0856	0.107	0.1284	0.0231	0.0463	0.0694	0.0926	0.1157	0.1389
$\frac{3}{32}$	0.028	0.056	0.084	0.112	0.140	0.168	0.0295	0.059	0.0885	0.118	0.1475	0.177	0.0313	0.0627	0.0941	0.1255	0.1569	0.1882
$\frac{1}{8}$	0.036	0.072	0.108	0.144	0.180	0.216	0.0377	0.0754	0.1131	0.1508	0.1885	0.2262	0.0395	0.079	0.1185	0.158	0.1975	0.237
$\frac{3}{16}$	0.0524	0.1048	0.1572	0.2096	0.262	0.314	0.0541	0.1082	0.1623	0.2164	0.2705	0.3246	0.0559	0.1118	0.1676	0.2236	0.2795	0.3353
Thickness	12 B.W.G. $\frac{3}{32}$ $\frac{1}{10}$ Aver. T=0.1009						$\frac{1}{8}$ T=0.125						$\frac{3}{16}$ T=0.1875					
Degrees	15	30	45	60	75	90	15	30	45	60	75	90	15	30	45	60	75	90
Radius																		
$\frac{1}{32}$	0.0187	0.0374	0.0562	0.0749	0.0937	0.1124	0.0213	0.0425	0.0637	0.085	0.1063	0.1275	0.0278	0.0556	0.0834	0.1112	0.139	0.1668
$\frac{1}{16}$	0.0269	0.0538	0.0807	0.1076	0.1345	0.1614	0.0294	0.0589	0.0883	0.1178	0.1472	0.1767	0.036	0.072	0.108	0.144	0.180	0.216
$\frac{3}{32}$	0.0351	0.0702	0.1053	0.1404	0.1755	0.2106	0.0376	0.0752	0.1128	0.1504	0.188	0.2256	0.0441	0.0883	0.1324	0.1766	0.2208	0.2649
$\frac{1}{8}$	0.0433	0.0866	0.1299	0.1732	0.2165	0.2598	0.0458	0.0916	0.1374	0.1832	0.229	0.2748	0.0523	0.1047	0.1570	0.2094	0.2617	0.3141
$\frac{3}{16}$	0.0596	0.1192	0.1788	0.2384	0.2980	0.3576	0.0621	0.1243	0.1864	0.2486	0.3107	0.3729	0.0687	0.1374	0.2061	0.2748	0.3435	0.4122

Wing frames are standardized, each piece being made to drawing and the pieces made up for stock. These are then taken from the stockroom in sufficient quantity to build one or more wings, which are loaded on a truck and wheeled to the wing assembly department. Here the frames are assembled and carefully finished, and the wing, or panel, is then ready for covering. The covers are made up to pattern, slipped over the wing frame and sewed in place. No tacking is used except as a temporary fastening while the cover is being sewed on the frame. It is then ready for the coat of "dope," which shrinks the cloth taut on the frames and also makes it waterproof.

Ailerons, rudders, elevating planes and stabilizing planes all go through the same process, except that some of these have frames made entirely of metal, while others are made of combinations of wood and metal. The method of covering is the same in both cases, however, except that no temporary tacking is possible on the all-metal frames. Then the wings and other parts are ready for assembling into their respective units and for final assembly on the completed machine.



BENDING ALLOWANCES FOR SHEET METAL

The wings are tied together with guy wires of substantial size, these being of wire cable with thimbles spliced into the ends for fastening into the various fittings and to the turnbuckles, by which they are kept taut. The splicing of these wire cables around the thimbles revives an art which formerly belonged to the seafaring man. It results in a most substantial fastening, and safety is the chief requirement in an airplane. This splicing is now done very deftly and rapidly by women as well as by men, which is hardly in keeping with nautical lore.

The prime essential in airplane building is careful work at every turn, and this is impressed on the workers by frequent signs which read, "A Hidden Defect May Cause the Death of a Man." All material is carefully tested, steels are broken to test strength and toughness, wood is tested both in the solid and when glued up, and the greatest care possible is taken to avoid error.

Wood to be glued is heated in special ovens before the glue is applied, so that the latter may keep hot and liquid until the parts can be properly clamped in the gluing press. The glue itself is kept at a uniform temperature and is made up fresh each day so as to secure the best possible results and to avoid the danger of laminations or glued joints becoming loose through inferior glue or improper working conditions.

TABLE II. DRILL SIZES

Taper Pins

Pin Size	Diameter End of Reamer	Fractional Size	Drill Size	Decimal Size	Fractional Size
00000	0.078	5/64	No. 46	0.081	5/64
0000	0.091	3/32	No. 42	0.0935	3/32
000	0.108	7/64	No. 34	0.1110	7/64
00	0.125	1/8	No. 30	0.1285	1/8
0	0.134	9/64	No. 28	0.1405	9/64
1	0.145	9/64	No. 25	0.1495	5/32
2	0.161	5/32	No. 19	0.166	11/64
3	0.182	3/16	No. 13	0.185	3/16
4	0.205	13/64	No. 3	0.213	7/32
5	0.239	15/64	D or 1/4	0.246 0.250	1/4
6	0.270	17/64	J	0.277	9/32
7	0.328	21/64	Q	0.332	21/64
8	0.395	25/64	Y or 13/32	0.404 0.406	13/32
9	0.479	31/64	31/64	0.484	31/64
10	0.578	37/64	19/32	0.59375	19/32

Cotter and Clevis Pins

Pin Size	Decimal Size	Fractional Size	Drill Size	Decimal Size	Fractional Size
1/16	0.0625	1/16	No. 52	0.0635	1/16
3/32	0.09375	3/32	No. 41	0.096	3/32
1/8	0.125	1/8	No. 30	0.1285	1/8
5/32	0.15625	5/32	No. 21	0.1590	5/32
3/16	0.1875	3/16	No. 12	0.189	3/16
7/32	0.21875	7/32	No. 2	0.221	7/32
1/4	0.250	1/4	F or 1/4	0.257 0.250	1/4
9/32	0.28125	9/32	L or 9/32	0.290 0.281	9/32
5/16	0.3125	5/16	O or 5/16	0.316 0.3125	5/16
3/8	0.375	3/8	V or 3/8	0.377 0.375	3/8
	0.4375	7/16	7/16	0.4375	7/16
	0.5	1/2	1/2	0.5	1/2

TABLE III. DRILL SIZES FOR WOOD SCREWS, MACHINE SCREWS AND BOLTS

Screw or Bolt Size	Decimal Size	Fractional Size	Drill Size	Decimal Size	Fractional Size
No. 0	0.060	1/16	No. 52	0.0635	1/16
No. 1	0.073	5/64	No. 48	0.076	5/64
No. 2	0.086	3/32	No. 43	0.089	3/32
No. 3	0.099	3/32	No. 35	0.1100	7/64
No. 4	0.112	7/64	No. 32	0.116	7/64
No. 5	0.125	1/8	No. 30	0.1285	1/8
No. 6	0.138	9/64	No. 28	0.1405	9/64
No. 7	0.151	5/32	No. 23	0.154	5/32
No. 8	0.164	11/64	No. 19	0.166	11/64
No. 9	0.177	11/64	No. 15	0.180	3/16
No. 10	0.190	3/16	No. 10	0.1935	3/16
1/4	0.250	1/4	F or 1/4	0.257 0.250	1/4
5/16	0.3125	5/16	O or 5/16	0.316 0.3125	5/16
3/8	0.375	3/8	V or 3/8	0.377 0.375	3/8
7/16	0.4375	7/16	7/16	0.4375	7/16
1/2	0.5	1/2	1/2	0.5	1/2

Another example of the care taken is shown in the accompanying table of allowable bends for sheet steel. The data were carefully worked out from actual tests so as to avoid fractures when bends are necessary, as they are in many cases. The other tables are also the result of study on the part of the company's engineers.

From Jack to Bill—Correspondence Courses and Inspectors

Dear Bill—Thare was a geezur in the shop yistiddy sellin corsponduns coarses. You pays so mutch a munth and thay sends you lesons awl about awl kinds of wurk, it must be fine for lurners but not yuseful to skild mecanniks like I bee. I wish thare was corsponduns coarses for boses, for thay shure needs em Bill. Thay dont seam to no nothin but ownly jorin and cusin. The inspekter hear he sees Ime a real mecannik so he ast me to hellp him for he sez hes rushed awl the time. He givs me a too and three sixteen plugg and says put it throo them hoals. It went eezy in moast but in one it jusst woodent so I trys to maik it with a hamer but the moar I hamrd the wurs it stuk so I went to mawl it bak with the peane and the handl come out busted the handl of the plugg I meen, Bill. How cood I no it was jusst a cast iurn handl with a ring of steal onto the end, and the bos he jord.

I havent toald you Bill but Ime alurnin on a boarin mil but not so boarin yet oanly ternin like on a laith. I gut on fine and the bos he says youve struk your gate at last, too hunderd peaces maid and awl O Kay and I fellt good and thort Ide of found a bos with sum sents. Then thay brort me a lot of castins for coanshaiped cluches and one finnished for a paturn for me to go buy Bill and the bos he sais maik em like that and I dident want to ast no one how to sett the hed rite for the taypur and git toald moar about taypur oil and eels hine leggs, so I puts the paturn on the mil and gits up on a boks and skwints a long the slidin part of the hed sitein to git it tipd rite for the coan. Then I done ten or levven coans and then trys the gaij and it dident just fit. I think the oald mil is on the hogg. So I rapd the hed oaver a little and done em oaver and they lookd fine oanly but sum loos in the gaij and the bos he cusd. Then he had a geezur no real mecannik Bill but a boarin speshlist you no, sett the hedd and I done a hundred and the inspekter he sed thay hadent any but foar of em but oanly thurty thousands shaik in the gaij but I no he lyes for it want moar than a thurty seccund and I dont no how menny thurty seccunds is in a thousands but I lookd on my mike and the thousands marks are so fur apart I gess a thousands is the saim as a sixteen isnt it Bill? But the inspekter yuses wat he cawls a vurnyur calliper and mezhers thousands with it and the marks aint nowhere neer the saim fur apart thay are on the mikes. Witch is rite, Bill, and how menny thousands is thare in a inch.

Tomorrer Ime to boar and tern at the saim time on the boarin mil and thay are rigin it up to cutt a

AINT THARE NO LIMMIT TO THE TIRRANY OF THE PLEWTOCRATTIC BOSSES?—

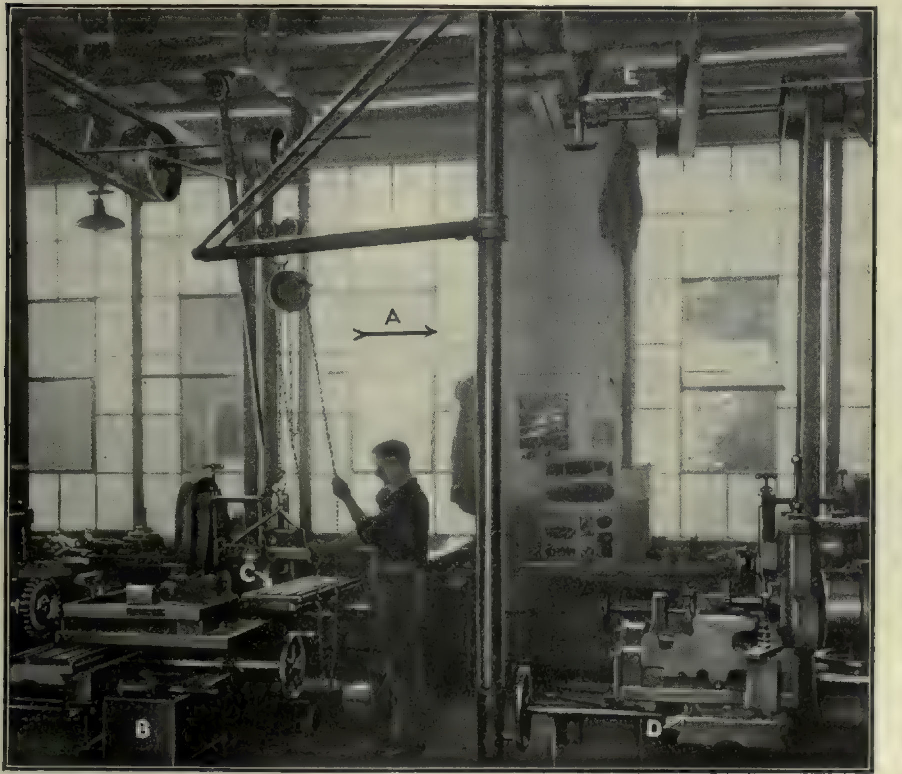
left handed thred but I dont see how for I no a jobb has to run bakwuds for a lefthanded thred and the mil hasent no bakin belt. Ive gut moast awl kinds of speshlizin lurnt now Bill and wil soon be reddy for that 5 doler jobb in Misshergun. Wel Bill that corspondguns guy he talked a lot about how mutch a man cood lurn by studdyin in room of goin to shoze, but Ime goin to a moovy now to see wat the red avenjer did affter he had fell oaver the clift so no moar from

JACK.

PS—Bill thay tels me that in that Misshergun shop thay has showr baths and maiks evry man yuse em evry day. Do you bleev it Bill and aint thare no limmit to the tirrany of the plewtocrattic boses and wood you advize me to go to that shop and be treeted like that but 5$ a day does look good Bill tho I hait to bee a down trodn slaiv.

Installing Overhead Apparatus Reduces Overhead Expense

The small machine-manufacturing plant must use considerable ingenuity to secure the advantages that come to the large shop through quantity manufacture, without incurring too heavy charges. It is a comparatively simple matter in the large shop with a great volume of standardized work to arrange machine equipment so that pieces proceed from operation to operation with the least amount of handling and expense.



HANDLING WORK BETWEEN OPERATIONS IN A SMALL SHOP

The illustration accompanying this article comes from the Asa S. Cook Co.'s shop at Hartford, Conn., where wood-screw machinery is built and where the parts are processed in quantities, notwithstanding that less than one hundred men are employed.

This photograph shows an arrangement of millers by which the central swinging jib crane *A* permits the handling of work from one machine to another, all three millers *B*, *C* and *D* taking care of individual operations. One man operates these three machines, on which the tool and fixture set-up is permanent.

Another feature worthy of note in this illustration is the arrangement of overhead beams shown at *E*, which allows great flexibility in arranging countershafts. These beams consist of two angle irons mounted back to back, with a space between them to receive bolts and cast-iron spacing blocks riveted in at intervals.

The Foreman of the Future

By Entropy

The kind of men, to say nothing of women, who are available now to man our shops is so different from those of a few years ago that foremen find themselves at a loss to know how to handle the new situation.

It seems only yesterday when, if a foreman took exception to the way an employee wore his hair, he could fire him out of hand and with no compunction whatever, knowing that he could replace the workman without any difficulty whatever.

Now he knows that every man lost is likely to be replaced by poorer material rather than by better. All the effort that is being put into proper training and holding men means that those who are leaving one shop for another are likely to be more or less undesirable. We used to say to a man who came to us from the Blank Machine Co.: "Yes, sir! Lots of good men come from there, and the better they are the sooner they come." Now we know that the Blank Machine Co. is keeping track of why its men leave, and we know that the chances are that its tailings are pretty poor stock. When a man left us to work in some other machine shop in town, we used to cuss the other fellow out as a thief; now when the same thing happens, we congratulate ourselves and wonder how the other fellow will feel when he finds how he has been stuck. Then again, the foreman of the future will have to get his ideas of men's pay all readjusted. No one can say within several dollars how much a man is worth unless he has figures of production to back it up. Once there was margin enough and wages were low enough so that the foreman's guess was good enough. Now it is a matter of the market rate and what a man produces. The day of the big stick has gone. While it may be hidden behind the door, it is not so much in evidence. A man's a man today, whether his skin is one shade or another; and the farther down the scale of efficiency he is, the stronger his hold on us. It almost seems as if the time is in sight when we will have to pay more to have the spittoons cleaned than we will for toolmaking, on the score that the disagreeable job should be the highest paid.

The greatest jolt that is coming to foremen, however, is that they will no longer be "boss" in the literal meaning of the word. They will become diplomats. A diplomat is a man who leaves the big stick behind the door when he goes out after his man. If orders are right, then there is no reason why they should not be obeyed promptly and cheerfully, except that they are misunderstood. If the orders are wrong, there is no especially good reason why they should be carried out. It hurts a foreman's pride terribly to have a workman tell him the truth about some of his blunders; but if he is sensitive about it, he should cut out the blunders.

Definite instructions would reduce the internal friction of many a shop so that one would think it ran on ball bearings. Oral instructions, hastily given, only to be denied in case of error, bring about a situation where someone has to leave, and it is usually the innocent party.

BACKING UP THE FOREMAN

Backing up a foreman, right or wrong, is something that is fast passing. It is safer to be right than to back up a man who is wrong. The shop cannot afford to have it done, because the reputation that comes from this practice drives good men away. If every foreman could hear all that is said about him behind his back, he might be a great deal more careful in his own speech. He could well imitate the men of large affairs and maintain a press-clipping bureau, to give him all that is said about him, both for and against.

In fact, a foreman is really a public character, within a small range, and should be able to feel with discrimination the public pulse. It would certainly be better for him to know openly what is now being said behind his back. There would be less said, and he would better know how to conduct himself. The foreman who is all suavity when the big boss is around and all snarls when his subordinates are on the carpet is losing out, because no one who knows his failings is in a position to tell him of them. It would be better for him if he could have the mirror held up before him in private; but it might give him a jolt that would make a lasting impression, if his men could do it for him with safety. It is, however, almost universally true that the man who does catch his foreman with the goods and makes him come to time is forced out. The foreman's power to assign distasteful jobs makes it possible for him to make life anything but worth living for those whom he wishes to be rid of. This evil can only be met by making foremen bigger men.

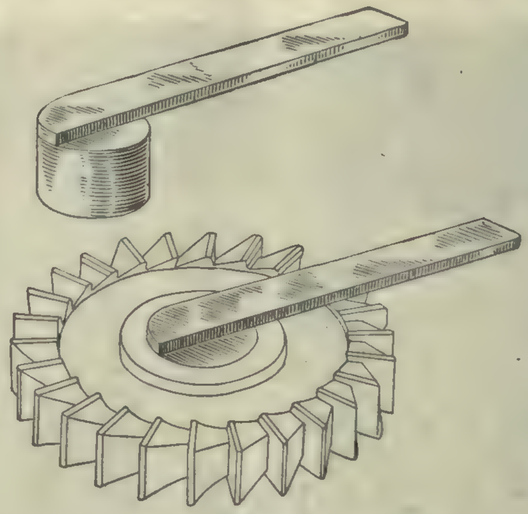
BIG MEN FOR FOREMEN

This is really the keynote to the situation. Bigger men. That means bigger salaries, for the big man can name his own price within reasonable limits. It means that those who are now foremen can retain their jobs only if they can see their subordinates as fellow workers working with them for the company. It means more self-control. It means putting the interest of the employer first and individual pride last. It means that each foreman must surround himself with men who will make up a balanced team. Most men who can get to the height of foremanship are more or less unbalanced, in the sense that they have abnormal ability in some direction and are not equally developed in others. They can preserve the balance only by employing men who have the qualities that they do not have. They may despise other men for having those same qualities; but they need them and they must put up with them, not merely because it is best for the organization, but because it is best for them in the long run. A man who thus supplements himself will ultimately, by association, absorb some of the qualities that he at first had little use for. Thus a man who is not systematic, who hates to plan out his work, should pick out a few good routine men for his organization, to keep him running in one track. He may hate them, but after a time he is bound to absorb some of their liking for their work, or at least to see its value.

Cutter Grinding Gage

BY MEYDRON DELMER

Walter G. Groocock, on page 18, describes a method of correcting incorrectly formed cutters by altering the angle of the cutting face. The writer has known of this method being used by a manufacturer of formed tools to correct slight errors in gear hobs before shipping them to particular customers. While this method has its advantage if intelligently handled, it should in no wise be followed without due regard for the fact that very close measurements must be taken in order to improve on the results of the average formed cutters sold by reliable tool manufacturers.



GAGE FOR CUTTER GRINDING

In the larger shops, where the sharpening of hobs and other formed tools is left to someone with little or no mechanical training, there is often much trouble caused by the unwitting changing of the angle of the cutting face. In order that this trouble may be avoided, the person sharpening formed cutters should be provided with a gage similar to the one herewith. The sketch shows a short plug turned to a sliding fit in the hole in the hob or cutter, with a strip of $\frac{1}{8}$-in. thick steel securely fastened to the plug with one edge passing through the center of the plug. In use, the plug is inserted in the hole in the cutter; by sighting across the edge of the blade that passes through the center of the plug and bringing the face of a tooth in line, it is readily seen whether or not the tooth face is radial.

Precision Drilling Machine

BY C. E. DAVIES

SYNOPSIS—*Construction details of a machine that insures accurate drilling of holes in toolroom work are here given. With older methods, it would require the labor of five men to equal the output of this precision drill.*

VERY accurate drilling or boring of holes by any of the common toolroom methods is an expensive operation. In a toolroom requiring large quantities of precision drilling, the problem of getting accurate work promptly is acute. The toolroom of the Smith Premier Works is engaged principally in the making of punches and dies, drill jigs and assembling or milling fixtures for typewriter work. This product requires considerable precision drilling, and the problem of production in this class of work has been met by the construction of a special machine—the "precision drill," the subject of this article.

GENERAL DESCRIPTION

In general, the precision drill is an extremely rigid drilling machine with a table that can be accurately located, and a "drill support" that can be brought down close to the work to prevent the drill from springing or crowding when at work.

The precision drill resembles the miller in the arrangement of the table, which can be moved from side to side on the saddle. The latter rests on and is moved from front to back on the knee, which can be raised and lowered on the frame. Any movement of the table to the right or left, or of the saddle front or back, can be measured by scales mounted on the table and saddle, and corresponding verniers on the saddle and knee, which can be read in thousandths of an inch. The scale on the table may be seen in Fig. 1 and that on the saddle may be seen in Fig. 2. The table has a travel of 18 in., and the saddle has a travel of 10 in.

The drill spindle is supported in two bearings on the spindle slide and is driven by a belt, from the cone at the back of the machine, running over idlers. The driving pulley is on a bushing, and the spindle moves vertically through the bushing, from which it is driven by a spline. The belt pull is transmitted to the frame by means of the bushing. Six speeds are obtained by means of the cone pulley and a double-throw clutch on the countershaft which connects to either of two countershaft belts moving at different speeds.

OBJECT OF THE POWER FEED

A power-feed mechanism is provided to lessen the danger of crowding the drill from its path and running in the holes. A shaft *A*, Fig. 1, is driven by a belt from the driving shaft. The shaft *A* may be connected to a wormshaft by any one of three sets of gears, determined by the location of a sliding key on the shaft *A*. The worm at the end of the wormshaft is in mesh with a large wormwheel, turning idly on a pinion shaft that engages a rack on the back of the spindle slide. The large handwheel on the left of the machine is in reality a nut which, when tightened, clamps the wormwheel against a collar on the pinion shaft. The wormshaft is always turning when the machine is in motion. The clamping of the wormwheel therefore connects the feed mechanism with the pinion shaft, and the spindle is moved vertically. A lever on the right of the machine, Fig. 2, acting through a pawl, is used for bringing the drill spindle to the work and raising it again.

The important feature of difference between this machine and any other machine is the drill support This device consists of a frame, slide, bushings and clamp. The frame, as may be seen by consulting Figs. 1 and 2, is fastened to the main frame of the machine and is so arranged that the slide may be telescoped into the frame or brought out and clamped securely in position with the center of the hole in the slide directly in line with the center line of the drill spindle. A set of hardened-steel bushings is provided varying in diameter of hole from No. 54 drill size to $\frac{3}{8}$ in. These bushings may be inserted in the hole in the slide and clamped in position by the setscrew on the outer end of the slide. The equipment necessary for the operation of the precision drill consists of a complete set

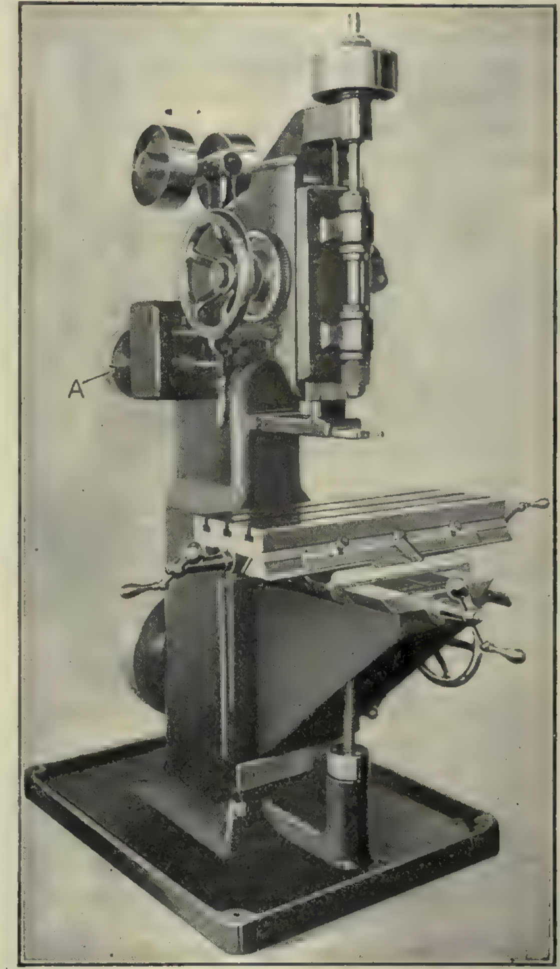


FIG. 1. PRECISION DRILLING MACHINE

of standard twist drills and rose reamers to correspond to the set of bushings.

The main problems in the design of the precision drill were the necessity for rigid construction and the provision against excessive wear. Taking into consideration the fact that the largest hole to be drilled on this machine is ¾ in., the lines of the frame, as shown in Fig. 1, give ample assurance of extreme rigidity. Holes as large as 2 in. can be bored in this machine by means of an eccentric boring tool. The advantage of this machine as a support at the point of the tool does not hold above ¾ in., however, as that is the size of the largest bushing. The stress on the machine when boring a 2-in. hole will not be greater than when drilling the ¾-in. hole, if a reasonable feed is used for the boring. Excessive wear is provided against by large bearing surfaces scraped all over and the use of quickly adjustable taper gibs in the slides.

The effectiveness of operation of this machine depends entirely on the accuracy and care given to its construction. The machine in use at the Smith Premier Works was built in the shops. Two additional machines were built at the same time for use in the other two factories of the Remington Typewriter Co. As a first step in the construction, the spindle slide and the knee slide on the frame were made exactly parallel. Then the knee and the drill spindle were placed in position, and the upper surface of the knee was scraped perpendicular to the drill spindle. This was accomplished by placing a sweep in the chuck and locating four points on the knee which determined the plane perpendicular to the center line of the drill spindle. The surface of the knee was scraped to these four points. The upper surfaces of the saddle and table were scraped in the same manner to insure perpendicularity of the surfaces to the center line of the drill spindle. The slides on the knee and saddle were then scraped to provide for exact perpendicularity between the movement of the table and the movement of the slide.

Accuracy of the Machine

To show how well this part was accomplished, two plates were clamped, one on top of the other, on the table, as shown in *A*, Fig. 3. A milling cutter was placed in the drill chuck; and by moving the table, the sides of the plates were milled in the direction *B*. Then by moving the saddle, the side in the direction *C* was cut. These two plates when opened out and placed on a surface plate, as at *D*, Fig. 3, pinched a sheet of paper, measuring 0.001 in. in thickness, at all points along the edge *C*. An exaggerated condition of inaccuracy is illustrated at *E*, Fig. 3. Any inaccuracy is shown twice its true size by this method, and therefore the uniform pinching of the paper along the edge *C* is proof of the accuracy of the machine.

Great care was taken in the making of the set of bushings. Each bushing was lapped to exact size, in outside and inside diameter, so that they would fit in the lapped hole in the drill-support slide with a wringing fit and guide the drill or reamer without vibration.

To show the accuracy of the entire machine, a ½-in. hole was drilled and reamed at the intersection of the center lines of a plate ⅜ in. thick and 12 in. on each side. This hole was taken as the starting point, and four ⅜-in. holes were drilled in the same plate at the corners of a square 8 in. on a side and having the ½-in. hole as the center. Great care was taken in reading the scale and in moving the table, so that the personal element was reduced as low as possible. Then this plate was removed from the precision drill, and a second similar plate was placed on the machine. Five holes were made in this second plate to correspond to the holes in the first plate, but the order of drilling the holes was reversed in the drilling of the second plate.

The two plates were then placed with the ½-in. holes coinciding, and a ½-in. plug lapped a half-thousandth undersize was slipped through the two ½-in. holes. After locating the two plates so that a three-eighths plug lapped a half-thousandth undersize would go through a ⅜-in. hole in both plates, it was possible to easily slip a second three-eighths plug, a half-thousandth undersize, through the other three holes in the two plates. It was also possible to superpose one plate over the other in any position and get the same indication of the exact coincidence of the holes. This test shows the extreme accuracy of the machine; and comparing the time of three hours to drill both plates with the time required to bore the plates as accurately with the button method, the economy of the precision drill is plainly and convincingly shown.

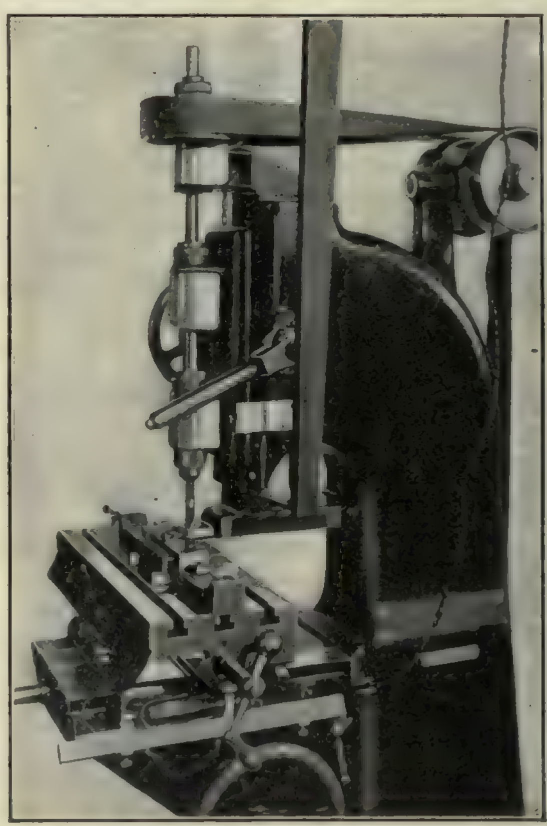


FIG. 2. DRILL-SPINDLE CONTROL

The Use of Precision Layouts

The toolmaker in charge of this machine is assisted considerably on the job by the provision of a precision layout by the drafting room. The layout is made at the same time the tool is drawn up and gives, for the sake of clearness, merely the information needed to perform the precision drilling. Samples of these layouts are shown in Figs. 4, 5 and 6. The toolmaker clamps the work to the table and brings the work under the spindle so that the latter is directly over the zero point as indicated on the layout. The zero point may be scaled from the edge of the work, as is necessary in Figs. 4 and 5, or may be at the corner of the block, as in Fig. 6. When the drill spindle is over the zero point as shown by an indicator in the chuck, the scales on the table and spindle are set very carefully at zero. The holes on the layout are all located in thousandths from the zero point in two directions, thus enabling the toolmaker to complete the drilling without resetting the scales. The rest of the operation is simple, the toolmaker carefully moving the table until the scale readings correspond to the coördinates as given on the layout and then selecting the proper bushings, drill and reamer to complete the hole. Care is taken to have the work close to the drill-support slide so that the point of the drill is steadied as it enters the work. To change the drills, the drill is raised from the bushing, the slide unclamped and pushed back in the frame and the drill taken out.

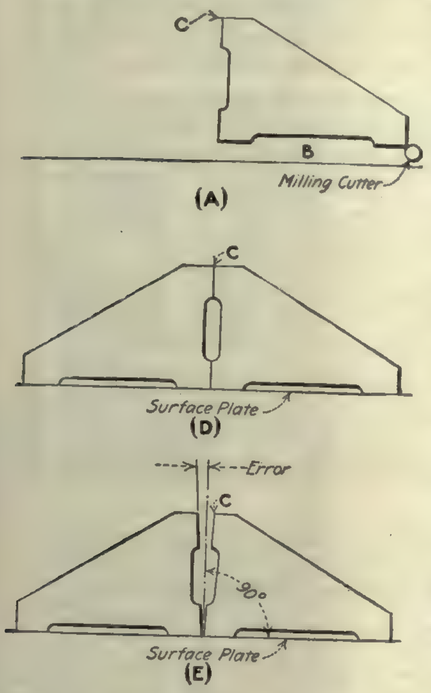


FIG. 3. TEST MILLING DONE ON THE MACHINE

The use of the scales permits the exact location of the work in relation to the drill spindle regardless of any backlash or wear in the lead screws. The drill support, which insures the drilling of the hole in the exact spot desired, is used only until the drill is started in the work. Then it is moved back and the hole drilled. This is done to reduce the wear in the bushings. The reaming is done through the bushings.

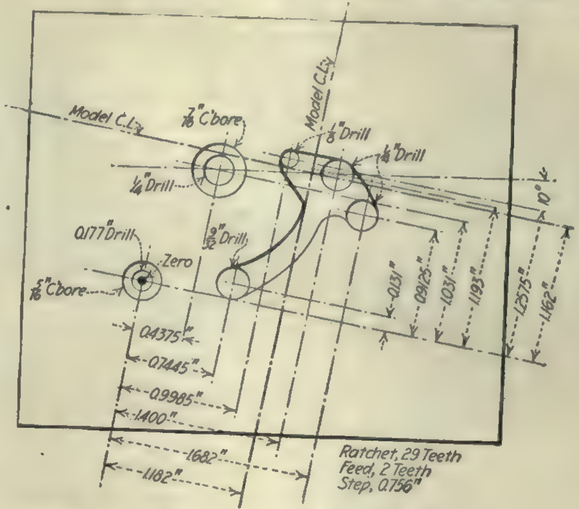
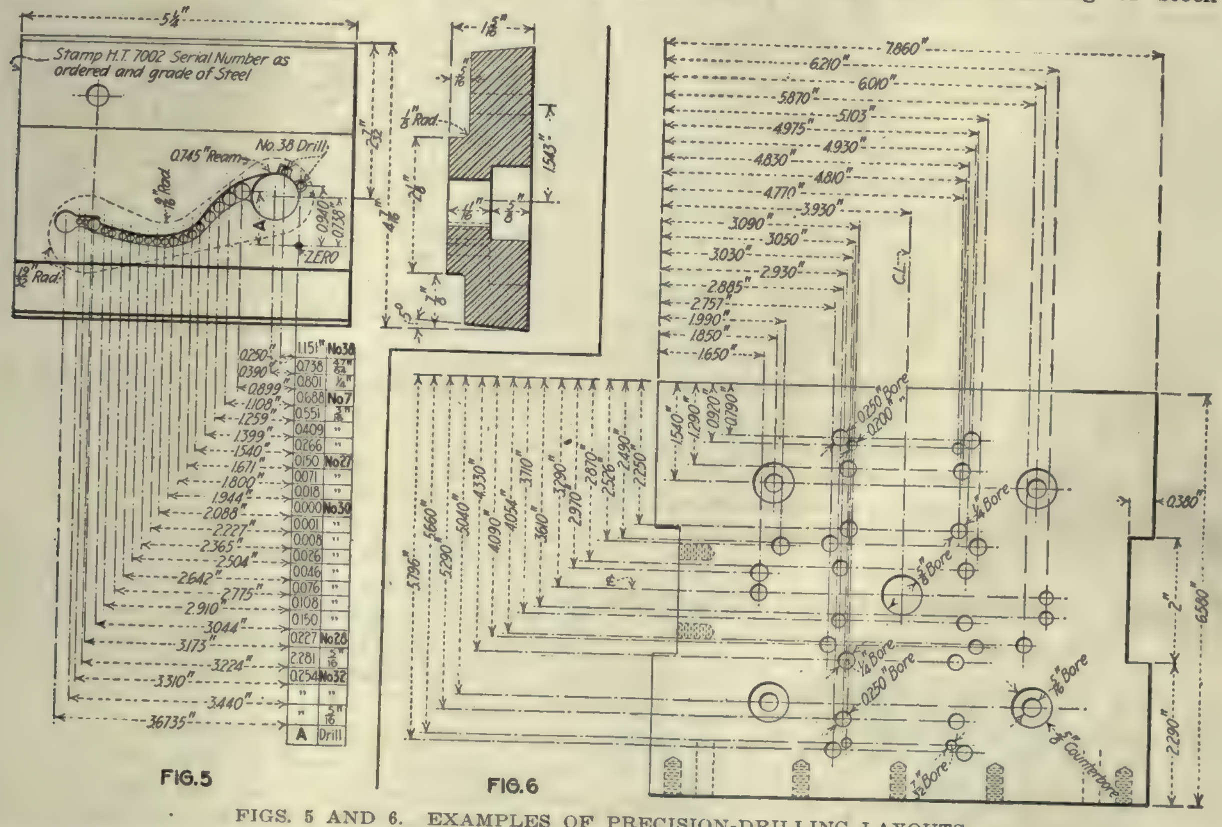


FIG. 4. LAYOUT FOR BLANKING DIE

The precision drill has been used effectively in the laying out of dies, in the removing of stock from die blocks and the location of bushing holes in drill jigs. It has also been of great assistance in the making of models, which are always made up before regular production is commenced.



FIGS. 5 AND 6. EXAMPLES OF PRECISION-DRILLING LAYOUTS

In Fig. 4 is shown a good example of the layout for a blanking die to be used in a press with automatic feed. The exact location for the holes for piercing punches and leaders in the die block is thus quickly provided. The layout in Fig. 4 is shown with the axes at an angle of 10 deg. with the side of the die block. This does not lengthen the operation on the precision drill, as the stock can be clamped on a swivel table and turned to the required angle quickly. The work of preparing the layout, however, is considerably decreased, as the axes are parallel to the center line of the part drawing and therefore the calculation of the coördinates is simplified by merely having the block turned at the required angle.

In Fig. 5 is shown an example of a die block with a large part of the stock removed on the precision drill. This die is subjected to severe service and therefore requires frequent replacement. Consequently, it was considered economical to provide a very complete precision layout giving ordinates and drill sizes so that the finishing time for the die would be considerably reduced. The irregularity of form of this die would make a difficult job of the laying out for drilling by the diemaker in a sensitive drilling machine. The irregularity of form would also increase the probability of error and the consequent spoiling of the die by the diemaker. The precision drill, however, takes care of this job in a very simple fashion, and the work comes to the diemaker in a manner that requires the minimum of stock removal.

ELIMINATES TEMPLET MAKING

The use of the precision drill for Fig. 5 does away with the necessity for making accurate templets for laying out the curved edges of the die.

The drill jig plate shown in Fig. 6 is an excellent example of this class of work. The drilling of this plate was actually accomplished in 12 hours. A reasonable estimate of the time necessary to drill the 35 holes by the method of buttoning in the lathe would be at least a week.

The precision drill at the Smith Premier Works was put in commission in 1910 and has been in continuous use, requiring the services of one man constantly to turn out the work for the die and jig makers. A conservative estimate covering the condition at the Smith Premier Works is basis for the statement that the work done on the precision drill during the past year would require the labor of five men using old methods, and a capital investment in lathes and millers greater than the first cost of the precision drill.

Efficient Herringbone Grate Patterns

BY M. E. DUGGAN

As I have had considerable experience in making patterns for single- and double-angle herringbone grate bars for furnace and boiler fireboxes, also for catchbasin grates in various designs, my method may be an improvement on the one followed by many patternmakers.

Cutting and fitting—one at a time—the bars to the side frames is slow and tedious; especially is this true in the making of a herringbone grate pattern. One of several patterns for catchbasin grates recently made will serve as an example and will aid me to make clear the description of my method.

A corner of the assembled pattern is shown in Fig. 1. The frame *FG* is made and varnish finished. The angle bars *B* are made and varnish finished on the flat sides only. In Fig. 2 is a board 1 in. thick and 6 in. wide, planed flat and true on one face. Strips of drawing paper 1 in. wide are fastened with glue at the edges of the planed surface; and construction lines are drawn across the face of the drawing paper, indicating the angle and position of the bars and the spaces. The bars are "spot" glued to the drawing paper, wide face down. Remember, a *spot* of glue; a "slobber" of glue will spoil the job. When the glued spots have set, lay the frame on the "board side" of the bars, and mark along the inside edge. Tilt the band-saw table at the same angle as the inside of the frame, and band-saw along the line. If the marking and sawing are carefully done, the bars will drop into place in the frame without further fitting.

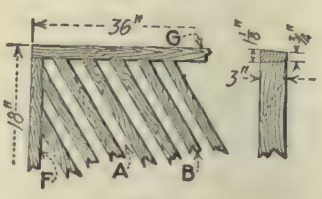


FIG. 1

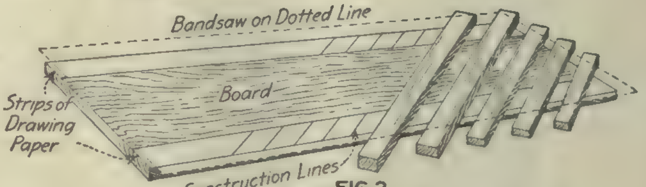


FIG. 2

FIGS. 1 AND 2. PATTERNS FOR CATCHBASIN GRATE

Varnish (not glue) the ends of each bar; assemble and fasten with wire nails, first drilling small holes to receive the nails. This is important. To remove the board, start each "spot," using a wide chisel and hammer. A light, smart tap will do the job. Plane and finish the edge surfaces.

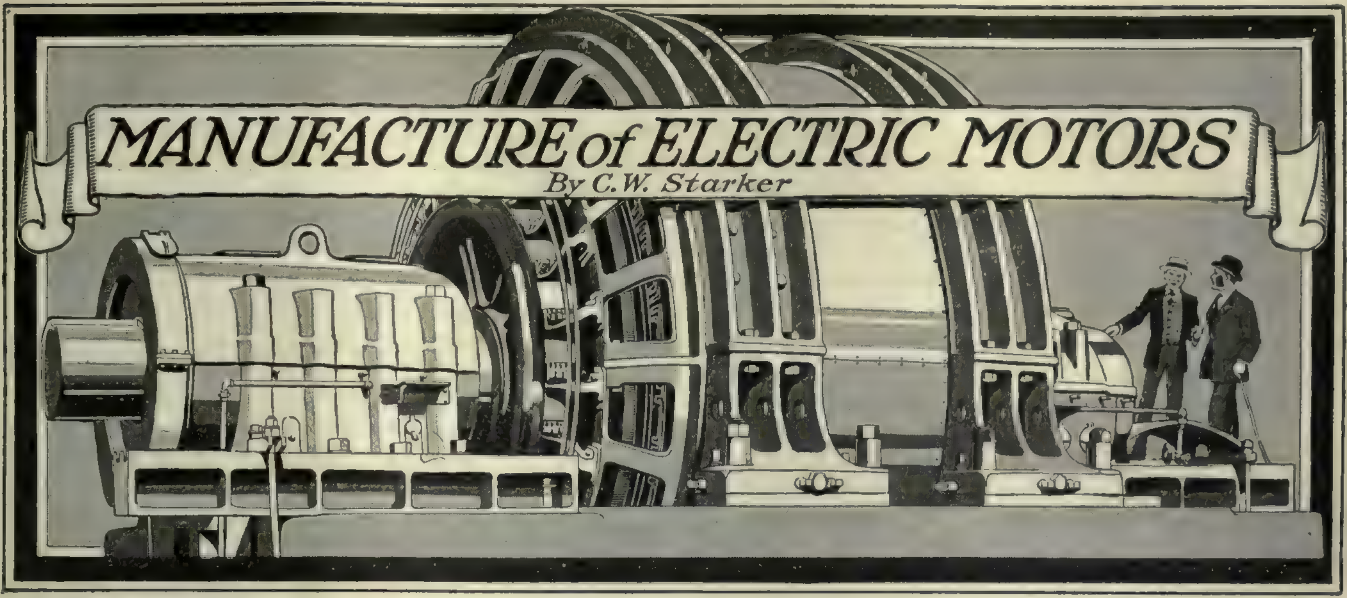
Brazing and Welding Stellite to Carbon Steel

BY THOMAS FISH
President Ready Tool Co., Bridgeport, Conn.

I was somewhat surprised to see an article by Howard Bogart on brazing high-speed steel and Stellite tips to low-carbon shanks, as I supposed our company to be the only one doing this job satisfactorily. Recently, Mr. Haines, the inventor of Stellite, stated that he had made tests and found that Stellite is weakened by brazing.

Arc welding is unsatisfactory, as it leaves blow-holes and is inclined to crack Stellite. Butt welding gives satisfactory results, as only the two faces in contact are heated to the fusion point and for a short space of time only. It does not injure the strength or cutting qualities of the Stellite.

[We have tried brazing Stellite with very unsatisfactory results.—Editor.]



MANUFACTURE of ELECTRIC MOTORS

By C. W. Starker

III. Machining and Building Up Frames and End Shields

SYNOPSIS—*This article describes the machining of frames, the building of primary cores and frameless, or built-up, type of motors and pressed-steel end shields.*

IN DESIGNING any line of apparatus it is fundamentally wrong to design all sizes alike, varying merely the dimensions, as is sometimes done. By this we mean that it is wrong to design a 100-hp. motor exactly like a 10-hp. motor except for a proportionate increase of the dimensions. The market conditions are different, as well as the requirements in manufacture and in service. A rolled-steel frame is used on the large size, while the smaller size is of the built-up, or frameless, type. The same general idea is followed in both, forged steel being selected in both cases for the stationary parts, so that the same general process of manufacture and equipment can be used.

The manufacture of steel frame rings and of the pressed-steel motor feet, including the drilling and riveting, has been the subject of the preceding article. The next step in the manufacture is the boring of the frame rings. This is done on vertical boring mills, illustrated in Fig. 26. As the hot-rolled steel material is uniform and free from hard spots, high speeds are permissible in turning and facing the ends of the rings. The bore must be accurate so that a tight fit is obtained for the punchings to be assembled in the frame. These punchings will vary in diameter according to the condition of the die; that is, whether it is slightly worn or new. It is customary, therefore, to use the punchings as a gage in boring the frame.

The bore is cylindrical, and therefore obtainable without turning the rings around on the boring mill. This means that the seats for the bearing brackets on both ends are necessarily concentric for both ends, as well as concentric with the punching bore. This insures good bearing alignment and is essential in view of the comparatively small air gap that is necessary in modern machines, on account of the high performance demanded. After boring, the drilling and tapping of bolt holes for the bearing brackets comprise the next operation. Then comes the milling of the keyway that engages the primary punchings as a safeguard against their revolving, due to the motor torque or to vibration in severe service.

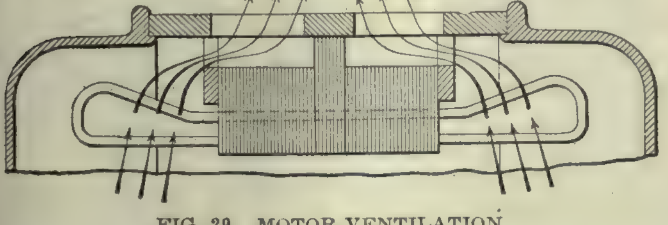


FIG. 29. MOTOR VENTILATION

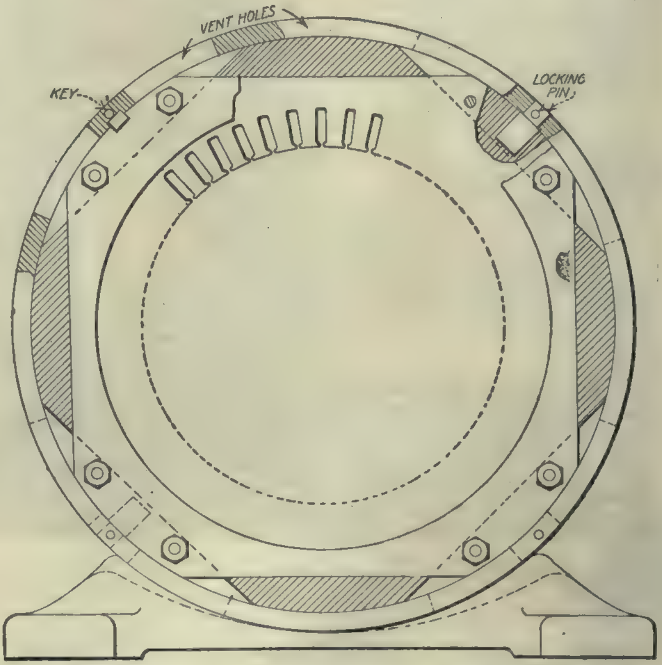


FIG. 28. STATOR OF ALTERNATING-CURRENT MOTOR

As stated in the preceding article, direct-current motors have rolled-steel frame rings similar to those used in alternating-current motors, except that they are of thicker section, for in this case the frame serves not only as a mechanical support, but as the actual flux-carrying member. The machining operations for these direct-current motor frames are practically identical with those employed on alternating-current motors and, therefore, permit the use of the same equipment. Instead of having iron laminations assembled in them, as in the other type, poles are clamped to the inner periphery by means of bolts. Such poles are either laminated—that is, bundles of punchings riveted together—or made solid from hot-rolled steel bars.

The punchings on all alternating-current motors of this construction are of square form with rounded corners. Some of these punchings are shown at *A*, Fig. 27. There are several reasons for adopting this shape in preference to the circular punching. One of the reasons is that it gives the most economical use of material. In manufacturing punchings from long rectangular sheets, there is a much smaller loss in material with square punchings than with circular punchings. The difference between the square sheet of raw material and the finished circle is practically a total loss. The importance of reducing waste in the punch shop has been pointed out in an article on the "Design and Manufacture of Punchings for Electric Motors," in the *American Machinist*, Vol. 44, page 529. A further object of the square punchings is to secure good ventilation of the motor.

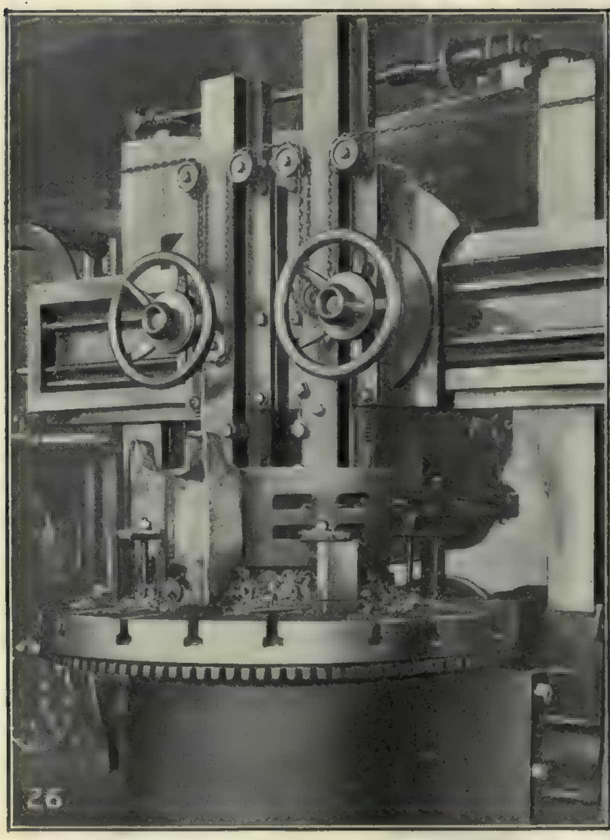


FIG. 26. BORING AND FACING ROLLED-STEEL MOTOR FRAMES

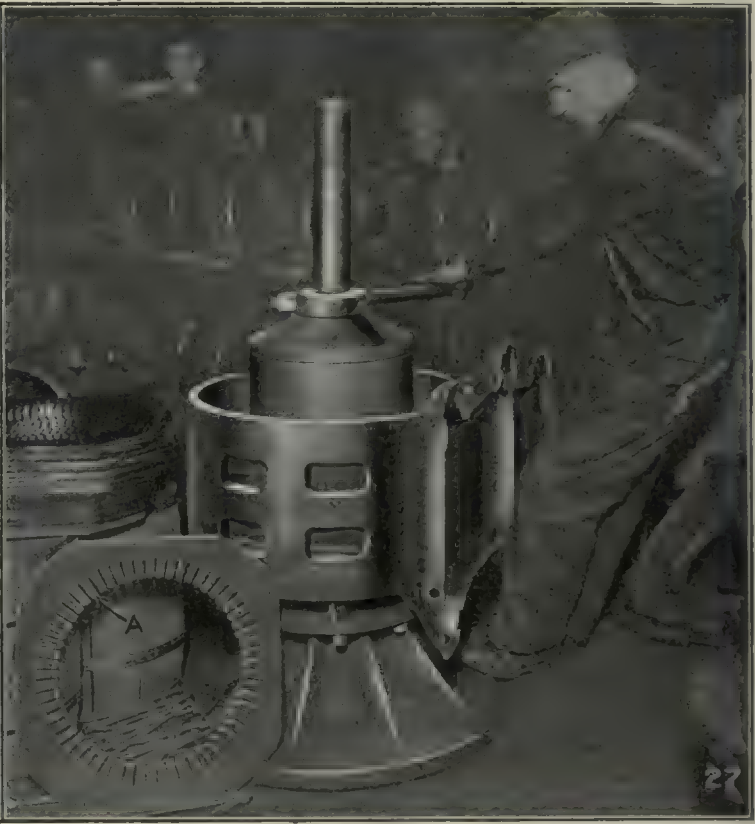


FIG. 27. BUILDING LAMINATIONS IN ROLLED-STEEL FRAME

This is best understood by reference to the diagrammatic view, Fig. 28, which is an end view showing the location of the ventilating openings in the frame rings relative to the flat sides of the punchings. Fig. 29 is a sectional view showing how the air current, produced by blower vanes mounted on the rotating element, passes over the primary punchings, thereby effectively cooling them, before passing out through the openings in the frame ring. It will be noticed that the middle bundle of punchings is staggered 90 deg. This feature also has several objects—namely, to form a partition wall, preventing the meeting of opposite air currents, as will be understood from the arrows in the illustration. Another object of this staggering is to increase the average depth of iron below the bottom of the slot. At the corners, this depth—that is, the amount of material useful for magnetizing—is greater than at the flats.

A third object is to provide a space or recess for inserting a plug or pin, intended to prevent lateral shifting of the core. Two such plugs or pins are used diametrically opposite, as shown in Fig. 28. An arrangement of this sort permits the building up of various widths of laminated cores within the same frame ring, as may be required to secure the desired characteristics of the motor. This is possible without any change in the component parts, other than a different number of punchings.

In Fig. 27 is illustrated the building up of the punchings in the frame. This is done on expanding mandrels. On each end of the core, heavy punchings ($\frac{1}{16}$ to $\frac{3}{32}$ in.) are used to reduce the flare of the core, and in addition to these there is an end plate at each end made from hot-rolled steel bars $\frac{1}{2}$ to $\frac{5}{8}$ in. thick, rolled up and sheared square, as shown in Fig. 30. These steel end plates are unbreakable and, therefore, preferable to cast iron. After enough punchings have

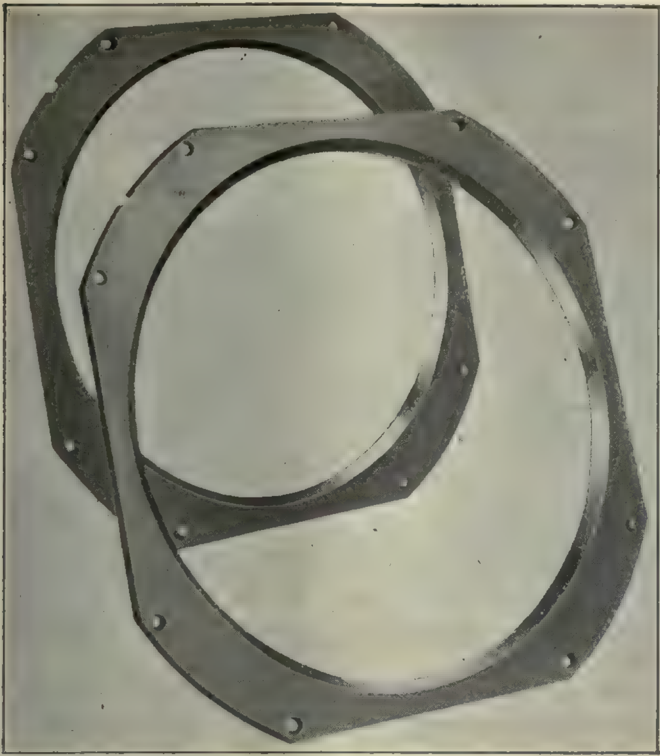


FIG. 30. PRIMARY END PLATES FOR ALTERNATING-CURRENT MOTORS

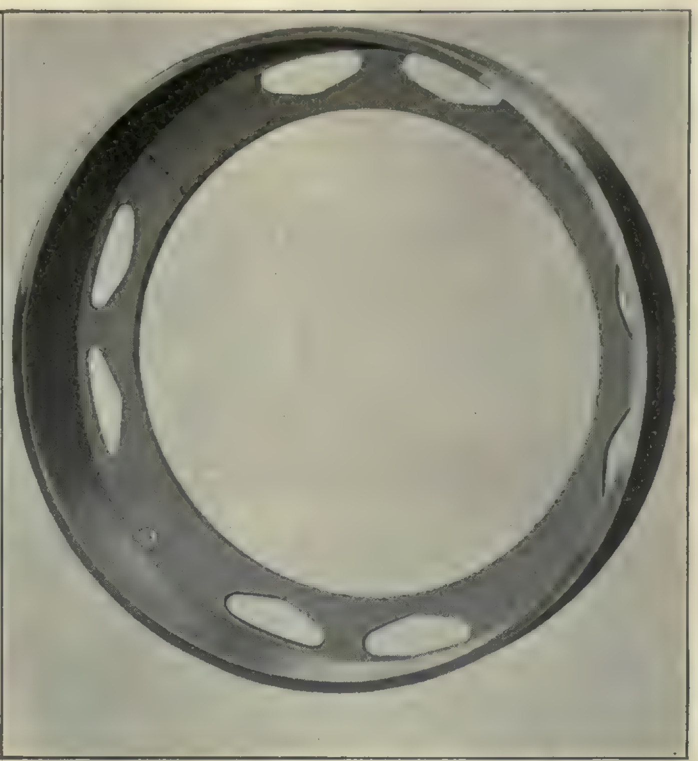


FIG. 32. PRESSED-STEEL END SHIELDS FOR BUILT-UP MOTORS

been assembled on the mandrel, the core is compressed by means of a large screw and nut at the top of the fixture; eight bolts are then inserted extending through the core and end plates, and these bolts are drawn tight and peened over while the core is still under pressure.

Certain alternating-current motors are of a still simpler construction and still more flexible in design. In these, no frame ring is used, and the laminated core consists of a number of bundles of square punchings, usually seven or thirteen bundles. Each bundle is staggered 30 deg. from the preceding one, so as to average the depth of iron below the slot and incidentally produce effective cooling ribs at the outside of the core. This core is built up on expanding mandrels, as shown in Fig. 31, with an end shield at each end, the details of which may be seen in Fig. 32. These shields are made from steel plate ¼ to ½ in. thick, pressed into pan shape on hydraulic presses. The centers are punched out next and the ventilating holes pierced on a somewhat smaller motor-operated eccentric press.

After the punchings have been built up on the expanding mandrel, 12 rivets are driven through the core and end shields and their heads upset on the special hydraulic riveting machine shown in Fig. 33. This is done while the core is still on the mandrel and under compression. The use of an expanding mandrel and riveting while under pressure secures perfect alignment of the bore of the punchings, and the insertion of 12 rivets makes a solid unit of the entire structure, which permits rough handling without risk of distortion. In the next step a one-piece pressed-steel motor foot, such as previously described, is riveted to both of the end

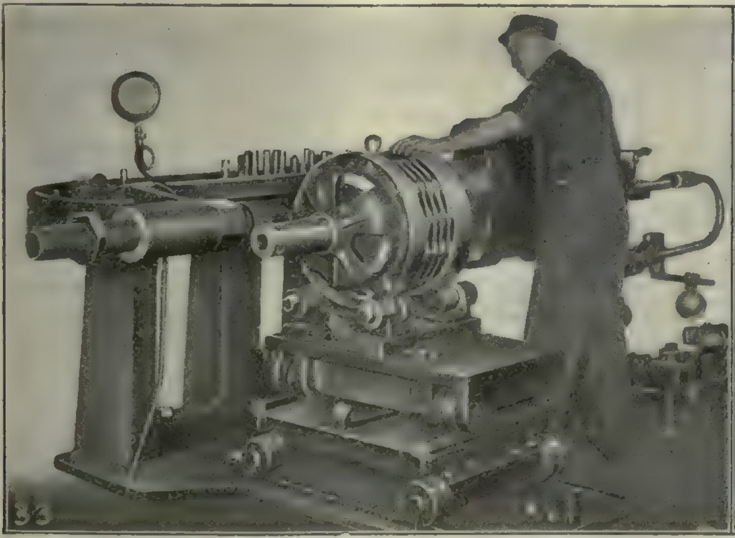


FIG. 33. HYDRAULIC RIVETING PRESS FOR RIVETING BUILT-UP CORES

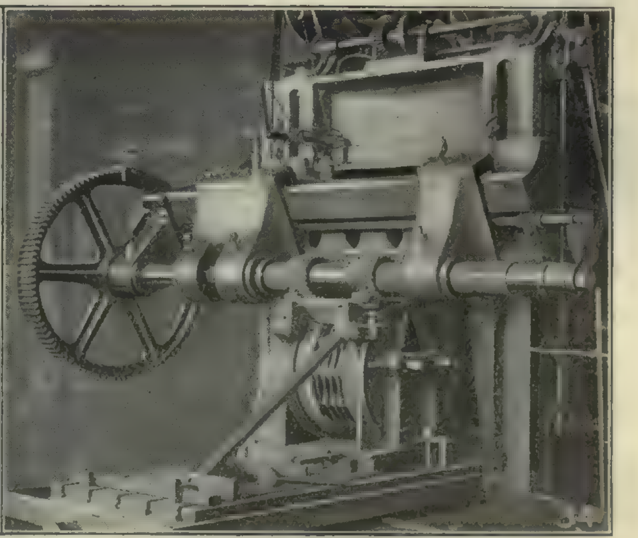


FIG. 34. MILLING BASE OF MOTORS ON HORIZONTAL MILLER

shields, on a hydraulic press quite similar to that illustrated in the preceding article.

With this one-piece base further tying the two ends of the core together, a stator is obtained which withstands even quite unreasonable treatment in service. In one of the early tests, a stator built up as decribed was purposely dropped from a crane 6 ft. above floor level. The bore of the punchings was measured accurately before and after dropping, and no change in alignment was found.

After the core is built up and riveted and the foot riveted on, the pressed-steel end shields are machined on both ends for bracket fits. Attention is again called to the flexibility of this design, by which good manufacturing conditions are obtained in spite of the great variety of product unfortunately existing in the electric-motor industry. Certain standard widths and diameters of these pressed-steel end shields have been established, and with these practically any width of core can be obtained and any length of extension of primary coils accommodated that may be necessary for the individual motor rating.

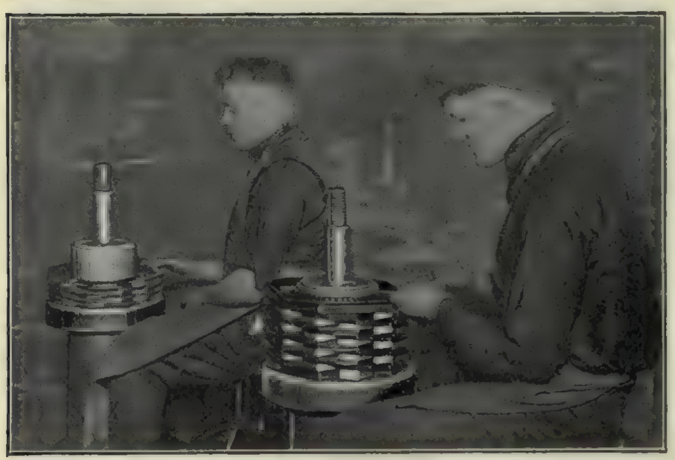


FIG. 31. BUILDING UP OF "FRAMELESS" STATORS OF ALTERNATING-CURRENT MOTORS

The next step in the manufacture of both frame-type and built-up type motors is the milling of the base. This includes the milling of slots or grooves for the slide rails used in belted motors. This operation is shown in Fig. 34. A word should be said here in reference to the accuracy of this milling, which is sometimes not fully understood and in regard to which the practice of different manufacturers varies, some of them permitting a variation of as much as $\frac{1}{8}$ in. The following manufacturing limits have recently been suggested for adoption by the American motor manufacturers:

The permissible variation in height from the center line of the shaft to the bottom of the motor is to be from plus zero to minus $\frac{1}{32}$ in. That is, the nominal dimension will never be exceeded, but liners up to $\frac{1}{32}$ in. may be required to secure alignment of a motor for gearing or coupling, etc. In reference to parallelism of the axis of the shaft to the bottom of the motor, it has been proposed to permit a maximum variation between the two ends of 0.025 in. for shafts 3 ft. long or less, and 0.032 in. for shaft lengths above 3 ft. and up to 6 ft. In applying motors to machine tools, elevators, etc., these manufacturing variations should be taken into account.

The last step in these machining operations is the drilling of the foundation bolt holes. This operation is done after all the machining on the stator has been performed, so that with the use of jigs, close accuracy is obtained in the location of the bolt holes. However, in large-scale manufacture, manufacturing limits are required and should be kept in mind by motor users. Best practice permits a variation of $\frac{1}{32}$ in. in spacing between centers of foundation bolt holes or between center of bolt holes and center line of motor.

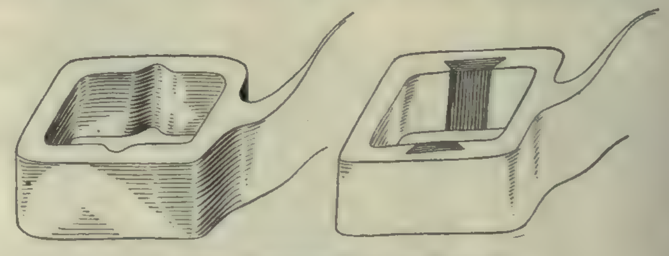
As for the size of foundation bolt holes, a definite standard has not yet been arrived at by the motor manufacturers, and the practice of motor users differs in regard to the desired bolt clearance. For general purposes a considerable amount of clearance is contemplated between bolt and bolt hole—namely, $\frac{5}{32}$ in. on the diameter for $\frac{5}{8}$- to $\frac{7}{8}$-in. bolts, and $\frac{3}{16}$ in. for 1-in. and $1\frac{1}{4}$-in. bolts. This large clearance is required on account of inaccurate spacing of bolts in concrete foundation, on structural work, etc. When belted motors are assumed, standard bolt sizes of $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$ and 1 in. are intended to be applied in each case by the motor users.

In all those cases where it is desired to locate a motor definitely, such as in geared or coupled service, dowels may be used, but many motor users prefer the so-called tight-fitting bolts. The foundation bolt holes in the motor feet are selected with this point in mind. For instance, the drilled holes in the motor foot are made $\frac{25}{32}$, $\frac{29}{32}$, $1\frac{1}{32}$, $1\frac{3}{16}$ and $1\frac{7}{16}$ in. in diameter with the idea of using $\frac{5}{8}$-, $\frac{3}{4}$-, $\frac{7}{8}$-, 1- and $1\frac{1}{4}$-in. bolts respectively for ordinary purposes and $\frac{3}{4}$-, $\frac{7}{8}$-, 1-, $1\frac{1}{8}$- and $1\frac{3}{8}$-in. bolts where *tight-fitting* bolts are desired. This leaves theoretically a slight clearance between the body of the tight-fitting bolt and the hole, but in actual practice it is necessary to figure with a slight clearance due to variation in drilling, both of the motor foot and the base on which it is mounted, so that the bolt sizes and holes given result in practice in a tight-fitting bolt equivalent to dowels.

Repairing Belt Shifter

By H. Lauterbach

The belt shifters of a planer that had been in use for a long time became so badly worn that it was necessary either to repair them or replace them with new ones. They were repaired in the following manner: Taper, dovetailed grooves $\frac{3}{16}$ in. deep and 2 in. long were filed at the worn places, pieces of hardened steel were fitted into the grooves, and the edges were rounded to conform with the shape of the shifter. This repair was made three years ago, and the plates do not show the slightest wear.



STEEL INSERTS IN SHIFTER

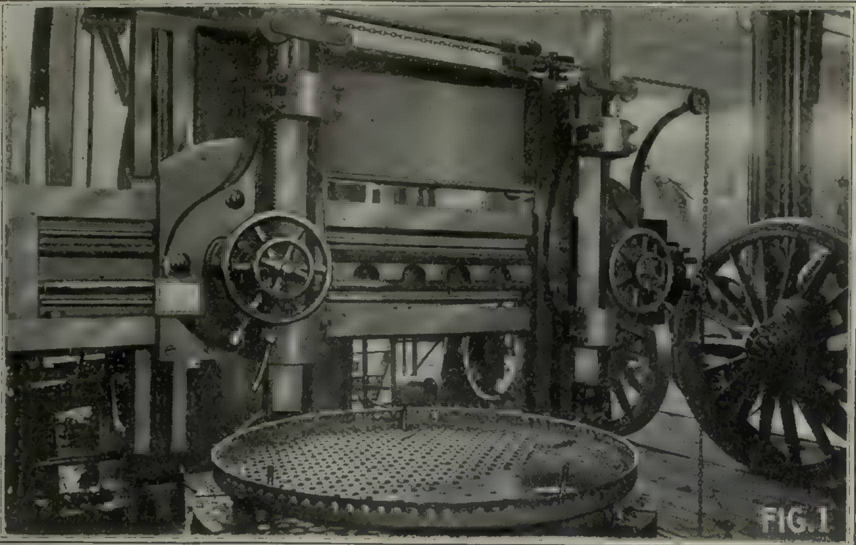


FIG. 1

Boiler Work in a Nevada Railroad Shop

By Frank A. Stanley

SYNOPSIS—*The equipment of this shop in all departments is very good, and the boilermaking department is no exception. Some of the special features are of interest to many mechanics not in railroad work.*

THE accompanying illustrations show some of the methods in boiler work at the Sparks, Nev., shops of the Southern Pacific Co. While Fig. 1 represents an operation on a boiler part, it is obviously a machine-shop illustration, the work having been sent in from the boiler shop for convenience of handling on the vertical boring and turning mill.

The flanged sheet, circular in form and provided with flue, staybolt and rivet holes, is shown ready for clamping on the boring-mill table for the operation of squaring off the edge of the flanged surface. The method of locating on blocks on the table and the application of bolts and straps for holding down the work will be apparent upon inspection of the photograph, although two of the straps and nuts were not in place when the negative was made.

OXYACETYLENE FLAME FOR BENDING

Figs. 2 and 3 show an interesting application of the oxyacetylene flame in the process of bending up a flanged sheet, so that the angle of the bend comes in the flanged edges themselves. This bending operation is carried on in the rolls, which are squeezed together upon the edges of the flanges to produce the bend in both flanged portions and in the body of the sheet itself; that is, the angle is bent straight across the flat portion and the flanged edges. In order to accomplish this readily, local heating is resorted to—by applying the oxyacetylene blowpipe in the manner indicated in Fig. 2.

The portable apparatus is seen at the right of the bending rolls, and the operator is holding the pipe against the inner edge of the flange at the point where bending pressure is to be applied by the rolls. Both flanges are treated in this way until hot enough to allow the flanges to bend easily, when the upper roll is screwed down by means of the long hand lever, which is swung around by the workmen, as represented in Fig. 3. It takes but a moment to heat the sheet in this way sufficiently for the purpose stated, and very satisfactory results are secured.

TRESTLES AND SPECIAL SUPPORTS

In earlier articles reference has been made to the light but strong metal trestles, or horses, used throughout this plant. Fig. 4 shows one of these handy affairs in front of the work and two at each end, the three most conspicuous in the view being all of different dimensions and giving therefore some idea of the various sizes that have been found most useful in the shops. As already pointed out, these trestles are built up of old boiler tubes swaged in along one side to form a flat crescent section, which is stiff against bending and also handy in form for the riveting on of the rungs, or cross-tying, members.

Another convenient piece of boiler-shop apparatus is that shown by Fig. 5, which illustrates a sling and hoist carried by another tube-built structure. This support is used for handling and holding various sheets and other members for the convenience of the men working on boiler and tank construction. The structure is swung about to any desired position to suit the location of the boiler job and can be used for suspending a sheet or other part in any place required according to the character of the work. The trolley that suspends the hoist carries a large disk at the front, which is provided around the edge with a series of holes in which a locking pin is adapted to fit to hold the trolley proper at any point along the horizontal tube on which it travels. The structure stands about 10 ft. high, and the trolley rail, or tube, has a length of approximately 10 feet.

LARGE LAYING-OUT AND FORMING PLATE

Fig. 6 illustrates a laying-out and forming plate made of a heavy sheet flanged about the edge and placed upon blocks to bring it to a convenient height for the workmen. On this plate, layouts are marked; also work to be bent up is tested for accuracy of angles and dimensions in general by placing upon the outline drawn on the surface of the plate. It is also a form of surface plate for boiler work for laying out directly many

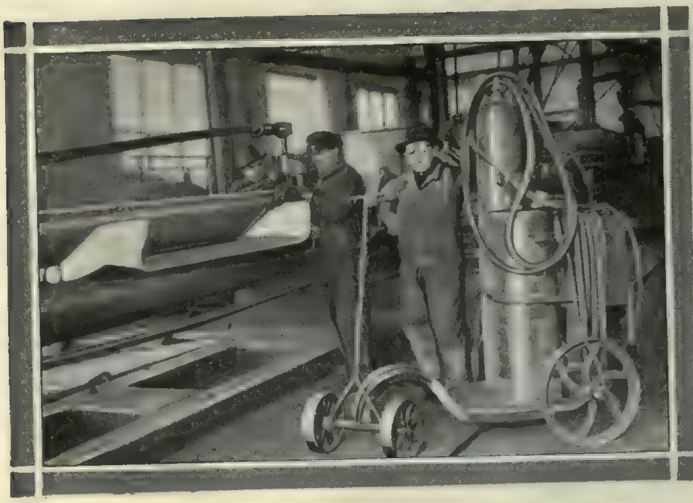


FIG. 2. HEATING FLANGED SHEET FOR BENDING

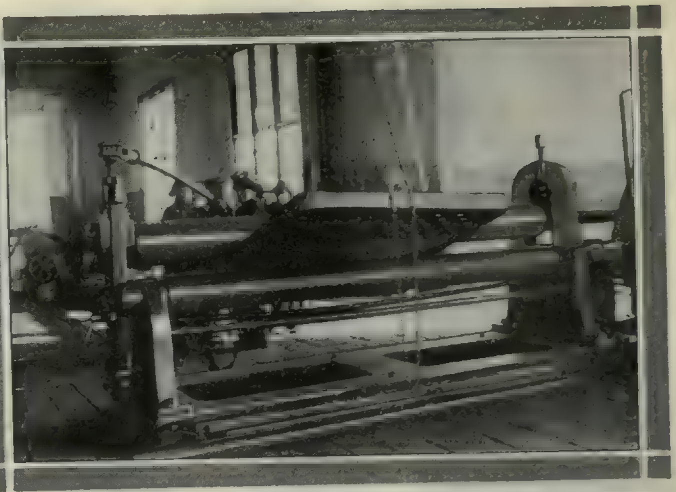


FIG. 3. BENDING THE SHEET IN THE ROLLS

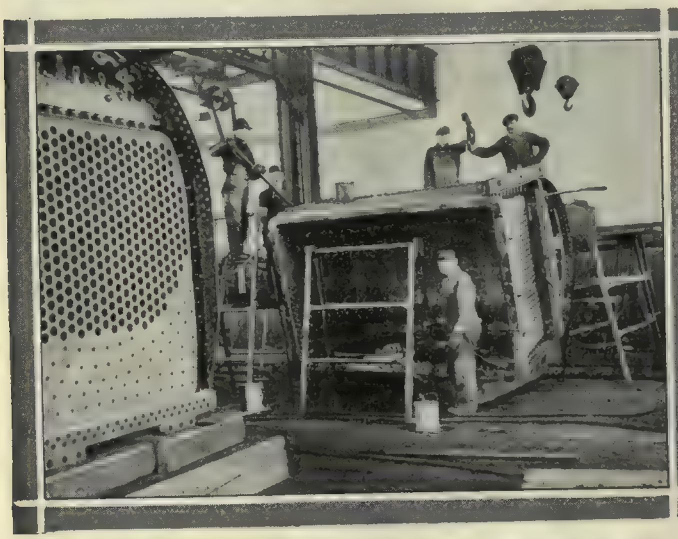


FIG. 4. TRESTLES, OR HORSES, USED IN BOILER SHOP

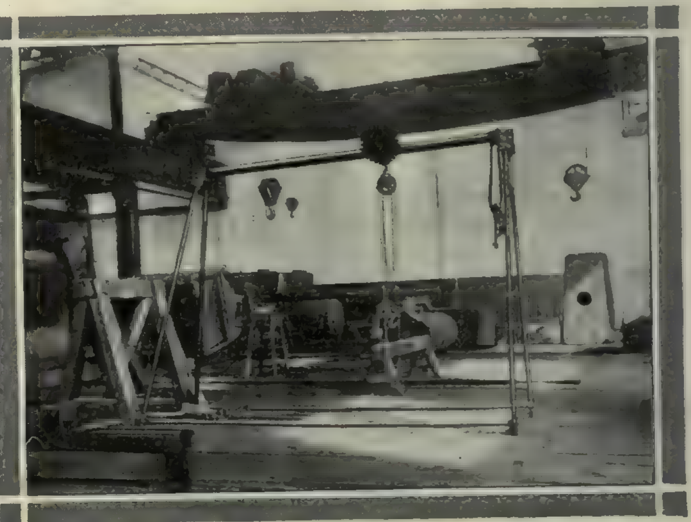


FIG. 5. A HANDY PORTABLE SHOP HOIST

pieces and for testing with square and other tools the correctness of such parts when bent up or formed in machines or under the hammer. This plate is very convenient for this work and has saved considerable labor. Mention has been made in other articles of the very complete system of machine guards applied throughout these shops. Figs. 7 and 8 are further examples of such precautions taken to prevent accidents to workers about punches, shears, rolls, etc. The illustrations are practically self-explanatory, but it may not be out of place to call attention to one feature, the height to which the guard rails are extended above the floor. This height of pipe standard and rail is such as to make it impossible for anyone to walk into contact with belt,

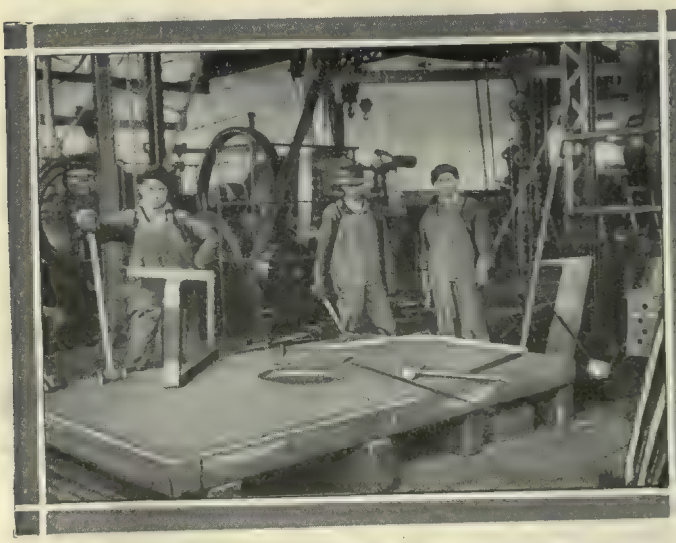


FIG. 6. LARGE LAYING-OUT AND FORMING PLATE

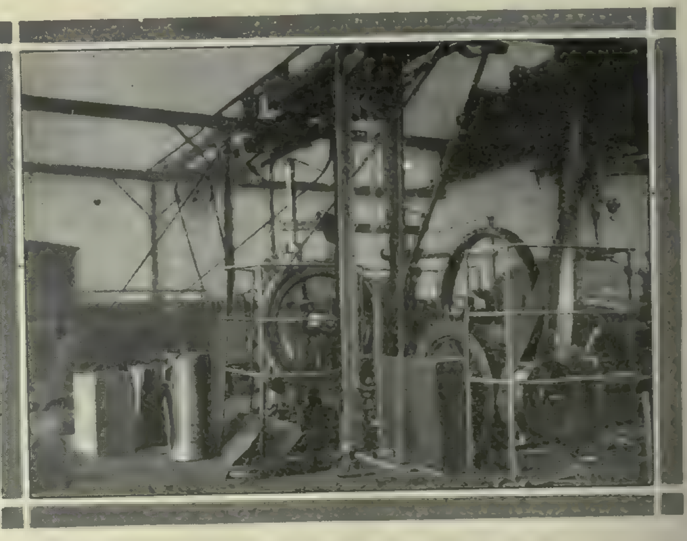


FIG. 7. METHOD OF GUARDING PUNCHES AND SHEARS

gear or pulley or to touch any of these running members without deliberate carelessness upon his part.

Deliberate carelessness of the workmen is a thing that is common to the large majority of shops. Why men will be careless when they see the accidents resulting from this cause is hard to explain, but it is, nevertheless, a fact that cannot be disputed.

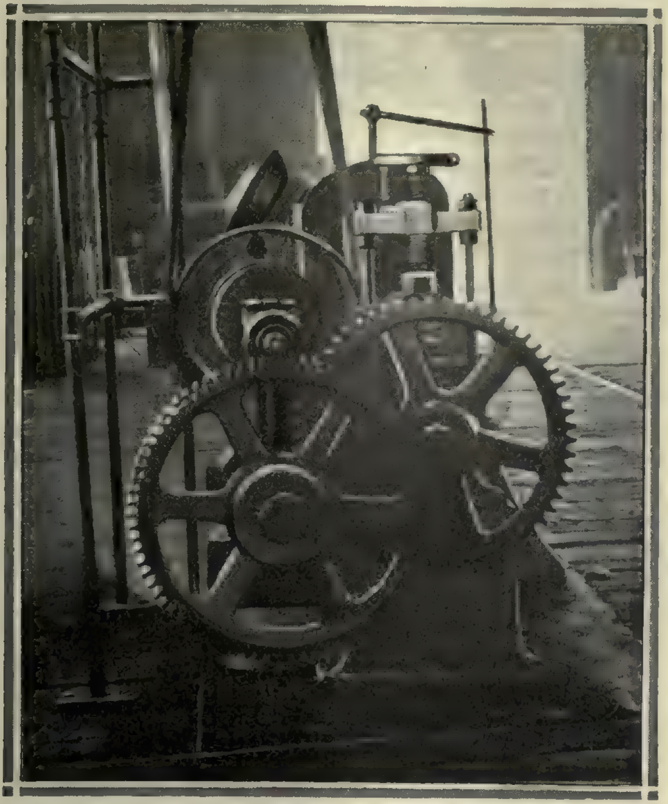


FIG. 8. GUARD FOR BENDING ROLLS

Standard Marking for Distinguishing the Various Steels

By Thomas Fish

There is one thing in connection with steel which I think could be used to advantage throughout the country, and that is a universal color scheme for the marking of the various grades so that when steel is received by the consumer, jobber or dealer he would at once know machine steel from tool steel and tool steel from high speed, etc.

We have adopted certain markings, and these, with the reasons for our choice, are given below:

All machine steel and screw stock we mark white, as this is the general custom for low-carbon steel. Chrome-nickel and other alloy steels we mark with yellow, as this is economic. High-speed steel we mark red, as this seems to be so closely connected with the understanding of high-speed steel. This leaves for tool steel, the other principal color, blue.

Then, if you have a steel that is halfway between any of these; for instance, an air-hardening steel that is neither tool steel nor high-speed, mark it blue and red. If you have a high-grade machine steel that is neither machine steel nor tool steel, mark it blue and white and the same with other combinations.

If this idea could be adopted by all the steel plants, it would save a great deal of confusion and expense. People constantly come to us asking whether stocks they have are tool steel or high speed, and even ask us to differentiate between tool steel and machine steel. This is a problem that is very difficult to solve unless a person is familiar with the various grades.

Of course from our experience we can quickly tell, but the ordinary supply house, and in fact most factories, cannot tell the difference. With some such scheme of marking as the foregoing, however, all this trouble would be eliminated.

We mark the full length of the bar in stripes if it is a combination steel, but in a solid color if a known standard grade that agrees with the standard market. If we have any short ends they are always marked.

Shall We Allow Our Industries To Be Disabled?

By Thomas S. Vierow

One of the most vital things necessary to successfully carry through the program of national defense is to keep the highly skilled mechanics in the industries. The time is past for a national protest against the acceptance of such men in the army and navy. The craftsman who strongly desires to defend the nation in active service is imbued with the healthy spirit of civic pride, but his lot must not be a matter of choice, likes or dislikes.

The efficiency of the enemy demands that we keep the first-class mechanics at their work. Though the demand for skilled men far exceeds the supply, and Government agents are hot after delinquent, but helpless contractors, yet thousands of these men have been permitted to enlist.

Do men in official positions realize the strain upon a workman engaged in the production of munitions? Do they know the perseverance and patience required, and the strain upon a man engaged in producing work to a degree of accuracy of one ten-thousandth part of an inch? Do professional men know that these men cannot bury their mistakes and that engineers are most poorly paid?

Think of the task at a sweltering furnace, a machine in the atmosphere of smoking oil, the dust of a sparking grinder, the noise of pounding presses, and then think of getting into the fields or upon the sea. Is he who sticks to this job a "slacker"? There are many in this army of peace, who, disregarding the obligations they owe those who gave them a place in the work of civilization, have misinterpreted the cry of "Don't be a slacker" and have joined the colors to the detriment of the country.

To engage green men is costly, and the burden does not fall upon the wealthy; the poor must always pay. Russia is offering the greatest inducements of all times to get our men and methods across the sea, and men are organizing in the east and west, crating machinery, and going across.

The cry has been "Wake up, America," but shall the disabling of our means of production continue in the awakening?

Sending Machine Tools to France

Special Correspondence

Those who are sending or who wish to send machine tools into France will be interested in the decisions of the French Ministry in regard to the importation of machine tools and small parts. This information is contained in the following paragraphs, which give the exact status of machine-tool importations at the present time.

The decree of Apr. 14, 1917, placed goods included in list No. 3 of the decision of Apr. 13, 1917, under the control of the "Commission Interministérielle des Métaux et des Fabrications de Guerre" (C.I.M.). This list, completed by later decisions, includes notably —under the heading "Metal Work"—machine tools and small parts. Moreover, the decision of July 8, 1917, stipulated that the authorization to import must be prior to shipment.

Requirements for Importing Machine Tools

In future, machine tools and small parts can be imported only if covered by an import permit prior to the placing of the order or contract. Any buyer proceeding otherwise can rely neither on the intervention of the state for any facilities whatsoever, nor be sure of obtaining, later, the requisite import permit. Further, the goods are liable to be requisitioned or to be held up at the custom house, at the risk and expense of the buyer, or even to reëxportation.

It must be borne in mind that requests for import permits are to be made by the buyer himself: To the Service Technique du Ministère du Commerce, 66 Rue de Bellechasse, for all goods passing through salesrooms; to the departments or services interested, in all other cases.

To facilitate operations, buyers must present only one import permit request for each order to the same dealer, whatever may be the importance and dates of shipment; on arrival of goods, and on presentation of this original import permit, the C.I.M. will, if advisable, give direct, for part deliveries, partial import permits, and will continue thus until the number stipulated on the original import permit is attained.

When Permits Are Not Obtained

In order to settle the question of orders which have been placed without import permits having been first obtained, it will be necessary, exceptionally, to proceed as follows:

Requests will be grouped by the applicant according to categories a, b, c, d, e and f (see below), this classification forming one of the points for examination of the requests.

A. Importations of manufacturers working for the national defense: (a) For all orders prior to Apr. 15, 1917, the applications for import permits must be addressed by the buyer direct to the C.I.M., who, on presentation of supporting documents, will decide regarding the import permits; (b) for all orders after Apr. 15, 1917, the applications for import permits must be addressed to the department or service interested, which, on presentation of supporting documents, will give its opinion and transmit the application to the C.I.M., who will decide regarding the import permit.

B. Tradesmen's importations. Whatever may be the date of the order and the date of shipment, applications for import permits must be addressed to the Ministère du Commerce, 66 Rue de Bellechasse; they must be presented by category: (c) Orders previous to Apr. 15, 1917, with shipment prior to July 15; (d) orders prior to Apr. 15, 1917, with shipment after July 15; (e) orders after Apr. 15, 1917, shipment prior to July 15; (f) orders after Apr. 15, 1917, shipment after July 15. The Ministry of Commerce will give its opinion and transmit the request to the C.I.M., who will pass upon the import permit.

C. Importations other than those covered by paragraphs A and B. For these importations the applicants will proceed as set forth in paragraph B; but the C.I.M. will reserve to itself the right, in case the import permit is granted, to have the imported goods requisitioned on arrival.

With a view to settling immediately the situation of orders placed without import permits having first been obtained, the corresponding applications, indicating the probable date of arrival of the goods, must reach either the C.I.M. or the department or service before Sept. 25, 1917, after which date they will not be received. Import permits will be granted in a measure calculated to restrict the amount of importations effected to the limit fixed by the C.I.M.

Selective Assembling and Interchangeability

By Albert F. Guyler

The scheme given by F. H. Bogart on page 513, Vol. 46, is hardly one that would commend itself to a firm manufacturing a number of machines each having a hundred or so parts, owing to the amount of stock necessary to be carried and the liability of errors occurring in assembly. The result would be a poorer class of work than in interchangeability, besides which, as he remarks, "the public demand that the component parts of any mechanism purchased be interchangeable . . . will limit the field of the selectively assembled product."

On his "typical gaging table" he provides for 11 different sizes of one part the working limits on which are ±0.004 in. (divisions being for "outsizes," each part of which would require special attention). If this trouble is incurred for each of several hundred different parts, one would imagine that the added expense of taking care of these pieces and of making special sizes in order to keep the stocks down would outweigh any of the disadvantages that would be incurred if the product manufactured was made simply interchangeable.

The example quoted, of the ball thrust washers, would be all right if they were to be sold singly; but it is the practice with some manufacturers to buy their thrust bearings, separate them into their component parts, assemble these parts with the parts of the machines to which they are to be fixed and bring the three parts of the bearing together again only on the final assembly of the machine. This, of course, refers to thrust bearings having ball races and not to the flat-washer type, the former being made so that one part fits the shaft while the other fits the part supporting or revolving round the shaft.

The fact that ball bearings are interchangeable makes it possible to remove a broken race and replace it quickly with a new one. If the shaft or housing had to be turned or bored to suit the bearing, considerable time would be occupied and trouble given.

Then, how would parts be classified which have two important dimensions, one being plus and the other minus? It would appear therefore that only simple parts of one important dimension would be included in the scheme and that at greater expense than with an interchangeable product, as the "wrinkle worked to even up mismated parts" would be a case of working to set dimensions with no tolerance—certainly not a good manufacturing proposition.

There is one case, however, where selective assembly would be an advantage; and that is where one fit must be made to a fine limit, as by using a combination of selective assembly and the limit system, the working limits could be doubled and interchangeability still guaranteed with the required fit.

For example, let us assume a ½-in. diameter running fit, the hole to Newall *B* class and the shaft in class *X*. The Newall limits for this fit would be: Hole, ±0.0005 in., giving a tolerance of 0.001 in. The shaft would be —0.001, —0.002, a tolerance of 0.001 in. This would give a possible difference in the mating parts of 0.0005 in., 0.0025 in. By increasing the tolerances to ±0.001 in. for the hole and —0.0005 in., —0.0025 in. for the shaft and dividing each part into the lots on gaging, the holes being +0.001 in., +0.0005 in *A*, 0.000 in *B*, —0.0005, —0.001 in *C* and the shafts —0.0005, —0.001 in *D*, —0.0015 in *E*, —0.01, —0.0025 in *F*, then *A* would be assembled with *D* or *E*; *B* with *D*, *E* or *F*; *C* with *E* or *F*; *D* with *A* or *B*; *E* with *A*, *B* or *C*; *F* with *B* or *C*. Care would be needed to see that *A* was never assembled with *F* nor *C* with *D*, and *B* and *E* would always be used for repairs or replacements. In this way the maximum clearance of 0.0025 in. possible with the Newall system will never be exceeded, yet the working limits are doubled while interchangeability is retained.

Preventing Cracks in Hardening

By B. Borden

After reading the article by Mr. Hampson on how to prevent cracks in hardening, and also the one on hardening high-speed steel by Mr. Rogers, I would like to say a few words on the same subject from the standpoint of the blacksmith in the small shop, where equipment is usually very limited, often consisting of a forge, a small open hard-coal furnace, a barrel of water and a can of oil. With this equipment the smith is expected to, and usually can, produce good results if proper care is taken.

I differ from Mr. Hampson in a few things in my method of hardening carbon tool steel in water to prevent cracking. Too much cannot be said in favor of slow, careful heating, nor against overheating, however.

My experience has taught me, however, not to take the work from the hardening bath and leave it exposed to the air if there is any heat left in it, because it is more liable to crack than if left in the bath until cold. The reason for this is not hard to find. In heating, plenty of time is taken for the work to heat evenly clear through, thus avoiding strains caused by quick and improper heating. Now in quenching in water, contraction is much more rapid than was the expansion while heating, and strains begin the moment the work touches the water. If the piece has any considerable size and is taken from the bath before it is cold and allowed to come to the air, expansion starts again from the inside so rapidly that the chilled hardened surface cracks before the strains can be relieved.

The method that I have been most successful with is to have the hardening bath about blood warm. When the work that is being hardened is nearly cold, it is taken from the water and instantly put into a can of oil, where it is allowed to finish cooling. The heat in the body of the tool will come to the surface more slowly, thus relieving the strain and overcoming much of the danger of cracking.

The temper should be drawn as soon as possible after hardening; but if this cannot be done for some hours, the work should be left in the oil until the tempering can be done. Forming dies and punch-press dies that are difficult to harden will seldom crack if treated in this way. Small tools or pieces that are very troublesome because of peculiar shape may be hardened in a bath composed of 1 lb. corrosive sublimate, ½ gal. vinegar and ½ bbl. rainwater at a much lower heat than is required for clear water, the temper to be drawn in the usual way. This bath should be warmed the same as the water, and the work hardened in it should be also put in the oil. This solution works well on drill bushings, taps and dies, small punches and the like.

For high-speed steel in such a shop as the one I have just mentioned, and where a small hard-coal furnace is located, excellent results may be obtained in the following manner: Place on the fire a graphite crucible large enough to admit the work to be heated without touching the crucible. Build up brick as high as the top of the crucible; fill that with lead, and the space between the crucible and the brick with coal. When the lead begins to boil, skim it and cover its surface with fine charcoal. Now put on blast enough to bring the heat up to the degree wanted. If the lead is kept well covered with charcoal, it will not burn away. Preheat the work on the fire before it is put into the lead. A uniform heat is thus obtained. Some small particles of lead will stick to the work, but will scrape off easily after the tools are cold. Taps, dies, reamers, milling cutters and, in fact, all fine tools may be heated in this way without injuring their cutting edges.

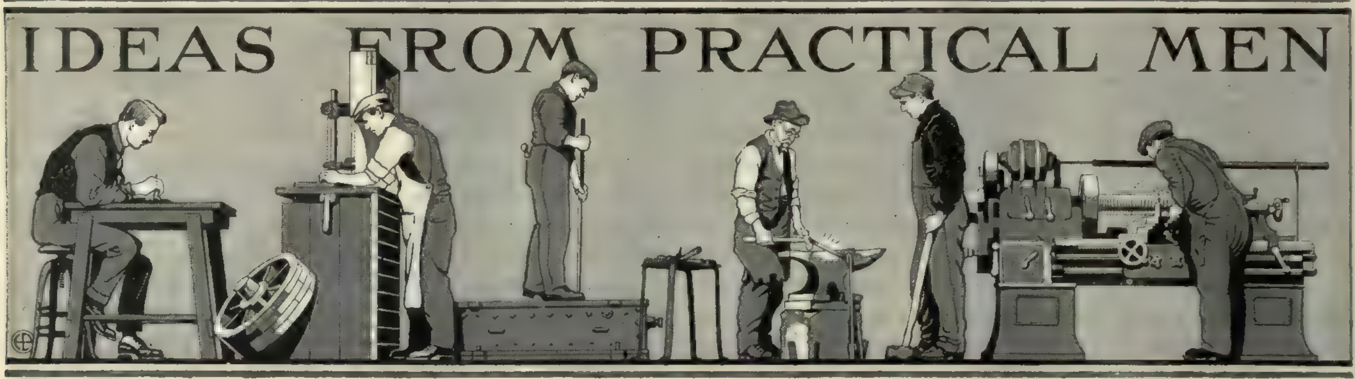
The writer has used this method for a number of years and has had very few complaints. The tools thus hardened give as good satisfaction as those which were heated in an electric furnace.

Deodorizing Lard Oil

By Ernest E. Hess

We have a problem in our shop; namely, to find a substance that will act as a deodorant for lard oil, which we use for a coolant in metal cutting. The oil is all right for a few days after exposure to the air, when it quickly gets rancid. Some water is mixed with the oil. Can anyone furnish a solution for this difficulty?

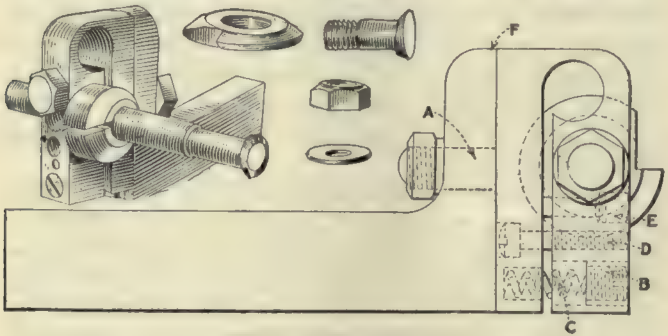
IDEAS FROM PRACTICAL MEN



Thread-Cutting Tool

By F. H. Minett

The writer, with many years' experience on thread-cutting tools and precision-gage work, offers a thread-cutting tool that he has not seen surpassed for usefulness. The cutter head swivels at *A* and is set to the angle of the helix, $\frac{\text{pitch}}{\text{pitch diameter} \times 3.1416} = \text{tangent}$ of helix. The screw *B* adjusts the tension of the spring *C*, the screw *D* acts as a stop, so that the cutter will return to proper position after the cut; *E* is the lock-screw by which the tool may be locked for roughing external threads and to hold the tool rigid for internal cutting, using the cutter bar as shown in the illustration.



THREADING TOOL

The great advantage of this tool is that the circular cutter may be removed from the holder for sharpening and be returned accurately to its position. The spring feature also insures a smooth, well-formed thread, so difficult to obtain with the fixed tool.

What Are the Correct Sizes for This Pattern?

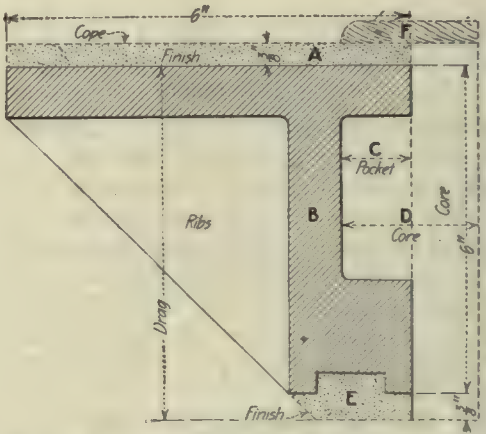
By M. E. Duggan

The pattern under discussion is illustrated and described on page 640, Vol. 46, by Jan Spaander. His description is somewhat confusing. Are the figures given the dimensions of the pattern or of the finished casting? What is wanted, as I understand the article, is a pattern from which a casting can be produced and finished for a punch holder. Only one casting is required.

Why not make a simple sketch of the machine part wanted, showing the design, the dimensions and the parts that are to be finished? Leave the making of the pattern and the allowance for finish to the patternmaker. If he allows a half inch for finish and you think it more than is really necessary, do not let that worry you. The planer will rip that off in one cut, and the few extra pounds of scrap will never be noticed or bankrupt the man who pays the bill.

To make a pattern with a slot of this size and from it produce a casting with a finish allowance at the sides only, is not efficient, economical or practical. To do this, a perfectly straight casting must result; but this you will not get in a casting of the given length. In the second place, it hinders rather than aids the machinist. I doubt if a machinist would approve of this, even if the castings were made in large quantities. The slot should be cut out of the solid metal.

If there is any question about the casting springing, take the matter up with the molder before making the pattern. He may be able to offer a suggestion that, if carried out, will prevent a spring in the casting; but I doubt it very much. The spring in a casting can very often be corrected by the molder after he has experimented with a few castings. This has been my experience. The casting, Mr. Spaander says, "came out straight." This was probably *luck*. However, when but one or two castings are wanted, it is good practice to allow a little extra for cleaning up, in case a spring occurs in the casting. The molder asked how the pattern should be molded. Was he a molder? This question is usually asked when a pattern is so made that it is impractical to mold it, which is not the case with this pattern.



PUNCH-HOLDER PATTERN

The trouble with many of us is that we are putterers. We were taught to be putterers or we acquired the habit through association with others who were putterers, to whom the rounded corner, the filleted angle and the piano finish were of much more importance than the making of a pattern in a way suitable for the purpose for which it is intended and to answer the requirements of the molder and the machinist.

I would make this pattern as shown in the illustration, with allowance for finish at *A* and *E*. The pockets, I would make in a dry-sand core, using the pattern for a core box. Strips of wood, as shown at *F*, tacked to the sides and ends of the pattern, form the full core.

A pattern for a one-casting job should be as simple as the purpose to which it is to be put permits. The cost of a machine or of a machine part is influenced by the cost of making the pattern and machining the parts. The proper design of the parts, with a view to pattern and machining simplicity, should be given careful consideration. Can this test be applied to the punch holder originally shown?

Are Ambitious Men Wanted?

By H. D. Murphy

As I recollect the tenor of Mr. Baker's remarks on the subject of opportunities for ambitious men, on page 602, Vol. 46, I do not think that Entropy, in his comments on page 14, Vol. 47, has kept the main idea in mind. He states that it is hard to imagine a "live" shop where a man with ambition, etc., is not welcome. Very true; but when an ambitious man finds himself working in a "dead" shop—that is, where his work is not appreciated—he naturally seeks some other plan of employment. It is the heads or owners of these other shops who are practically unapproachable. Of course, if one has no assurance that a new employer is interested in his ability or in fostering his ambitions, to make a change is a waste of time.

Not long ago the writer read the remarks of a certain well-known employer concerning the inability of obtaining competent help and, to prove his own theory, which is somewhat the same as Mr. Baker's, wrote a letter setting forth certain qualifications and soliciting an interview. As was expected, no reply was received. Undoubtedly, the letter never reached the person to whom it was addressed, as probably, like many other employers, he does not want to be continually bothered by applicants. How, then, do these employers hope to get in touch with the competent help which they claim is so scarce?

Economy in Hacksaw Blades

By R. S. Barlow

The article by Frank E. Merriam, on page 583, Vol. 46, gives us some guidance with respect to one of the minor machines and possible smaller savings of the machine shop. I think his conclusions are correct, and I should like to add briefly my own experience with hacksaw-blade testing and using. It confirms in some measure his concluding paragraph.

Some years ago, I was instructed to carry out a series of tests designed either to show, for advertising purposes, that the blade we were handling as merchants was superior to any other on the market, or to provide data by which our manufacturer could be pressed to improve his product. I quickly found that there was a size of bar whose area, combined with a suitable pressure (increased as the blade dulled), proved our blade could cut more pieces in a given time than any competing blade. I also found that, had I been interested in some of the other blades, I could have developed conditions more suitable for them than for our own blade.

Our advertising claims sent me into various shops to prove the superior qualities of our blade, and often by alterations to speed and pressure I was able to do it. Being now back in the machine shop, I try to use the experience of my selling days. For odd work I like a machine or two to spare, so as to let the blade jog through without much regard to time. This saves blades. The operator can easily push things on a rush job where the cost of a blade is as nothing compared to getting the work out quickly.

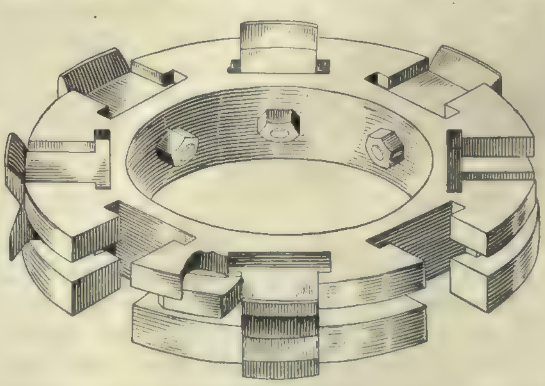
For repetition work I like a carefully selected machine of suitable size and power and a blade thin yet strong enough to carry sufficient weight to wear itself out on its later cuts. I fix a position for the weight which on a blade's first cut will not tear out or destroy the sharp edges of the teeth; also, a cutting time that must not be exceeded per piece. The first cuts take less than this maximum time, and the operator increases the pressure as the time taken gets longer. A blade that is too thin breaks before being worn out, and one that is too thick takes a longer time before being worn out. An adjustment of the weight position and alteration of the time allowance will soon discover the best average conditions for any make of blade on standard work on any machine.

Most of the good brands of saws give satisfactory results if they are studied and conditions arranged to suit them. These conditions are very simply determined and are, I think, in actual operation more frequently than some writers believe.

Gang Turning Fixture

By S. W. Potts

The sketch shows a fixture for turning several small pieces to a given radius. The old method was to drive the work into the grooves. They had to be driven out from the back of the faceplate when finished, and the work did not come true. The fixture had to be made out of malleable iron or steel. I devised the means shown of clamping the work with special T-head bolts.



GANG TURNING FIXTURE

This method has proved very satisfactory and does not distort the work. The fixture is made of cast iron, and the work can be put in and taken out in much less time than formerly. The same method could be used with other kinds of work, provided the lower part is larger than the upper.

Peculiar Shaving

The shaving shown was cut from a large hammer-forged crankshaft in the shop of the Domestic Engine and Pump Co., Shippenburg, Penn. It is one of the freaks of metal formation that the shopman sometimes encounters. The shaving is about 2 ft. long and 2½ in. in diameter at the large end. The spiral part of the shaving is a beautiful blue, but the little spurs, or spines, are almost white.

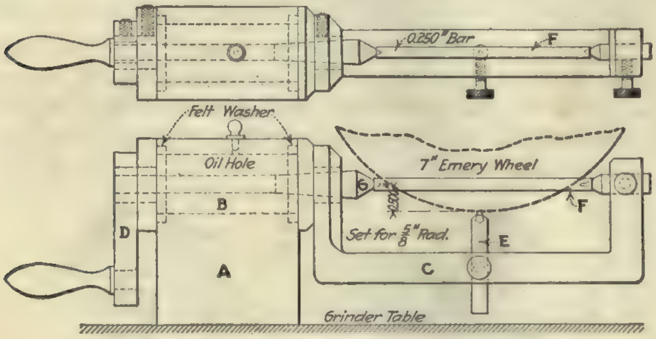
CHIP CUT FROM A HAMMER-FORGED CRANKSHAFT

Radius Wheel-Dressing Fixture

By C. M. Moore

The accompanying illustration shows a radius-forming fixture for grinding wheels. It was designed and used very successfully on wheels for gages by R. G. Dorval, assistant foreman of the New England Westinghouse Co. It is a simple device, consisting of the head block *A*, which supports and carries a spindle *B*. On the outer end of the spindle is the frame *C*, and at the other end the handle *D* for moving the spindle and frame past the face of the grinding wheel.

The frame *C* carries the wheel-truing diamond *E*, which is swung past the face of the grinding wheel by means of the handle *D*. The setting of the diamond is the important part of this work and is readily accomplished by means of the test bar *F*, which in this case is 0.250 in. in diameter. As shown, this bar is centered at each end, requiring a special center *G* in the spindle *B*. In the later machines this center was omitted and a female center was bored in the end of the spindle itself. This change simply necessitated turning one end of the test bar with a 60-deg. point, the operation being the same as with the center shown.



RADIUS WHEEL-DRESSING FIXTURE

Having the test bar of known diameter, it is easy to set the diamond by means of a standard gage block placed between the bar and the diamond point. The illustration shows the diamond set for a ⅝-in. radius, the diamond being ½ in. below the test bar, making the radius ½ + ⅛ in.

For making a concave radius it is necessary to set the diamond point above the center to the desired amount. This can be accomplished in various ways by testing from the frame *C* with suitable blocks.

Casehardened Jig Bushings

By W. Miller

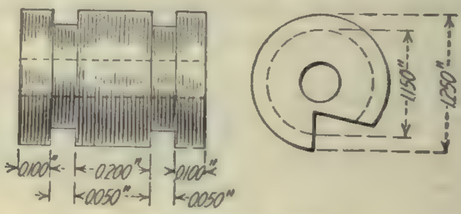
Surely, H. W. Johnson is in error in suggesting, on page 712, Vol. 46, of *American Machinist*, that jig bushes are invariably made of tool steel hardened and ground. This practice is followed in many shops, no doubt, but I have also known places engaged on the manufacture of high-class products where jig bushings were always made of mild steel casehardened. In my opinion there is no advantage in the tool-steel bush over the casehardened bush, with regard to wearing properties. As the case is generally not less than 0.006 in. thick, the bush is scrapped for inaccuracy long before the softer core is reached.

The casehardened bush has the further advantage that, when forced into the body of the jig, the compression will be largely taken up by the soft core and very little of it communicated to the hardened case surrounding the bore of the bush. There is thus less likelihood of cracking the bushes, should the forcing allowance by any chance be left big.

Forming-Tool Information Wanted

By Stephen Jaross

Would some one of the readers of the *American Machinist* enlighten me as to what are the best and quickest ways in which to make a forming tool like the one shown, and obtain the sizes within 0.0005 in.?



THE FORMING TOOL

Forged High-Speed Bits

By A. H. Johnson

In reference to the article by J. A. Raught, on page 871, Vol. 46, I would like to say that I have had the same experience with bits forged from high-speed steel.

I have found that the lightest cut would take the edge off and ruin the tool.

To remedy this defect, I harden and draw the temper to a very light yellow, and with that temper it stands up just as well as the original piece did before it was hammered out.

Largest Broaching Machine Ever Built

SPECIAL CORRESPONDENCE

SYNOPSIS — *The machine here shown does not differ in principle from the line with which our readers are familiar, but its huge proportions for a machine of this type and the number of cutters used will be of general mechanical interest.*

THE machine shown in Fig. 1, which weighs complete 14,700 lb., is undoubtedly the largest broaching machine of this type ever built. Fig. 2 will give a good idea of the general plan of this machine and also some of its unusual and large sized dimensions.

The machine was originally designed for one of the big electric companies for the purpose of broaching grooves in motor frames. Twelve rectangular grooves ⅜ in. wide and 14 in. long are broached at once on the inside of the frames, as shown. The frames indicated are 22 in. inside diameter, and the holding fixture or work bushing on the head of the machine alone weighs 700 lb.

While this machine is shown with an extra-wide bed, so made to provide for the large hole needed in the faceplate for the admission of the 12 cutter bars set in a 22-in. circle, the same machine is regularly made with a narrower bed for general use on heavy work of this character.

Every part is specially heavy, to accommodate the great weight of the whole machine. Triple operating handles are provided on each side to enable the operator to control the machine from the most convenient position. A telescoping housing protects the screw where it projects from the rear of the machine, keeping the screw safe from dirt or injury, and it also safeguards workmen from any possible injury.

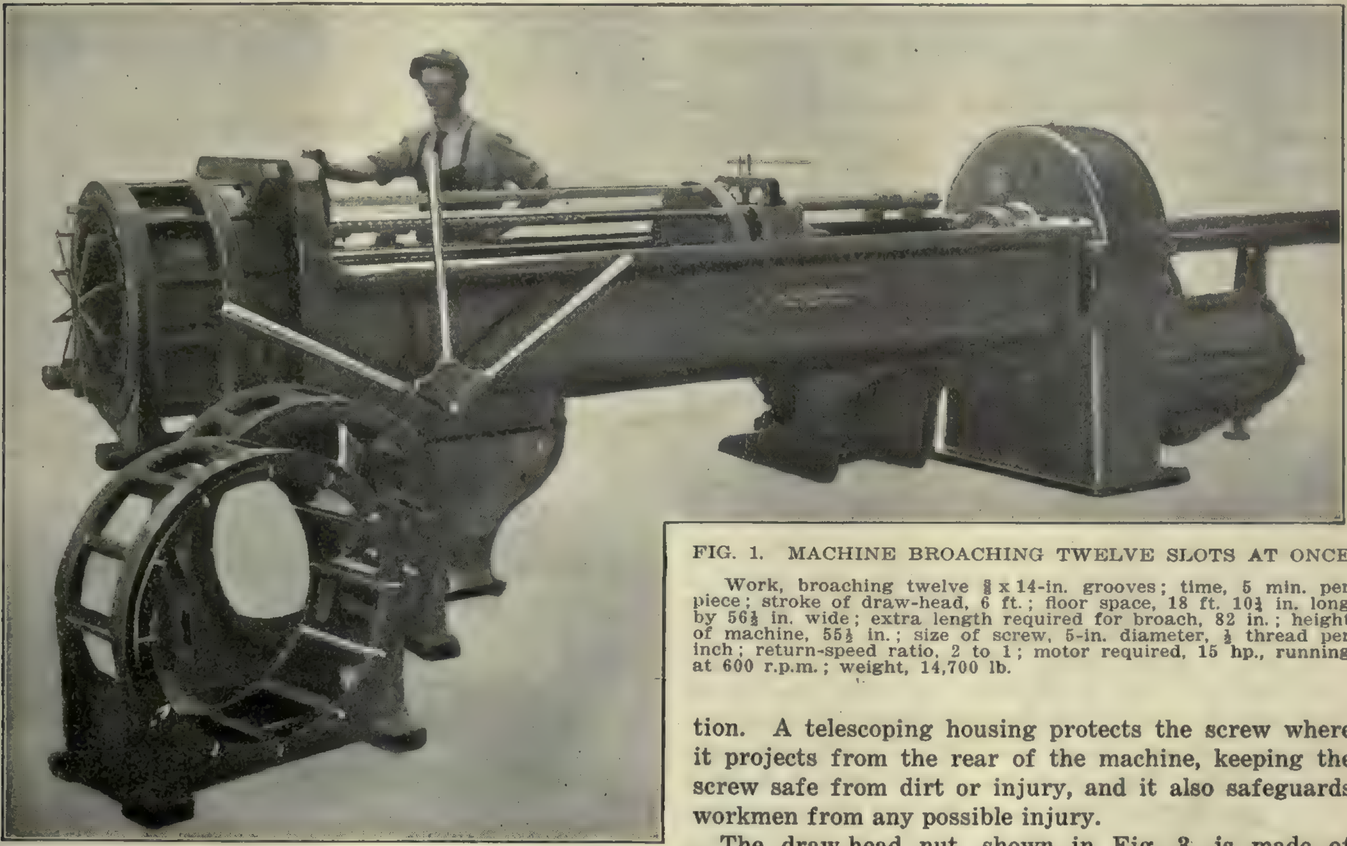


FIG. 1. MACHINE BROACHING TWELVE SLOTS AT ONCE

Work, broaching twelve ⅜ x 14-in. grooves; time, 5 min. per piece; stroke of draw-head, 6 ft.; floor space, 18 ft. 10¾ in. long by 56½ in. wide; extra length required for broach, 82 in.; height of machine, 55½ in.; size of screw, 5-in. diameter, ½ thread per inch; return-speed ratio, 2 to 1; motor required, 15 hp., running at 600 r.p.m.; weight, 14,700 lb.

The draw-head nut, shown in Fig. 3, is made of Lumen bronze. It is 30 in. long and is threaded to fit the 5-in. operating screw. The drive is direct through a silent chain from a 15-hp. motor. The chain and all other moving parts are effectually guarded. The

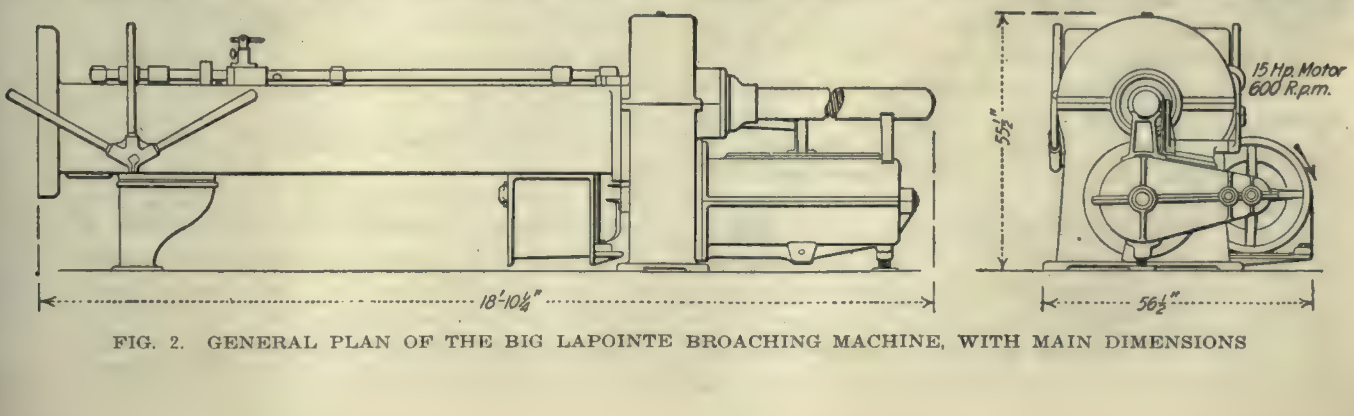


FIG. 2. GENERAL PLAN OF THE BIG LAPOINTE BROACHING MACHINE, WITH MAIN DIMENSIONS

return of the draw-head is made at the rate of twice the work stroke, 5 min. being the total time taken to broach the 12 grooves.

The outer ends of the cutter bars are connected by means of radial springs that draw them to a common center. The rear ends of the bars are cut away on the inside so that, when the draw-head is out ready for the return stroke, the cutters are drawn in toward the center, clear of the work, which can then be easily slipped on or off the work holder or bushing on the faceplate.

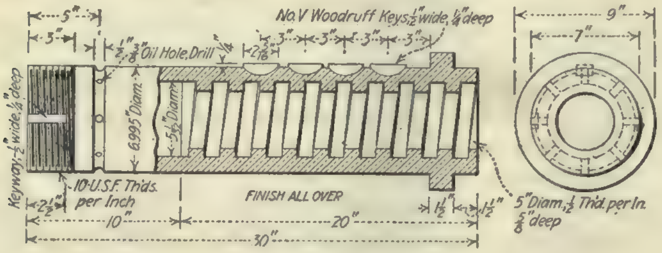

5"
3"
$\frac{1}{2}$"
$\frac{3}{8}$" Oil Hole, Drill
$\frac{1}{4}$
2$\frac{5}{16}$"
No. V Woodruff Keys, $\frac{1}{2}$" wide, $\frac{1}{4}$" deep
3"
3"
3"
3"
9"
7"
Keyway, $\frac{1}{2}$" wide, $\frac{1}{2}$" deep
6.995" Diam.
5$\frac{1}{32}$" Diam.
10-U.S.F. Th'ds. per Inch
FINISH ALL OVER
2$\frac{1}{2}$"
1$\frac{1}{2}$"
1$\frac{1}{2}$"
5" Diam., $\frac{1}{2}$ Th'd. per In. $\frac{5}{8}$" deep
10"
20"
30"

FIG. 3. DETAILS OF DRAW-HEAD NUT

This machine is made by the J. N. Lapointe Co., New London, Conn., and is known as the company's No. 5 broaching machine.

How Can Our Boys Fight Without Guns?

By W. F. Devine

Your editorial on page 298 will astound many and make everyone who reads it indignant. That such a condition exists is a disgrace; it is more than that—it is a crime.

In order that our young men may fight effectively they must be armed as well as is the enemy and as are the Allies who will fight beside our boys. But your statement will not surprise those who have had experience with the men in authority over munition making for our Government.

You have given, in the past, detailed drawings and descriptions of the Springfield rifle. The receiver of this rifle is of a form that no thoroughly good mechanical engineer would ever think of attempting to manufacture. But where can a man trained at West Point get any *practical knowledge* of the *mechanical arts?* How can it be expected that any man coming from that otherwise admirable institution can make any decision on mechanical details? It is out of the question that he can do so with any intelligence.

Ballistically, the Springfield weapon is admirable; but after all the care taken with it, it was only discovered after many of these rifles had been made that the gun could be fired without pulling the trigger.

Since the war started, and in fact some time before, fermetures have been shown to the officials, the cost of whose production would have been one-third that of the present fermeture. These fermetures were handled precisely as the present one, and there was absolutely no change in the essential locking feature; yet not one of these models was given serious attention.

The records show that, when the percussion cap was presented to our Government to take the place of the flint, it was solemnly declared by the authorities that, while the cap had some advantages, especially in wet weather, its use was not recommended, because the "soldier might forget to take the caps with him or lose them, and above all it was clear to the board that if other countries had within their borders such good flint stones as were to be found in the United States the cap would never have been considered."

And again, the Government, investigating breech loaders, decided against them because the idea of a case containing ball, powder and cap, all in one package, was too dangerous for consideration.

Other countries than ours train men especially as armorers. It is their business to decide mechanical details, and it is the military officer's duty to decide whether or not the mechanical product is of military value.

Ordnance Department officers in this country are responsible for the condition you cite, and the *American Machinist* is to be complimented for so boldly exposing the condition of affairs, which only a severe "shake-up" can rectify. This "shake-up" must come from the outside, not the inside.

Casting Annealing Pots

By A. E. Holaday

Replying to M. E. Duggan, on page 1140, Vol. 46, in regard to the casting of annealing pots, I do not use any bottom board. I first level off the floor and place my flask and pattern.

The pattern is made to draw, inside and outside, the cores are placed around the pattern, and the mold is filled with sand to the top of the pattern. (The drag part of the flask is made the same height as the pattern.) The whole is then leveled off and the other half of the pattern placed in position, forming the bottom of the pot. The cope part of the flask is placed in position and rammed up. The cope is then removed; both halves of the pattern are also removed, and the mold is finished, ready to pour.

It will be noticed that after the flask is placed in position, it is not moved. The flask or box is left on until after the casting is poured. This eliminates a lot of heavy lifting and unnecessary work.

Classifying Workmen

By Thomas F. Fournier

The experiences related by the author of the article under the above title, page 1044, Vol. 46, are, it is true, a too frequent happening. However, some of these annoyances can largely be eliminated.

More specific information in the advertisement will enable the applicant to realize that the advertiser knows what he wants, and that he has little chance of securing the position if he is himself at all in doubt of his ability to fill it.

As to the final rating that can be given an employee, actual observation is necessary, both of himself and his work. But the foreman or employment agent who, after a personal interview with an applicant, is unable to determine to a reasonable extent his experience and his fitness for the work at hand, has no qualification for the position he occupies, and is not being imposed upon any more than he is imposing on his employer.

Another Opportunity To Help Uncle Sam

The Second Liberty Loan Is Ready

THE second opportunity to show that we are ready to back our boys in France to the limit, that we stand solidly behind the Government in its fight against autocratic domination of the world, is now at hand.

□ □

It is up to each one of us to do all in our power to make this second loan an even greater success than the first, and we have no fear that the machine-building industry will not do its full share.

□ □

Just as a suggestion, we take the liberty of mentioning a method that the business men of Rochester, N. Y., used very effectively in the campaign for the first Liberty Loan—so effectively that a great majority of the employees of the city's industry were entered on the list of subscribers.

The business men's organizations got together early in the campaign and offered several prizes. These were for the greatest percentage of subscriptions in the machine industry, the clothing trades and other groups. Prizes were also offered for the highest percentage in each group. This made a double incentive, as each shop not only worked for the prize in its own class, but also to put its industry in the lead of the city's business.

This plan caused the keenest competition, each shop endeavoring to secure the highest percentage. One, at least, attained 100 per cent., every employee in both office and shop being on the subscription list. The percentage of other shops ran high up in the nineties, all tending to swell the total subscription from the City of Rochester and materially aiding the huge over-subscription secured.

□ □

It is hardly necessary to suggest that all shops make it easy for their employees to buy these new bonds. This practice is now almost universal and will doubtless be made to cover the new issue on the same basis as before. By affording these facilities and by calling attention to the new bonds as the next step in playing our part, there can be no question as to the outcome.

□ □

To few of us is given the opportunity to do the big things that will go down in history, but each of us can and must do our part in keeping the boys at the front supplied with all that they need. They are fighting for those of us who cannot go across. Buying bonds as we are able is the least we can do.

Start the new campaign in your shop today.

Editorials

Slicing the Steel Bill

A DECISIVE step toward putting the metal-using industries of our country on a practical basis of war efficiency was taken in Washington last week when prices were fixed for iron and steel. While the prices so reached are high when judged by pre-war standards, they are immeasurably better than those established within the last few months by overwhelming Demand bidding against limited Supply.

The *American Machinist* pointed out on Aug. 23 (page 345) that war conditions have brought about a series of artificial hills up which both manufacturer and consumer must climb laboriously to market. Raw materials represent by far the greater part of this increase. Following this comes the increase in the cost of labor, which in itself is largely based on the increase of the raw material, food.

As expressed by the War Industries Board on Aug. 9, "The war makes enormous drafts upon war material absolutely necessary to the industrial life of the nation, and to the ordinary existence of the people. This has resulted in the bidding up of prices of what is left of many materials of prime necessity in manufacture to a point obviously out of all relation to the cost of production."

This artificial stimulation in price which has occurred during the past few months especially has been felt by all manufacturers who use steel and iron as fundamental to their products. In no widely used mechanical manufactured product has the price of such a product been increased anywhere near in proportion to the increase in the cost of these raw materials. In most cases the increase in the price has been commensurate only with the increase in the cost of labor. Therefore, this arrangement between the Government and the steel and iron producers will come as a measure of relief to the manufacturers of machinery who were beginning to face impossible conditions.

Another effect that may be hoped for from this decision is an abatement of the feeling of unrest among those employed in industry. Secretary of Labor Wilson pointed out in his address to the United States Chamber of Commerce recently held at Atlantic City that a large part of this spirit of unrest is due to the belief among workers that corporations engaged in the iron and steel industries have been making enormous profits. When the amount of reduction that it has been possible to arrange for in the prices of these materials is considered, one can perhaps find reason for the existence of this feeling under past conditions, so that the removal of these conditions, let us hope, will be beneficial not only in making it possible for manufacturers to continue to fabricate iron and steel, but also in removing one of the most plausible grounds for labor disturbances.

The prices fixed upon become effective immediately and are subject to revision Jan. 1, 1918. It is understood that the prices quoted will not affect existing contracts where war work is now involved. The prices agreed upon and the percentage of reduction from the preceding market are as follows:

Commodity and Basis	Price Agreed Upon	Per Cent. of Reduction
Iron ore, lower lake ports	*$5.05	.....
Coke, Connellsville	†6.00	62.5
Pig iron	*33.00	43.1
Steel bars, Pittsburgh, Chicago	‡2.90	47.3
Shapes, Pittsburgh, Chicago	‡3.00	50.0
Plates, Pittsburgh, Chicago	‡3.25	70.5

* Gross ton. † Net ton. ‡ Hundredweight.

In connection with the fixing of prices the matter of priority of steel and iron products has been taken over under a definite procedure. In accordance with this plan, all orders and work will be divided into three classes, as follows:

A. War work, consisting of orders and work urgently needed in carrying on the war as, for example, arms, ammunitions, ships and the materials required in their manufacture.

B. Consisting of orders and work that are essential to the national welfare and public interest while not primarily designed for the prosecution of the war.

C. Comprising all work and orders not embraced in class A or class B.

All orders are to be classified in class C unless covered by certificates from the Priority Committee.

No certificates will be issued for class C orders.

Orders and work in class A will take precedence over those in class B, and both of these will be given precedence over class C irrespective of the date of the order. There are to be subdivisions also in classes A and B, such as A-1, A-2, A-3, etc., indicating the degree of urgency of various orders in these two classes.

The Council of National Defense and its Advisory Commission are to be congratulated on this concrete evidence of accomplishment of a fundamental problem.

About the Cost-Plus Plan

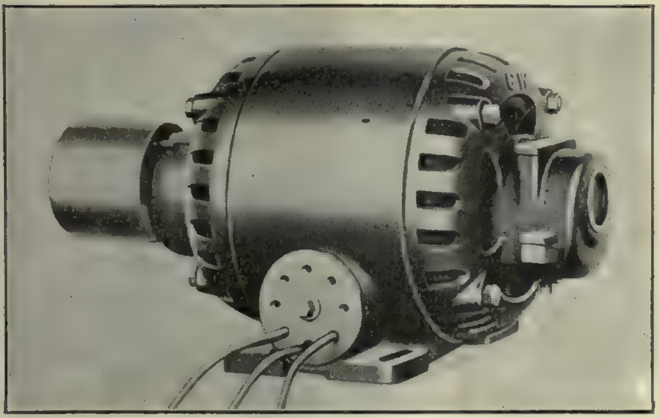
CONGRESSIONAL inquiry as to the cost plus 10 per cent. rifle contracts brings up several interesting questions. Those who are familiar with the experience of the rifle shops during the past two years will appreciate their hesitation in taking a contract at any flat price that might be considered reasonable.

This form of contract, however, enables the manufacturer to pay any rate of wages that may be necessary to secure a sufficient number of the men needed. Furthermore, this plan actually encourages the payment of abnormally high wages, as the greater the cost to the manufacturer the greater his profit.

We have no fear that mercenary considerations of this kind will affect the rifle contracts; but to prevent such motives from controlling in any case, it has been proposed that contracts be let on the basis of manufacturing cost plus a fixed profit *per piece* of the articles manufactured, this profit remaining the same regardless of the wage scale and the cost of materials.

Crocker-Wheeler Induction Motors

The illustration shows a new type of squirrel-cage induction motor recently placed on the market by the Crocker-Wheeler Co., Ampere, N. J., and known as the C-W Form P. These motors range in size from ½ to 3 hp. and are designed for constant-speed operation on 60-cycle, polyphase circuits. Among the features claimed for the machines are good starting torque, high power factor and good ventilation.



SQUIRREL-CAGE INDUCTION MOTOR

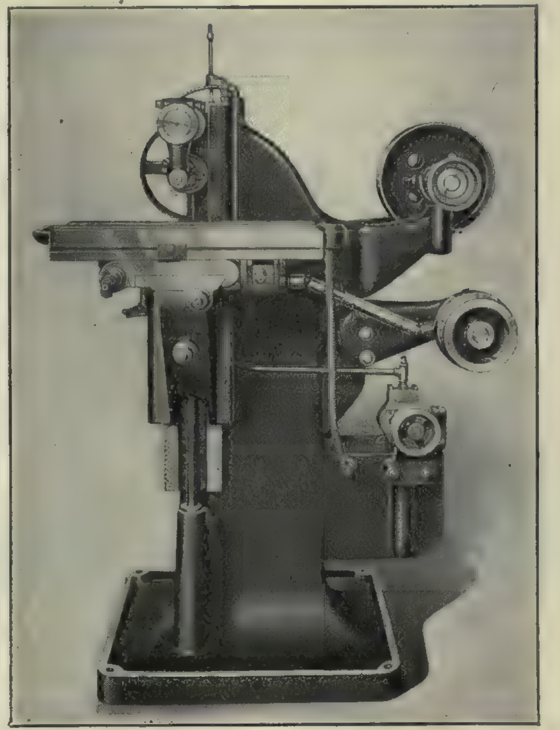
The stator housing is of cast iron and is cylindrical in form. The stator core is made up of sheet-steel laminations, riveted and bolted together. Windings are placed in insulated slots and treated with a moisture and acid-fume proof varnish. The rotor is also built up from steel laminations. Bearings are of bronze, with oil grooves so located as to distribute a film of oil regardless of the direction of belt pull. Motor feet are cast integral with the frame and are slotted to permit adjustment for belt tension.

Standard Milling Machine

The illustration shows the hand milling machine manufactured by the Standard Engineering Works, Pawtucket, R. I., equipped with power longitudinal feed and oil-pump equipment. The power longitudinal feed of the table is secured through a rack and pinion movement that permits a quick return of the table by hand. This feature, it is claimed, particularly adapts the machine for rapid operations on small duplicate parts.

Four power feeds are provided by means of two-step feed cone pulleys that are interchangeable. The feed is carried forward to the table through a pair of bevel gears, telescoping shaft and universal joints. All gears are inclosed in housings and run in oil, and an automatic stop is located on the side of the table. The machine may also be operated as a hand miller.

The same company markets a sub-base and motor bracket that is adaptable to any of its milling machines and allows equipment to be easily changed to that of the motor-driven variety. The floor space of the sub-base is 43½ x 24 in., and the weight is 325 lb.



POWER- OR HAND-FEED MILLING MACHINE

Vertical movement of headstock, 4½ in.; working surface of table, 4 x 21 in.; table dimensions outside oil pockets, 7¼ x 26¾ in.; table travel by hand lever, 6 in.; table travel by power feed, 8½ in.; table travel by crank, 14 in.; cross-adjustment of table, 6 in.; maximum distance from center of spindle to table, 15 in.; T-slot, ⅝ in.; feeds, four, 0.006 to 0.079 in. per spindle revolution; taper in spindle, B. & S. No. 9; floor space, 27 x 36 in.; weight with countershaft, 1025 lb.

Cincinnati Bickford Motor-Driven Radial Drilling Machines

The illustrations show some recent developments in variable-speed motor-driven radial drilling machines that have recently been placed on the market by the Cincinnati Bickford Tool Co., Oakley, Cincinnati, Ohio.

The machines are now furnished with four types of drive as follows: Cone pulley, gear box, motor drive through gear box and variable-speed motor.

Fig. 1 shows a plain radial drill that is made in 4-, 5- and 6-ft. sizes and fitted with a Reliance adjustable-speed motor. The speed of this motor is controlled by shifting the armature, which is accomplished by a small motor of the reversing type mounted at the rear. Control of the small motor is by means of a two-point push-button switch located on the drill head. The machines are fitted with a plain table, cutting-lubricant outfit and an air-column binder.

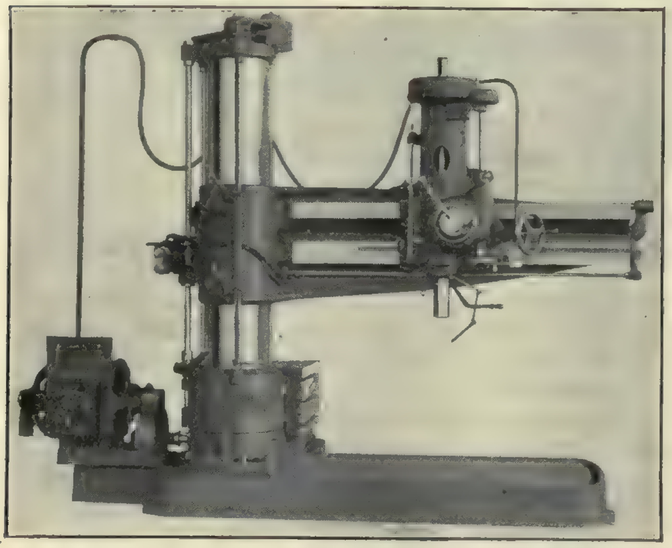


FIG. 1. RADIAL DRILL WITH ADJUSTABLE-SPEED MOTOR

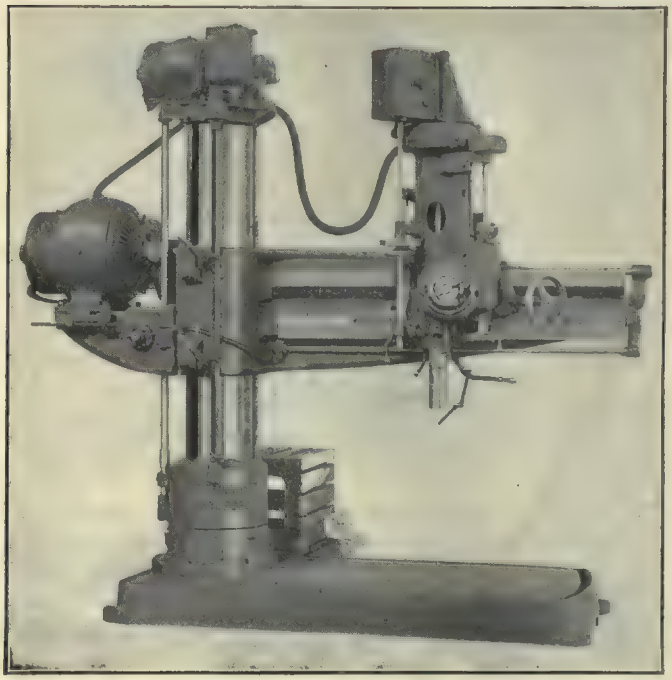
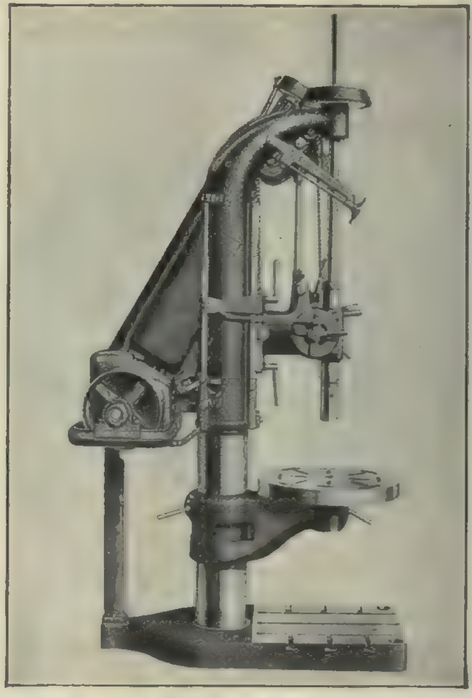


FIG. 2. RADIAL DRILL WITH VARIABLE-SPEED MOTOR MOUNTED ON AN EXTENSION OF THE ARM

Fig. 2 shows a drilling machine made in 4-, 5- and 6-ft. sizes and driven by a 3 to 1 variable-speed motor mounted on the arm and geared directly to the arm shaft. The motor controller is located on the drill head. The machines are fitted with a plain table, air-column binder and cutting-lubricant outfit. A compound-wound motor of the constant-speed reversing type is mounted on the top of the column and serves to elevate or lower the arm. Control is by means of a reversing switch and a dynamic brake. The switch is operated by a square shaft controlled by a patented interlocking device to prevent the power from being turned on while the arm is clamped into position. A revolving connection in the base of the column permits wires entering at this point to run up through the center of the column to the top.

Barnes All-Geared Drilling and Tapping Machine

The illustration shows the all-geared 26-in. sliding-head drilling and tapping machine upon which a number of improvements have been recently made by the Barnes Drill Co., 814-830 Chestnut St., Rockford, Ill. The machine is now equipped with a new style of self-oiling reverse gear and with outboard bearing support for the drive pulley. Friction clutches and driveshaft bearings are continuously oiled by a geared pump in the oil reservoir. The machine is adapted for tapping work and is provided with an automatic reverse.



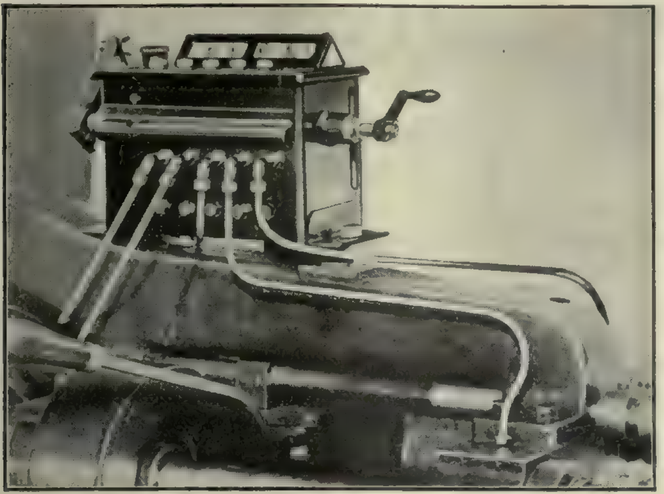
BARNES DRILLING AND TAPPING MACHINE

Height, $92\frac{1}{2}$ in.; distance from face of column to center of table, 12 in.; diameter of column, $8\frac{3}{4}$ in.; diameter of table, 23 in.; diameter of double splined spindle, $1\frac{15}{16}$ in.; diameter of spindle nose, $3\frac{3}{32}$ in.; taper hole in spindle, Morse No. 4 or 5; width of column face, 7 in.; vertical travel of table, 20 in.; travel of spindle, 14 in.; travel of sliding head, 20 in.; maximum distance, spindle to base, 54 in.; minimum distance, spindle to base, $18\frac{1}{2}$ in.; maximum distance, spindle to table, 40 in.; diameter of crown gear, $10\frac{7}{16}$ in.; diameter of double pinion, 5 in.; back-gear ratio, 4 to 1; spindle speeds, eight, 23 to 230 r.p.m.; feeds, eight, 0.005 to 0.075 in. per spindle revolution; weight, 1850 lb.; floor space (exclusive of pulleys, which overhang 10 in.), 22 x 49 in.

Madison Kipp Lubricator

The Madison Kipp Lubricator Co., Madison, Wis., has recently placed on the market the lubricator shown attached to a lathe head. The lubricator is automatic in action, stopping and starting with the machine, thus delivering oil only when the machine is in motion. A hand crank is provided for delivering oil at the start or in case the machine has been idle for a considerable length of time.

Each oil feed has an individual adjustment that may be so set as to deliver any reasonable amount of oil.

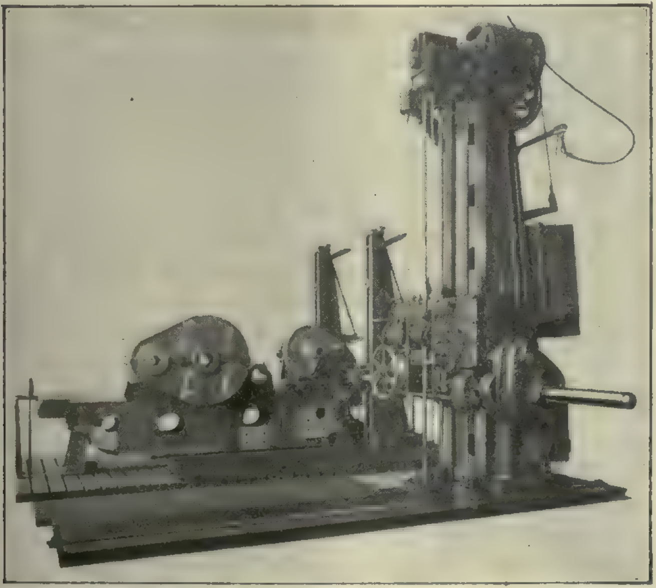


LUBRICATOR FOR MACHINE TOOLS

An advantage claimed is that, as there is only one oil tank to be filled for the whole machine, considerable time is saved in oiling and the oil is less likely to be wasted.

Pawling & Harnischfeger Drilling and Boring Machine

The Pawling & Harnischfeger Co., Milwaukee, Wis., is now marketing a horizontal drilling and boring machine, illustrated, which is somewhat similar to the company's No. 12 machine, except that the present model is provided with floor equipment and outboard supports for the boring bars. The vertical shaft is driven by the motor at the top of the column and not only drives the spindle, but serves for moving the carriage in a vertical direction and the column and carriage in a horizontal direction. The spindle is driven through a pair of bevel gears, while the travel mechanisms are connected by reversing friction clutches. The motor is provided with dynamic braking, which allows a quick stop to be made while tapping is being done. The carriage travel is operated through worms and worm-wheels that are provided with ball thrust bearings.



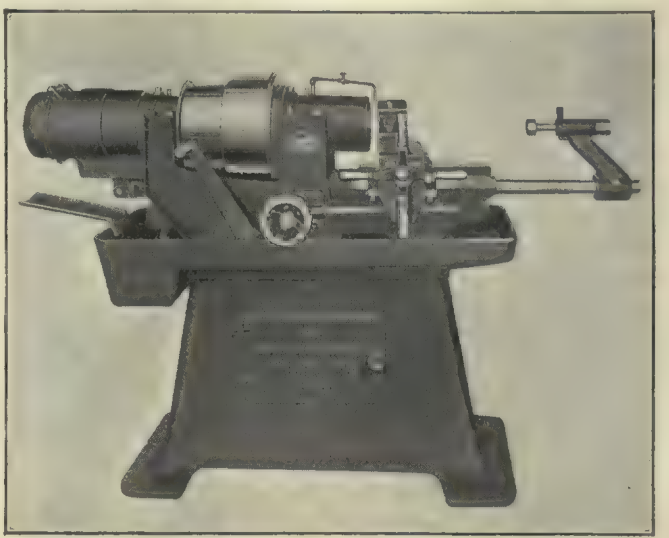
HORIZONTAL DRILLING AND BORING MACHINE

Motor, $7\frac{1}{2}$ hp., variable speed, 500 to 1500 r.p.m.; horizontal spindle travel, 3 ft.; vertical carriage travel, 6 ft. 5 in.; column travel, 11 ft. 6 in.; diameter of spindle, $3\frac{11}{16}$ in.; Morse taper in spindle, No. 6; spindle speeds, 10 to 450 r.p.m.; feeds, four, 0.008 to 0.07 in. per spindle revolution; rate of vertical carriage travel, 3 to 9 ft. per min.; rate of column travel, 4 to 12 ft. per minute

Four mechanical changes of spindle speed are incorporated. The spindle is made of high-carbon forged steel and is bored for a No. 6 Morse taper and provided with a cap nut for holding special boring bars. The thrust due to feeding is carried on a dustproof ball bearing, the spindle itself running in bronze bearings. Four changes of feed are incorporated, and changes from one to the other may be made from the operating position.

Etna Cutting-Off Machine

The 3-in. cutting-off machine illustrated is one of the recent products of the Etna Machine Co., Toledo, Ohio. The machine is of the heavy-duty type and is driven through a two-cone pulley from a friction countershaft. A 5-in. belt is used, the cone diameters on the machine being 10 and 12 in.



ETNA CUTTING-OFF MACHINE

Maximum capacity, 3-in. rounds, 2-in. squares, $2\frac{1}{2}$-in. hexagons; hole through push tube, $3\frac{1}{4}$ in.; hole through spindle, $3\frac{13}{16}$ in.; front bearing, $4\frac{13}{16}$ x $6\frac{1}{2}$ in.; rear bearing, $4\frac{13}{16}$ x $4\frac{3}{4}$ in.; tools, $\frac{1}{2}$ x $\frac{7}{8}$ in.; collet opening, $\frac{1}{8}$ in.; long adjustment of cross-slide, 8 in.; floor space, 26 x 62 in.; weight, 160 lb.

Improved Drip Can for Hangers

By D. E. Mapes

The usual drip can on a hanger is either a cast-iron cup or an old tin can. In a certain shop where new machinery is being installed with a view to saving all the time and material possible, several galvanized cans were made which are as long as the hanger bearing, and to the bottom of these cans a screw cap was added.

Any oil which drops of course goes into the can, and after a time the oiler merely unscrews the cap and saves every drop of oil, which is strained and used again.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Oct. 6, 1917—The problem of keeping airplanes in service requires constant care and a corps of trained mechanics to make necessary changes and repairs. But more than this, it also necessitates having a goodly supply of spare parts to draw from, so that damaged wings, ailerons, landing gears and other parts of the machine itself, not to mention small parts of the engine, may be readily replaced and the whole machine put back into service at the earliest possible moment. This requires not only a part of the output of the airplane factories to manufacture these spare parts, but also the enlistment and training of a corps of mechanics to handle the repairs and replacements when they become necessary.

In the case of the airplane engines, the parts that seem to require most frequent renewal are the cam follower guide assembly, carburetor setting jets, exhaust valves and springs, inlet valves and springs, cylinder gaskets, piston rings and magneto coupling rubber segment. The magnetos themselves also require considerable attention, such parts as interrupter contact springs, interrupter ground brush springs, pinion keys, distributor block stud, distributor finger brush and collector brush, jack washers and nuts, all requiring a fair number of spare parts to prevent unnecessary delay.

PARTS FOR PLANES

When it comes to the parts for the planes themselves, landing wheels complete and inner tubes for the tires are perhaps the most necessary supplies. Then come propellers and canes, for outer wing skids; struts for the landing gears; landing-wheel axles, ailerons and upper and lower planes. A much larger supply of lower planes is necessary, owing to frequent damage by the landing wheels or struts being forced up through them by a bad landing, when the upper plane remains intact.

It is customary to issue only half of the spare parts to the squadron in the beginning, the remainder being kept at the flying headquarters so as to have the latter act as a supply reservoir. Then, in case of any one flying camp having an epidemic of accidents of a certain kind, the extra spare parts needed can be drawn from the additional supply kept at the central-depot stores.

In order to keep the machines in repair a large variety of skilled mechanics is necessary. Some idea of the diversity of trades represented and the number of men in each line may be obtained from the following list, which was furnished by the Signal Corps in order to show the kind of mechanics that it is necessary either to train for this particular service or to draw from the industries where they are now employed. These men are regularly enlisted and must be between the ages of 21 and 45 years. They are trained in this particular work at the various flying camps, and it is also the intention to assign certain mechanics to the different factories building airplane motors, so as to become thoroughly familiar with the construction and repair of the different types of engines to be used. This is one of the opportunities for good mechanics to do their bit much more effectively than they could probably do it in the trenches. The following lists show the kinds of tradesmen needed for aëro and balloon squadrons:

AERO SQUADRON (Service)

1	Blacksmith
1	Cabinetmaker
26	Chauffeurs (first and second class)
9	Clerks
6	Cooks
1	Draftsman
1	Electrician
8	Engine-repair men
1	Engine tester
1	Lithographer
2	Machinists
27	Mechanicians, airplane
1	Metalworker
1	Magneto-repair man
1	Motorcycle-repair man
1	Propeller maker
2	Photographers
1	Radio man
1	Rigger
2	Sailmakers
1	Stenographer
1	Toolmaker
1	Vulcanizer
1	Welder
52	Skilled and unskilled laborers*
150	

AERO SQUADRON (Supply)

1	Cabinetmaker
34	Chauffeurs
33	Clerks
6	Cooks
1	Motorcycle-repair man
4	Packers
1	Photographer
1	Stenographer
2	Stock men
67	Skilled and unskilled laborers*
150	

AERO SQUADRON (Repair)

1	Blacksmith
1	Boat builder
1	Cabinetmaker
18	Chauffeurs
9	Clerks
6	Cooks
2	Draftsmen
1	Electrician
17	Engine-repair men
2	Engine testers
1	Instrument-repair man
4	Machinists
65	Mechanicians, airplane
2	Metalworkers
2	Magneto-repair men
2	Motorcycle-repair men
2	Molders
2	Patternmakers
2	Propeller makers
1	Propeller tester
1	Painter
1	Photographer
1	Radio man
1	Rigger
1	Saddler
4	Sailmakers
150	

AERO SQUADRON (Construction)

2	Buglers
3	Carpenters (boss)
51	Carpenters
20	Chauffeurs
8	Clerks
6	Cooks
3	Electricians
48	Laborers†
3	Painters
5	Plumbers
1	Truckmaster
150	

BALLOON SQUADRON

60	Aëronauts
4	Cabinetmakers
68	Chauffeurs
42	Clerks
24	Cordage workmen
10	Cooks
4	Draftsmen
4	Electricians
24	Gasworks employees
4	Instrument-repair men
16	Mechanicians
8	Magneto-repair men
8	Motorcycle-repair men
8	Riggers
60	Sailmakers
56	Tailors
400	

* The number of skilled and unskilled laborers should be made up, in so far as it is possible, of plumbers, steamfitters, gasfitters, metalworkers, woodworkers, painters, etc. † One of the laborers should be familiar with bricklaying.

AIRCRAFT SPECIFICATIONS

Preliminary specifications for international standards of airplane materials are being issued by the International Airplane Standardization Board in Washington. This work has been in charge of F. G. Diffin, chairman of the Standards Board, and copies of the standards adopted may be obtained by manufacturers interested, on application to the International Aircraft Standards Board, Room 224, Bond Building, Washington, D. C. All international standards on airplane materials and fabricated parts in the future will be issued from this office and can be had on application.

Restricted Exports

The Exports Administrative Board has announced a list of commodities, in addition to those published on Sept. 17, 1917, whose conservation is necessary on account of the limited supply and the needs of the United States in its successful prosecution of the war. Accordingly, the board has practically prohibited the exportation of the following articles: Oil-well casing; boring mills, vertical, 42 in. and larger; lathes with 30-in. swing and larger; planers, metalworking, 36 in. wide and larger; caustic soda.

Applications for the following articles will be subjected to the food administrator for his approval: Food grains and fodder (including, among others, wheat, corn, rice, barley, oats, rye, oil cake and oil-cake meal); animal fats and vegetable oils and soap.

Export licenses may be granted, however, for the above articles when destined for actual war purposes, or when they will directly contribute thereto; and in certain unusual cases when such exports will contribute directly to the immediate production of important commodities required by the United States; and also in certain other cases where the articles may be exported in limited quantities without detriment to this country, such as food grains and fats, which require the approval of the food administrator.

Shipments in Transit to Canada, Newfoundland and Mexico

Individual licenses will be required for shipments to Canada, Newfoundland and Mexico for all of the above-mentioned articles which are covered by railroad and for ocean bill of lading dated on or after Oct. 1, 1917. This date has been fixed in order to avoid interference with goods in transit.

Shippers' attention is called to the fact that where the quantities to be shipped are less than 125 bu. of food grains, 25 bbl. of flour, 125 lb. of butter, or 25 bbl. of sugar and are destined for Canada, Newfoundland or Mexico, they may be licensed by the indorsement of the collector of customs at the point of exit when the shipper presents to the collector the usual shipper's export declaration. Where it is ascertained that exporters are making applications for an excessive or unusual number of licenses for small shipments to the same consignee in order to avail themselves of the facilities offered by the above plan, applications will be refused by the collector and licenses previously issued will be revoked.

Complete Conservation List

The addition of the above articles makes a completed conservation list, as follows: Acetone, alcohol, aluminum, ammonia salts, ammonia nitrate, anhydrous ammonia, animal fats (x), arsenate of lead, arsenate of soda, boiler tubes (iron and steel), boring mills (vertical, 42-in. and larger), butter (x), carbolic acid (phenol), castor oil and castor beans (x), caustic soda, chrome-nickel steel, cotton linters, cottonseed oil (x), cyanide of sodium, ferromanganese, ferrosilicon, ferrovanadium, flax, food grains (including, among others, wheat, barley, corn, rice, oats and rye) (x), glycerin, iron and steel plates (including ship, boiler, tank and other iron and steel plates ⅛ in. thick and heavier and wider than 6 in., whether plain or fabricated), lard (x), lard compound (x), lathes with 30-in. swing and larger, mercury salts, nitrate of soda, nitric acid, nitric salts, oil-well casing, oil cake (x), oil-cake meal (x), phosphoric acid, phosphorus, pig iron, planers (metalworking, 36 in. wide and larger), potash and chlorate of potash, potassium salts, saltpeter, scrap iron, scrap steel, searchlights and generators (suited for army and navy use), soaps (x), sodium sulphite, spiegeleisen, stearine and stearic acid (x), steel billets, steel blooms, steel ingots, steel sheet bars, steel slabs, sugar (x), sulphate of ammonia, sulphur and sulphuric acid, superphosphate, tallow (x), tin plate, toluol, tungsten, vegetable oils (x), wireless apparatus, wheat (x), wheat flour (x), wool rags.

Important Information for Shippers

In making this announcement, the Exports Administrative Board takes occasion to advise exporters and commission agents of the necessity of securing export licenses before making purchases for export or engaging freight space or tonnage for all articles on the conservation list. The granting of export licenses for the shipment of the food products and fats in the "conservation list" (all commodities marked x) to countries other than those associated with the United States in the war is now being delayed, as, on the advice of the food administration, it is not desired to have any considerable quantities of the above articles exported. Heretofore many applications have been made by telegraph, but this practice will not be necessary if the above advice is followed, as telegraphic applications cannot receive a preference over those received in other ways.

Applications may be made at the Bureau of Export Licenses, 1435 K St., N. W., Washington, D. C., or at its branch offices or agencies at other points.—*Official Bulletin.*

Dividing on a Lathe or Shaper

By J. O. Reed

Being employed in a small shop, I am very much interested in the "Small-Shop Notebook," especially the "stunts" for the shaper as illustrated on page 626, Vol. 46.

As we have no miller or dividing head, when a job of circular dividing comes along we can generally find among the change gears of the four lathes in the shop a gear that has the same number of teeth or a multiple of the number of divisions required.

We then fit a mandrel to this gear and to the work to be divided, place it on centers either in the lathe or shaper and after fitting a suitable stop to go into the space between the teeth on the gear are able to do a fair job. In an emergency we have cut gears in this way in the shaper.

Machinery and Machine-Tool Trades Committee for the Liberty Loan

In the interest of the second Liberty Loan, being floated by the Government, a committee known as the Machinery and Machine-Tool Trades Committee has been formed. Governor Strong, of the Federal Reserve Bank, appointed J. W. Lane, president of the E. W. Bliss Co., chairman of this division for the City of Greater New York.

Chairman Lane called together the following men, prominent in the machinery world, to coöperate with him: Henry Prentiss, president Prentiss Tool and Supply Co.; George Doubleday, president Ingersoll-Rand Co.; R. L. Patterson, president American Machine and Foundry Co.; C. I. Cornell, treasurer Pratt & Whitney Co.; Henry Fuller, vice president Fairbanks-Morse & Co.; John H. Lidgerwood, president Lidgerwood Manufacturing Co.; A. J. Babcock, president Manning, Maxwell & Moore; Norman Dodge, vice president Mergenthaler Linotype Co.; H. R. Swartz, president Intertype Corporation; George J. Low, of F. M. Dyer & Co.; Charles A. Hirschberg, publicity manager for Ingersoll-Rand Co.

The committee held its first meeting on Friday, Sept. 28, when it elected H. R. Swartz vice chairman and George J. Low secretary and appointed Charles A. Hirschberg publicity member. The committee has established headquarters on the sixteenth floor, 334 Fourth Ave., New York City, and manufacturers of machinery and machine tools, as well as their employees, are asked to communicate with the secretary at the above address for full information, subscription blanks and other material. The personnel of the committee is such as to warrant the greatest confidence in the outcome of its efforts.

Personals

George W. Steenbergh is now a special representative of the metal-cutting department of E. C. Atkinson & Co., Inc., Indianapolis, Ind.

J. J. Dale, of Dale, Brewster & Co., 30 Church St., New York City, and Chicago, Ill., has returned from Europe after a stay of eight months.

William C. Bennett has been appointed superintendent of machinery of the Kelly Atkinson Shipbuilding Corporation, of Chicago, Ill., and Mobile, Ala.

General George W. Goethals has been elected president of the Wright-Martin Aircraft Corporation, whose main plant is located at New Brunswick, N. J.

N. C. Walpole, Southern sales manager of the Niles-Bement-Pond Co. and the Pratt & Whitney Co., with offices at Birmingham, Ala., has been granted leave of absence for the duration of the war and has been commissioned a major in the Ordnance Department.

New Publications

Shop Expense Analysis and Control—By Nicholas Thiel Ficker, Consulting Industrial Engineer and Lecturer on Factory Engineering and Cost Production, New York University School of Commerce, Accounts and Finance. Two hundred and forty 6 x 9-in. pages. Published by Engineering Magazine Co., New York City. Price, $3.

The first eight chapters of this book were published originally in the "Engineering Magazine." The last four chapters are new and appear in this book for the first time. The object of the book is to discuss the problems that center around factory expense and its distribution in the factory costs. The titles and scope of the twelve chapters are as follows:

Chapter 1, Establishment of the Unit of Time as a Basis of Distribution, discusses the necessity of using time as a basis of distributing expense to obtain correct results.

Chapter 2, Machine Expense and Material Expense, discusses the characteristics of expense and differences between expense incident to actual production and that involved in handling raw material.

Chapter 3, Classification and Interpretation of General Ledger Accounts Pertaining to Production, classifies the accounts of manufacturing concerns and indicates the charges that should be carried to each class of accounts.

Chapter 4, Distributing Manufacturing Expense to Production Centers and Segregating Power Expense, is devoted to methods of calculating expense and of merging administration expense and power expense into machine expense and material expense.

Chapter 5, The Standardization of Rent Expense Distribution, discusses the nature of rent and lists the items that the author believes should be included under this heading. The author broadens the term rent to include the service for grounds and building space employed in the factory as well as the care and upkeep of such facilities.

Chapter 6, Depreciation, Insurance, Taxes and Interest, as the title implies, deals with the character and disposition of these items. It also includes a discussion of fixed charges.

Chapter 7, The Machine Unit System, describes briefly a method for determining a machine rate, as it is most commonly called. It is questionable whether the author's name is an improvement on this latter well-known title.

Chapter 8, Current Variation Ratios for Adjusting Current Costs, deals with what is commonly known as the supplementary rate, and the author argues that the factory should be charged with only the undistributed expense that belongs to the work actually in process.

Chapter 9, Organization, discusses the forms of industrial organization with a brief account of the effect of organization on expense distribution.

Chapter 10, Waste in Manufacturing, deals with various forms of waste in manufacturing processes and the methods of charging off the same.

Chapter 11, Graphic Determination of Costs, is misnamed since the chapter deals with graphic cost analysis and graphic statistics. It is, however, a valuable chapter.

Chapter 12, Standard Reports, discusses the important subject of factory reports and gives many interesting examples of these documents.

It will be seen from the foregoing that this book is not a treatise on the general subject of cost finding, but is intended, as has been stated already, to bring out particularly the problems connected with expense distribution. The treatment of these problems, however, is not very broad, but describes only the methods which the author believes to be the best. Mr. Ficker advocates, generally, the use of the machine rate and supplementary rate, so called, which is admittedly the most logical method of expense distribution. Industrial enterprises vary tremendously, however, and the methods described may or may not be applicable to any given plant, depending on circumstances. The discussion is clear and illuminating and is based obviously on actual experience in this line of work. No theories are advocated that are especially new, but many of the forms and methods presented will be found to be interesting and instructive.

The author's use of new and unfamiliar names for old things may well be questioned, and some of his definitions seem somewhat arbitrary and not in keeping with present usages. The terms machine expense and rent expense, which are used to cover a variety of items, are illustrations of this, as is the use of the term, machine unit system, for what is commonly known as machine rate.

The book is not as well balanced as it might be. Thus, the important subjects of depreciation, insurance, taxes and interest occupy much less space than is devoted to the discussion of the many forms of waste that occur in manufacturing processes. The chapter on organization could have been omitted and its place filled with something more closely connected with the subject in hand. Many important topics have been so abbreviated as to make the discussion appear somewhat dogmatic.

The book, however, contains much useful and helpful material, and the discussion raises many questions that require further investigation. All will not agree with some of the author's conclusions, but managers, cost accountants and students of such matters will find the book refreshing and helpful. We need more discussions of its kind.—Dexter S. Kimball.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

The National Machine Tool Builders Association will hold its sixteenth annual convention at the Hotel Astor, New York City, on Tuesday and Wednesday, Oct. 30 and 31.

Condensed Clipping-Index of Equipment

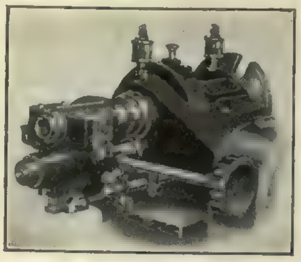
Clip, paste on 3 x 5-in. cards and file as desired

Screw-Cutting Device

Porter-Cable Machine Co.,
Syracuse, N. Y.

"American Machinist," Sept. 27, 1917

Will handle threading jobs up to 2½ in. in length. All gearing is eliminated between the spindle and carriage, the latter being actuated directly by the lead screw through a traveler connected to the carriage by a dovetail pull rod. The lead screw is made in the form of an externally threaded sleeve and is mounted on an extension at the rear end of the lathe spindle; this extension is screwed on the threaded end of the spindle

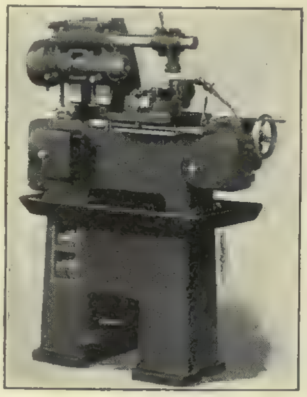


Gear-Hobbing Machine No. 3

Barber-Colman Co., Rockford, Ill.

"American Machinist," Sept. 27, 1917

Capacity, work up to 5 in. in diameter, 7-in. face and No. 12 diametral pitch; diameter of hob spindle, ¾ in.; maximum diameter of hob, $2\frac{1}{16}$ in.; taper hole in spindle, No. 9 B. & S.; driving pulley, 8 x 1⅞ in.; hob speeds, six, 100 to 500 r.p.m; hob feeds, 0.015 to 0.150 in. per revolution; floor space, 28 x 40 in; net weight, 1700 lb. Is fitted with either a right- or a left-hand hob swivel, the former accommodating a range of spiral settings from 60 deg. right hand to 90 deg. left hand, while the latter accommodates a range of spiral settings from 60 deg. left hand to 90 deg. right hand

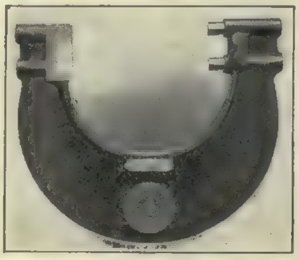


Gage, Adjustable Limit Snap

Slocum, Avram & Slocum Laboratories, Inc., 531-537 West 21st St., New York City

"American Machinist," Sept. 27, 1917

An adjustable limit snap gage made in 20 different sizes, covering all sizes up to 12 in. One end of the gage is provided with plugs adjusted by countersunk screws, the idea being that after the adjustment has been made the screws may be sealed, making it impossible to change the limits without detection. Anvils and plugs are ground and lapped as individual units. Is provided with an insulating grip made of fiber, attached to the cast-iron frame

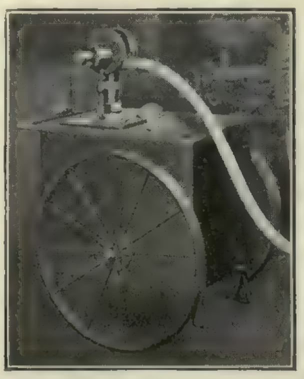


Tank, Portable Lubricant

Gilbert & Barker Manufacturing Co., Springfield, Mass.

"American Machinist," Sept. 27, 1917

A portable tank outfit for handling cutting oils and compounds. Has a capacity of 50 gal. and is furnished with a quick-acting pump that may be utilized either for delivering clean oil or compound to the machine or for collecting used compound and conveying it to some point where it can be filtered. Is mounted on wheels and may be easily moved from place to place about the factory

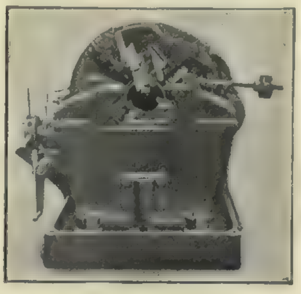


Cutting-Off Machine, 8-Inch

Charles Taylor, Ltd., Birmingham, England

"American Machinist," Oct. 4, 1917

Is equipped with an all-geared headstock carrying the cutter head, while the work is held in a self-centering vise with hardened steel jaws of such construction that a variety of sizes of stock may be handled without adjustments. Three cutting tools are used, a balancing attachment being incorporated to equalize the power applied to each cutter. Capacity, work up to 8 in. in diameter; floor space, 4¾ x 7 ft.; weight, 8000 lb.; driving pulley, 5½ x 16 in.; horsepower required, 9

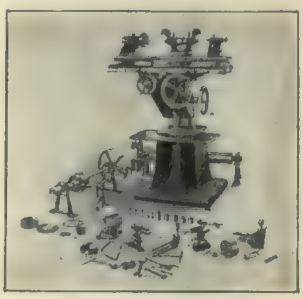


Grinding Machine, Universal Tool

Dauber Kratsch Co., Oshkosh, Wis., manufacturers; E. L. Essley Machine Co., 551-557 Washington Boulevard, Chicago, Ill., sales agents

"American Machinist," Oct. 4, 1917

Table surface, 5 x 36 in.; longitudinal table movement, 20 in.; transverse table movement, 8 in.; vertical table movement, 9 in.; maximum distance center of wheel to top of table, 8½ in.; swing on centers, 10 in.; maximum distance between centers, 22 in.; dead center in headstock, No. 3 Morse taper; height of spindle from floor, 48 in.; opening of universal vise, 2¼ in.; width of vise jaws, 4⅝ in.; chuck, 4-in. 3-jaw universal; depth of internal grinding permitted, 4 in.; belt width, 1½ in.; weight, 1350 lb.; floor space, 44 x 64 in.

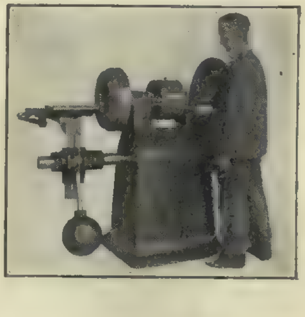


Grinding Machine, Disk, No. 17

Charles H. Besly & Co., Chicago, Ill., and Beloit, Wis.

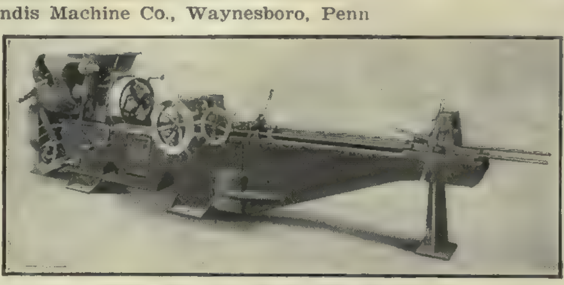
"American Machinist," Oct. 4, 1917

A combination disk and ring grinding machine, the features of which are the type of bearings used and the lubrication system. Bearing bushings are split and renewable, end thrust being carried by hardened and ground steel collars that bear against the flanged ends of the right bearing bushing. End play is taken up by an adjusting collar located under the rim of the spindle pulley. It is claimed that the grinder may be safely operated with all end play taken up in the spindle, as the bushing that carries the end thrust is provided with clearance to compensate for expansion



Threading Machine for Stay-Bolt Tools

Landis Machine Co., Waynesboro, Penn



"American Machinist," Oct. 4, 1917

For work on hollow stay-bolt tubes. Is equipped with an auxiliary bed that is attached to the main bed and supports a carriage fitted with threaded grips for timing the threads on the ends of the tube. The lead screw insures the thread being started correctly, and a pitch indicator serves to indicate the correct position for engaging the lead-screw nut. Is shown arranged for an alternating-current constant-speed motor with mechanical speed-change

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices, which went into effect Sept. 24, will have little effect on the general market for some time. Present warehouse stocks—bought at the old mill price—will probably be sold out before the present warehouse prices to ordinary consumers are reduced. The Government prices are: Pig iron, $33 per gross ton; steel bars (Pittsburgh-Chicago), $2.90 per 100 lb.; shapes, $3; plates, $3.25. New Government prices expected within two weeks.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Oct. 5, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	....	$47.00	$14.50
No. 2X Northern Foundry, Buffalo	....	53.00	19.75
No. 2 Northern Foundry, Chicago	....	55.00	19.00
*Bessemer, Pittsburgh	†$36.30	52.95	21.95
*Basic, Pittsburgh	33.00	50.95	18.95
No. 2X, Philadelphia	....	53.00	19.50
*No. 2, Valley	33.00	53.00	18.50
No. 2, Southern Cincinnati	....	49.90	17.40
Basic, Eastern Pennsylvania	45.00	50.00	19.75

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.
†Subject to revision.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Oct. 5, 1917	One Month Ago	One Year Ago	Oct. 5, 1917	One Year Ago	Oct. 5, 1917	One Year Ago
Structural shapes	$5.25	$5.25	$3.25	$5.00	$3.25	$5.00	$3.10
Soft steel bars	5.00	5.00	3.30	4.50	3.30	4.50	3.10
Soft steel bar shapes	5.00	5.00	3.25	4.50	3.25	4.50	3.10
Plates, ¼ to 1 in. thick	10.00	9.00	4.50	7.00	4.00	9.00@10	3.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Oct. 5, 1917	One Year Ago
Pitttsburgh, mill	$4.75	$2.60
Warehouse, New York	4.75	3.25
Warehouse, Cleveland	4.95	3.25
Warehouse, Chicago	4.50	3.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Oct. 5, 1917	One Month Ago	One Year Ago	Oct. 5, 1917	One Year Ago	Oct. 5, 1917	One Year Ago
*No. 28 black	8.00	10.50	10.50	3.65	8.50	3.40	10.00	3.35
*No. 26 black	7.90	10.40	10.40	3.55	8.40	3.30	9.90	3.25
*No. 22 and 24 black	7.85	10.35	10.35	3.50	8.35	3.25	9.85	3.20
No. 18 and 20 black	7.80	10.30	10.30	4.45	8.30	3.20	9.80	3.15
No. 16 blue annealed	8.20	10.20	10.20	4.45	8.70	3.70	10.20	3.60
No. 14 blue annealed	8.10	10.10	10.10	4.35	8.60	3.60	10.10	3.50
No. 12 blue annealed	8.05	10.05	10.05	4.30	8.55	3.55	10.05	3.45
No. 10 blue annealed	8.00	10.00	10.00	4.25	8.50	3.50	10.00	3 40
*No. 28 galvanized	9.50	11.50	12.00	5.00	10.00	4.70	11.50	4.75
*No. 26 galvanized	9.20	11.20	11.70	4.70	9.70	4.40	11.20	4.45
No. 24 galvanized	9.05	11.05	11.55	4.55	9.40	4.25	11.05	4.30

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Oct. 5, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Oct. 5, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	15.30	6.30
Chicago	13.50	5.50

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

* Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Oct. 5, 1917	Cleveland Oct. 5, 1917	Chicago Oct. 5, 1917
Tire	5.00	5.00	4.50
Toe calk	5.70	5.50	4.75
Openhearth spring steel	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜	42%	15½%	¾ to 1½	33%	17%
½	46%	31½%			
LAP WELD					
2	42%	29½%	2	26%	12%
2½ to 6	45%	32½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD. EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	38%	20½%	¾ to 1½	33%	18%
½	43%	30½%			
¾ to 1½	47%	34½%			
LAP WELD. EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4	43%	31½%	2¼ to 4	29%	17%
4½ to 6	42%	30½%	4½ to 6	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	38%	25%	38.8%	24.8%
3½ to 6 in. steel lap welded	18%	List+20	23%	39%	42.8%	27.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Oct. 5, 1917	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	26.00	29.00
Tin, in 5-ton lots	62.00	61.75	39.00
Lead	8.50	10.50	6.75
Spelter	8.50	8.00	8.50

*Nominal; no market until Government intentions are known.

ST. LOUIS

	Oct. 5, 1917	One Month Ago	One Year Ago
Lead	8.00	10.75	5.87½
Spelter	8.25	8.25	9.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Oct. 5, 1917	One Month Ago	One Year Ago	Oct. 5, 1917	One Year Ago	Oct. 5, 1917	One Year Ago
Copper sheets, base	35.00	39.00	37.50	33.00	38.50	34.00	38.00
Copper wire (carload lots)	38.50	38.50	32.00	33.00	33.00	36.00	33.50
Brass pipe, base	43.00–45.00	43.00	46.50	41.00	45.00	42.00	45.00
Brass sheets	40.00	40.00	44.50	33.00	42.00	37.00	39.00
Solder ½ and ½ (case lots)	39.25	39.25	24.62½	37.00	24.75	39.25	24.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Oct. 5, 1917	One Year Ago
Mill	$29.00	$42.00
New York	35.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Oct. 5, 1917	One Year Ago	Oct. 5, 1917	One Year Ago
New York	21.00	17.00	21.50	18.00
Cleveland	21.00	16.75	21.25	17.50
Chicago	22.50	17.00	23.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Oct. 5, 1917	One Year Ago
New York	15.00	13.50
Cleveland	16.50	13.00
Chicago	16.00	13.50

TOOL MAKING AND TOOLROOM PRACTICE

Elements of Gagemaking—II*

By C. A. MACREADY

SYNOPSIS — *Buttons and indicators are means used for the accurate locating of positions or gaging points. But neither are infallible. The possible errors peculiar to each are pointed out, together with the means for modifying or avoiding them.*

A BUTTON is a substitute for a result that is to be obtained; that is, it is a movable point that can be accurately located in a predetermined position. Generally, it is a substitute for a hole that is required in a certain place, but it can be used to locate "bosses" that are required to be an integral part of the gage. A button must be a true cylinder; and if made like Fig. 19, the ends must be parallel to each other and square with the body. The seating end only of the button shown in Fig. 20 need be square with the body. The uses of the several different styles of buttons illustrated in Figs. 19, 20 and 21 depend upon the work in hand, as for instance: The holes to be bushed in the soft gage, Fig. 22; hardened gages, as in Fig. 23, in which the holes themselves are finished by grinding and lapping; or the holes in hardened gages, which are ground out and lapped and then bushed to a certain size to maintain sizes and center distances, as in Fig. 24. In such gages the bushings when worn are replaced by new ones.

The diameter of the button in many cases is controlled by the center to center distances of the holes; also, whether it is to be used as a locating point for a surface. In Fig. 19 is illustrated a well-proportioned button. It is 0.50 in. in diameter and 0.75 in. high.

The height of a button should be, as nearly as practicable, equal to the length of the hole it is to locate. After setting, the button should run true at both ends when tested with the indicator. If the buttons are tested with a knife-edge square, or a block square from the surface to which they are secured when in position, this also will show whether or not the holes will be parallel to each other. It is good practice to test the buttons with the knife-edge square after setting and before indicating for position on the lathe faceplate.

The reason why the buttons are tested for squareness with the seating surface *A* will be made obvious by referring to the exaggerated error in squareness of the button shown in Figs. 25 and 26. At *B* and *C*, Fig. 25, are shown the contact points of the micrometer, and at *D*, Fig. 26, the location of the indicator point upon the button. The difference in distance from the surface *A*, Figs. 25 and 26, of the points of contact of the micrometer and of that of the indicator on the button might be as much as $\frac{1}{8}$ in., and the difference in the measurement might be 0.0001 in. on each button. This gives an over-all error at the beginning of the work of 0.0002 in. between the holes; and if the holes in one plate were required to match a set of correctly located holes in another, the plugs would not enter both sets of holes.

The spherical, or ball, button, Fig. 21, is used to determine axial intersections of holes. It also serves to ascertain the relation of holes to angular sides. In Fig. 27 is illustrated a gage with two holes equidistant from the sides. In Fig. 28 is shown one with a hole that is nearer one side than the other.

METHOD OF USING BUTTONS

To make plain the application of the buttons, we will take them in the order in which they are mentioned. The body of the gage, Fig. 22, is to be left soft, and all measuring points are to be renewable. This style of gage consists of an assembly of blocks, or pillars, attached by screws to a baseplate. The pillar *B* has been laid out to the measurement required, drilled in a drilling machine with a combination drill and countersunk, with an 0.031-in. drill to start the larger hole. This larger hole should be about 0.015 in. smaller than finished size, to allow material for boring to true position. This undersize hole is used for attaching the button *A* by means of a screw and nut. The screw is about 0.031 in. smaller than the drilled hole. This permits slight movement of the button, so it can be adjusted to position by light raps before tightening the nut *D*, which holds it in position.

Whenever possible, the button should be attached by screw and nut through a clearance hole in preference to tapping a hole in the piece and attaching by a screw, as shown in Fig. 19. Some gages have several of these pillars so attached to a baseplate that they are far from the edges of the plate. When so arranged and when the holes are small, the strongest boring tool that can be used is apt to be so slender that it will spring away from the cut when retruing a threaded hole to be drilled, especially when truing the bottom of the hole. It is very evident that the tapped hole for the screw will not be in proper location, and it will be difficult to start a drill at the true axis from the old drilled center.

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*Prepared for the author's forthcoming book on gagemaking; copyright, 1917, Mc-Graw-Hill Publishing Co., Inc.

One source of errors will be avoided by laying out the different holes in the pillars and drilling them in the drilling machine before they are attached to the baseplate. If this is not done, the pillar *B* is liable (after correctly locating the position of the button) to spring out of place, due to the pressure of the drill. This method will also eliminate a source of error an example of which is given in Fig. 29.

The removal of a large amount of stock, such as the holes in the piece shown in Fig. 29, is very liable to cause distortion of the parallel surfaces *A*, *A′* of the work, Fig. 29. When these surfaces are retrued and made parallel, the removal of the further amount of stock in locating the holes correctly is not likely to again cause distortion.

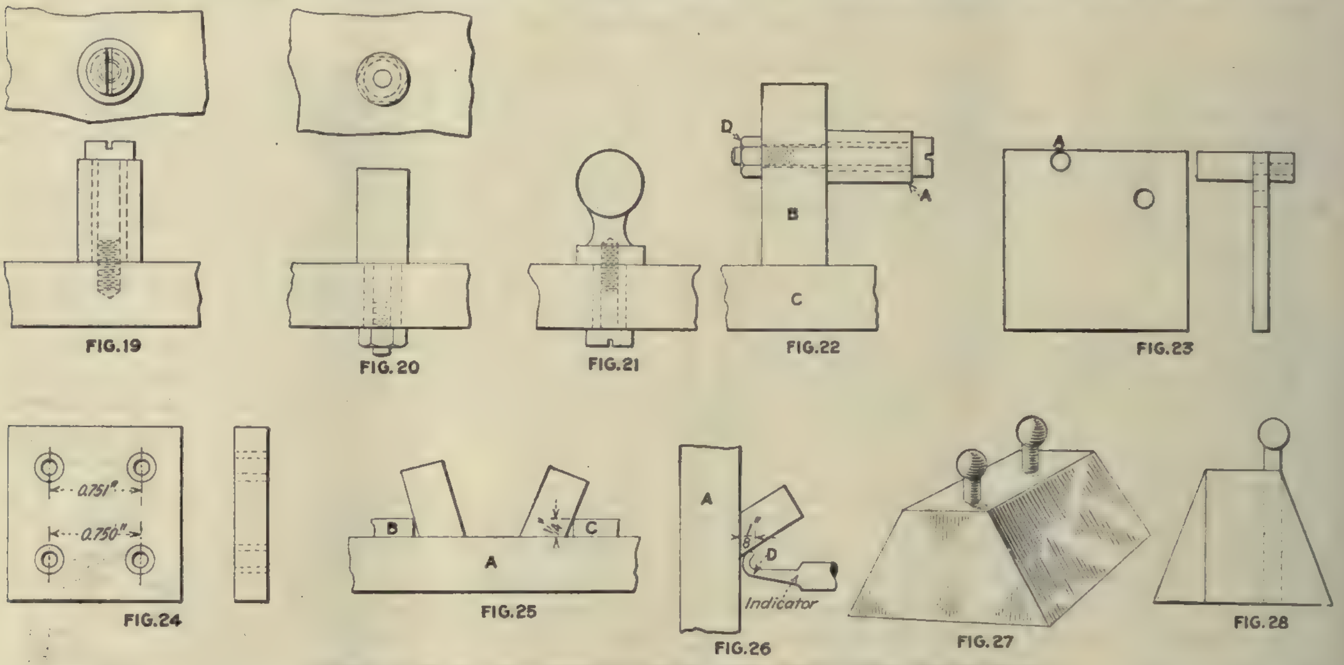


FIG.19 FIG.20 FIG.21 FIG.22 FIG.23 FIG.24 FIG.25 FIG.26 FIG.27 FIG.28

FIGS. 19 TO 28. VARIOUS BUTTON AND INDICATOR PROBLEMS

In Fig. 20 is illustrated a button of which the screw is an integral part. The body of the screw should be true with the body of the button and small enough to permit radial adjustment in the roughly drilled hole in the gage. In Fig. 23 is illustrated a gage that is hardened all over. The distance from the side of the hole *A* to the edge is only 0.005 in., and the diameter of the hole itself is only 0.07 in. This style of gage is hardened all over. The button shown in Fig. 20 will have to be used on this style of gage and all holes of small diameter.

In Fig. 24 is illustrated a gage that is hardened all over to maintain given center to center distances between the holes. The holes are, however, bushed; and when the holes in the bushings become worn, they can be forced out and new bushings inserted, so that the same center distances are still retained. The buttons shown in Figs. 20 and 22 can be used on this work.

One important qualification that is seldom considered by users and manufacturers of indicators is that they should respond to and record the *lightest contact with the work.* This does not mean contact with a positive surface, as when being drawn across the face of a parallel strip or sine bar or the surface of a hole that is concentric with the lathe spindle, but, for instance, when the indicator point just touches a portion of the wall of a small hole that is not set truly concentric with the lathe spindle. The tension of the spring controlling the indicator point should and can be made sensitive enough to record the slightest contact with the work.

While only two styles of indicators are shown in Figs. 30, 31 and 32, there are many other indicators that are just as good; in fact, all the commercial indicators are good. Some will indicate the front end of a small hole and also do all that the ones shown will do on work in which the holes are fairly large and not too deep. Styles of indicators, other than those shown, usually require more room to avoid interference with other parts of the work when the machine spindle is rotated and, so far as I know, lack the one qualification possessed by those illustrated—adjustability of the tension of the spring that controls the needle. In Fig. 32 is shown a complete set of pointers and extensions enabling one to reach and prove the positions of out of the way surfaces.

The importance of spring tension adjustment will be plain if the action of the indicator-needle spring is compared with the action of the indicator point when it comes in contact with the work. In Fig. 33 is shown the indicator point *A*, held in contact with the work by the spring *B*. It is very evident that, if the body of the pointer *A* is weaker than the spring *B*, it will give or bend and the indicator needle will not move. This in one sense is less dangerous than the condition shown in Fig. 34, as it is unreasonable to think that the button shown in Fig. 33 is central, while it is quite reasonable to think that the one shown in Fig. 34 is central.

In Fig. 34 the point *A* is shown in contact with a hole that can be seen to run out of truth. But part of the amount that the hole runs out of truth is lost through the bending of the body of the indicator point and is therefore not transferred to the registering part of the indicator. The spring *B*, which controls the indicating mechanism, is often under considerable tension merely to keep the parts in contact. That is why it is desirable to have tension adjustment for the spring controlling the indicating mechanism. Another way of showing that there could be an error even when the indicator apparently shows the hole to be concentric is as follows: Assume that the hole is 0.002 in. eccentric and that the indicator needle registers only 0.001 in. on the scale. With a condition like this the needle will not move at all when the hole is 0.0005 in. eccentric to the axis of the lathe, apparently proving the hole to be concentric. There is another possible condition conducive to false indication of untrue work, when the indicator point is so shaped that it will burnish or even cut the work and the tension of the needle spring is enough to induce either of these actions. This condition takes place, of course, with buttons like Fig. 20, which are generally left soft. When work is first placed upon the faceplate, it generally runs out, say from 0.01 to 0.02 in. This gives a greater pressure of the point on the "run out" side of the work. With a strong indicator spring, a cut or burnished contact point will be made on the soft button, and errors are sure to develop.

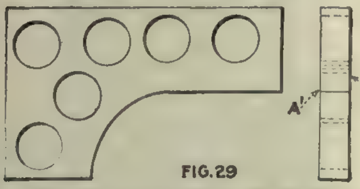


FIG. 29. EXAMPLE OF ERROR

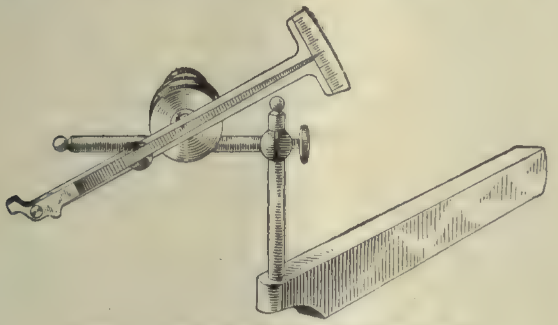


FIG. 30. ONE FORM OF INDICATOR

In Fig. 30 is shown a well-known make of indicator used to set the work approximately; then if greater refinement is required, the one shown in Fig. 31 is substituted.

The centers of the holes, even in accurate gages, are often made by the use of the transfer center punch, Fig. 12, which transfers them from holes already made. The transfer center punch should be a close sliding fit in the hole that is to be transferred. As the punch mark made by this tool is only about 0.01 in. deep, the weight or mass and construction of the indicator point used to indicate it when setting in the lathe must be taken into consideration. In Fig. 35 is shown how the pointer, Fig. 36, will abuse and displace a correctly located center mark if the work is moved on the faceplate while the female center of the pointer is on the tail center of the lathe and the male center of the pointer is in the center punch mark in the work. As it is only 5¾ in. from the face of the work to the tail center and as the pointer is 6 in. long, even with the greatest care when rapping the work to the true center of the lathe, the chances are considerable of forcing the sharp end of the pointer into the work and shifting the center punch mark.

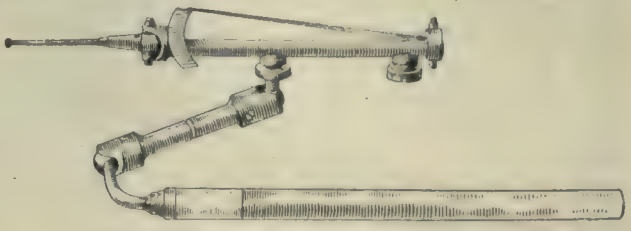


FIG. 31. INDICATOR FOR FINE WORK

This type of pointer is a very awkward one to use, even when released to allow the work to be moved, as one has to guess how much the work was moved at the last adjustment. An indicator reading cannot of course be taken while the pointer is removed to allow adjusting the work toward the spindle axis.

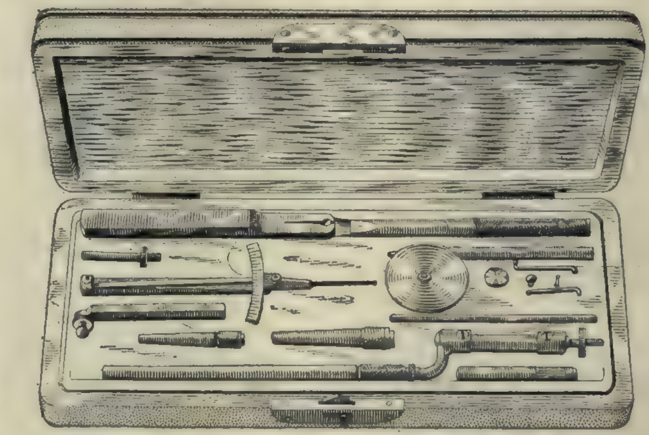
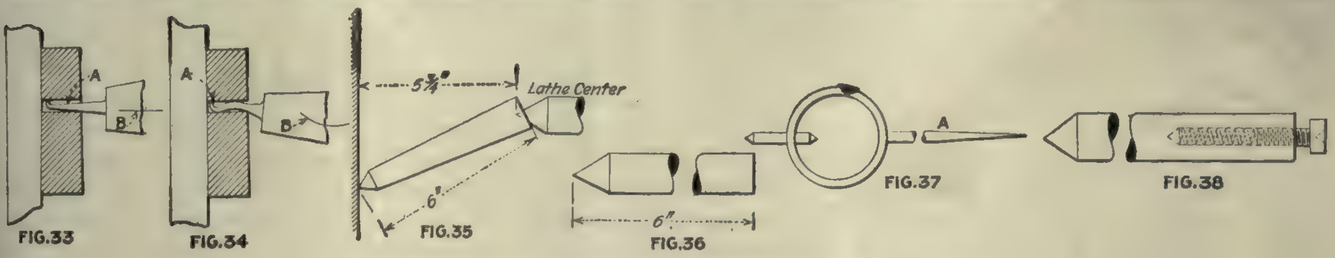


FIG. 32. POINTERS AND EXTENSIONS

In Fig. 37 is illustrated the principle of an indicator used by the old-time fine workmen. This indicator is very sensitive if the pointer *A* is made of wood and has little effect upon the location of the punch mark, but even with it one has to make a blind guess at the amount of movement involved in the last adjustment.



FIGS. 33 TO 38. A NUMBER OF GAGEMAKING METHODS

In Fig. 38 is illustrated a pointer that has a spring to compensate for the variation in length due to moving the work toward the center of the lathe. On the face of it, it looks all right; and it is all right if made like Fig. 39, which brings us to the cause of errors that are in *all* indicator pointers and that should as far as possible be eliminated when the pointer is used in delicate punch marks—that is, the inertia of the pointer.

The pointer is forced to move, not slowly, but with violent jumps when the work is rapped toward the center. The pointer should therefore be as light as is practicable, to offset as much as possible the stress upon the side of the center punch mark due to the inertia of the pointer. This stress becomes a blow the intensity of which varies with the force of the rap required to move the work, and the resistance of the indicator needle to be moved. In Fig. 39 is shown a good light pointer, which will offer the least resistance to a quick movement of the work from a state of rest.

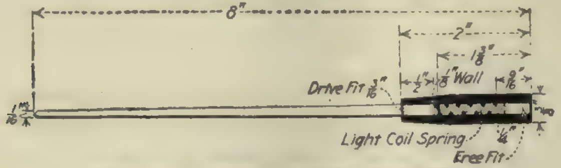


FIG. 39. A GOOD LIGHT POINTER

The errors cited are brought to the attention of the reader, because they are the points that must be considered in planning the making of gages. When their recognition becomes a habit of thought, they will flash through the gagemaker's mind as he studies a gage drawing. He can then determine whether a certain error can be allowed here and corrected afterward or whether the point must be made accurate to start with. All the causes of error that creep into refined measurements are not covered, but those selected are of such a nature that they would not be considered important by the average machinist who has had neither the occasion nor the means for measuring the accuracy of his work.

By this I mean, for instance, that when a machinist makes a plug a snug sliding fit for a hole, he is probably working to the fourth or fifth demical place, often without knowing it, as he has no tools that will record such measurements. Often, men who are capable of very accurate work are not aware how accurate it really is. Results obtained in testing frequently seem to indicate to them unduly large errors, when in fact the errors are practically microscopic. Take, as an example, two plates with two through holes in each at right angles to the surfaces, the holes in one plate being only 0.00005 in. out of line with the holes in the other. If the edges of the holes are sharp and the edge of the test plug is sharp, it will come up against the edge of the hole in the opposed plate as if it were coming in contact with a solid stop.

Design of New Military Truck

The designing of the new standard military truck, which must meet the field transportation problem of modern warfare, has been completed. A sample chassis, representing the efforts of approximately two score truck specialists, will be ready by the middle of October and final tests will be conducted. Deliveries are expected to begin in January, within four months after the War Department undertook the development.

After a series of conferences between military and civilian engineers the design of the standard truck was completed early in September. Within 10 days detailed drawings were made and sample parts ordered. Ordinarily, it requires several months to perfect and turn out such parts; but various manufacturers patriotically agreed to put ahead the Government's work, and delivery of the first parts was expected to be made by Oct. 1. The crankshaft die was sunk in seven days, and the crank-case pattern and first casting were made five days after receipt of the drawings.

It is believed the new standard motor truck will fully meet the requirements of the army in the field. Rapidity of manufacture, stability and standardization are the outstanding promises of the new truck.

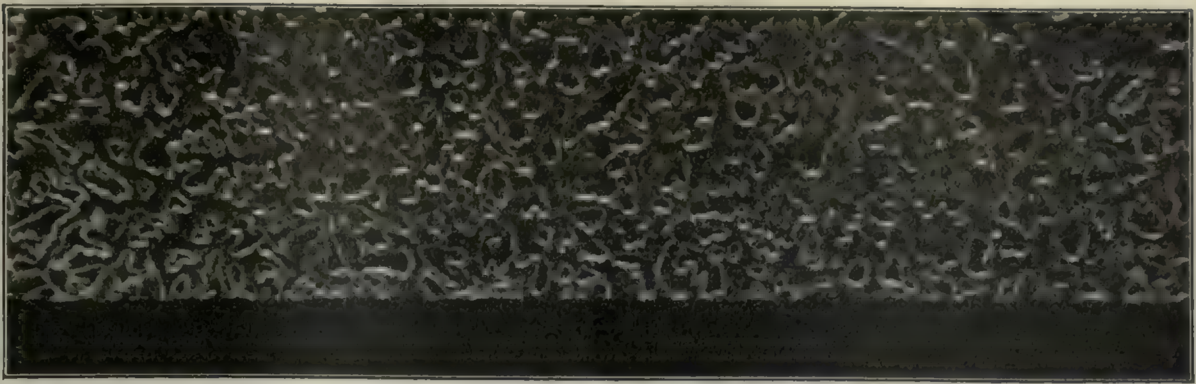
While the designing of the military truck lacked the dramatic features of the development of the United States aviation engine, or Liberty motor, it was brought about by similarly systematic and speedy methods. In the conduct of the war it is essential that we have large numbers of airplanes; it is also essential that transportation on land be highly developed.

In July the Quartermaster Corps initiated the movement for the production of a standardized military truck that would be an improvement over commercial designs heretofore used. Coöperation of truck manufacturers in all parts of the country was promised at a meeting held in Columbus in July. Early in August about 50 truck specialists and engineers of established reputation came to Washington at the invitation of the Quartermaster Corps. The Society of Automotive Engineers also sponsored the recent Washington conferences.

Both manufacturers and engineers generously contributed trade secrets in the designing of the military truck, just as they did in the development of the aviation engine. Engineers believe the new truck, a composite of the best there is in all commercial trucks, will be several years in advance of anything yet produced. Manufacture of the new truck will be carried on under direction of the Quartermaster Corps and the Automotive Committee of the Council of National Defense. Christian Girl, who has resigned as president of the Standard Parts Co., has been selected by Col. Chauncey Baker to supervise the work of production.

The new military truck will be made in two models, class A and class B. The engine used in the two will be the same in design, except for slight differences in cylinder bore, pistons, piston parts and riggings. To a large degree interchangeability of parts will be possible The class A model will have a nominal carrying capacity, under the arbitrary official ruling, of 1½ tons, with an actual commercial capacity of 3 tons. The class B truck will have a nominal capacity of 3 tons and an actual capacity of 5 tons. Both trucks will have a two-wheel drive, with a speed requirement of 14 miles per hour for the class A trucks and 12 miles for class B trucks.

It is planned that the first orders for the trucks shall call for 15,000 vehicles, to be delivered in the first six months of 1918. These orders will call for 10,000 class B and 5000 class A trucks. The adaptability of the new trucks to commercial as well as military uses is indicated by arrangements now being made by a number of manufacturers to produce them for commercial purposes.



HOW DULL TOOLS DISPLACE the GRAIN of BEARING METALS

By Christopher H. Bierbaum

VICE PRESIDENT, LUMEN BEARING COMPANY
CHAIRMAN OF THE BEARING METAL COMMITTEE OF THE A.S.M.E.

SYNOPSIS — *This article demonstrates very clearly what happens to bearing metal and other alloys when precautions are not taken against dull tools. Some remarkable photomicrographs of distortion caused by dull tools are presented.*

IN THE ideal bearing there is no metallic contact between the bearing surfaces (Reynolds, Royal Society, London, 1886); that is, in a bearing mechanically perfect both in design and workmanship, and while operating with proper lubrication, the journal is separated from the bearing by a continuous and unbroken oil film. The thicker and the more persistent this film is, the more nearly do conditions approach the ideal and the more readily can the ideal conditions be maintained. However perfect a bearing may be in its mechanical workmanship, and however perfectly it may have been "run in," the permanency of the film is still affected by the following interdependent variables: The viscosity and capillary affinity of the lubricant, the pressure per unit area upon the bearing, the surface speed of the journal and, finally, by the bearing clearance or the amount of freedom the journal has in its bearing. Other conditions permitting, an increase of viscosity of the lubricant increases the thickness of the film, and an increase of capillary affinity between the lubricant and the bearing surfaces increases the persistency of the film. In like manner an increase of speed increases the thickness of the film (Stribeck, "Zeitschrift des Vereins Deutscher Ingenieure," 1902), and even an increase of clearance within limitations increases the thickness of the film (Lasche, "Zeitschrift des Vereins Deutscher Ingenieure," 1902).

Under purely ideal conditions, therefore, it matters little as to the nature or kind of metals of which the bearing surfaces are composed. At such other times, however, when the ideal conditions do not exist and when the film of lubricant is destroyed, the nature and the condition of the bearing surfaces become of vital importance. No matter how near to the ideal conditions a bearing may approach when it is brought to rest, the oil film is completely destroyed and metallic contact between its surfaces is established; in addition, unforeseen accidents occur—interrupted lubrication, excessive loads, distortion and the like—and for these reasons it is necessary to consider the bearing value of all metals used in bearings.

In general, a bearing metal should be an alloy composed of a malleable, or plastic, matrix with relatively hard particles, or crystals, disseminated throughout. The compressive strength of the plastic matrix should be such that it can support the entire load placed upon the bearing without causing undue distortion. The function of the malleable part is also that of allowing the hard particles to conform to the required journal surface by individually readjusting themselves in the matrix. The function of the hard particles is that of supporting the pressure when metallic contact exists, these hard particles having the added advantage of offering less sliding friction upon the journal; and they, therefore, properly constitute the antifriction qualities of any particular bearing metal.

QUALITIES OF HARD PARTICLES

It is the possibility of readjustment of the hard particles that characterizes bearing metals; it is this particular quality that prevents scoring in a new bearing and facilitates being "run in." In no case, however, should these particles be hard enough to abrade the surface of the other bearing member. To illustrate, a soft low-carbon steel journal should not be run upon a pure copper-tin bronze, high in tin, since the hardest particles in this bronze are the copper-tin eutectic particles, Cu_4Sn, which are harder than soft machinery steel; a condition which in service always shows an excessive wear upon the journal. If, however, lead is added to this copper-tin alloy, somewhat different results are obtained, due to the fact that the miscroscopic particles of lead, upon cooling, locate themselves in close proximity to these eutectic particles during the solidifying of the bronze, thus permitting these hard particles to more readily adjust themselves in new positions to more nearly meet the bearing requirements. In a bearing properly "run in," the surfaces of these hard particles are higher than that of the matrix, infinitesimal in amount though it may be; nevertheless, it is sufficient to preserve a correspondingly small supply of lubricant disseminated between them.

It is commonly known, and it is almost generally appreciated, that a cold-rolled or cold-drawn material is not best adapted for bearing purposes. The reason for this is quite apparent when considered from a modern metallographic point of view. In the rolling or drawing process the metal is compressed and the natural orientation of the crystalline structure is changed, leaving the metal in a condition where the hard particles have become more permanently fixed in their position and where they have little or no freedom to adjust themselves to requirements whenever this cold-rolled stock is used for bearing purposes.

Now, it is interesting to find that a cold-rolled or drawn effect can be produced upon bearing surfaces while they are being machined with a dull or blunt tool; this fact does not seem to have ever received the attention that it deserves. This rolling or drawing effect upon bearings while they are being improperly tooled is highly undesirable. Though this effect in some cases may extend to but a slight depth, its presence is especially harmful since it is produced upon the very surfaces that take the initial wear. There are a few exceptions of alloys used for bearings in which the hard particles have no appreciable adaptability. These alloys, on the other hand, do not suffer in the same manner from improper tooling, and are, therefore, omitted from consideration.

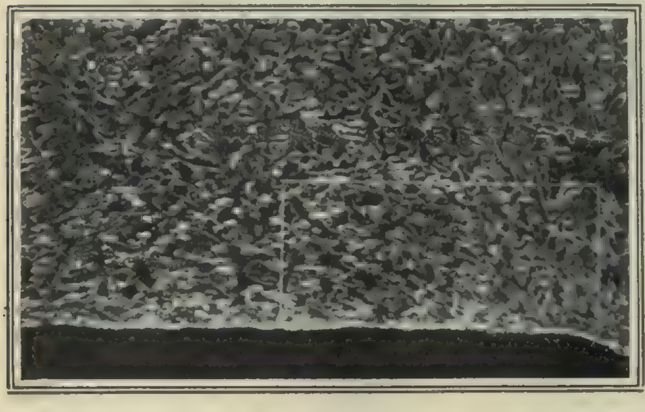


FIG. 1. DISTORTION OF THE GRAIN OF WORN WHEEL TOOTH, DUE TO A DULL HOB

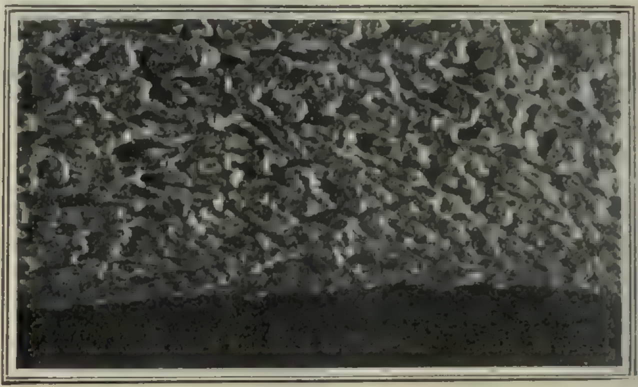
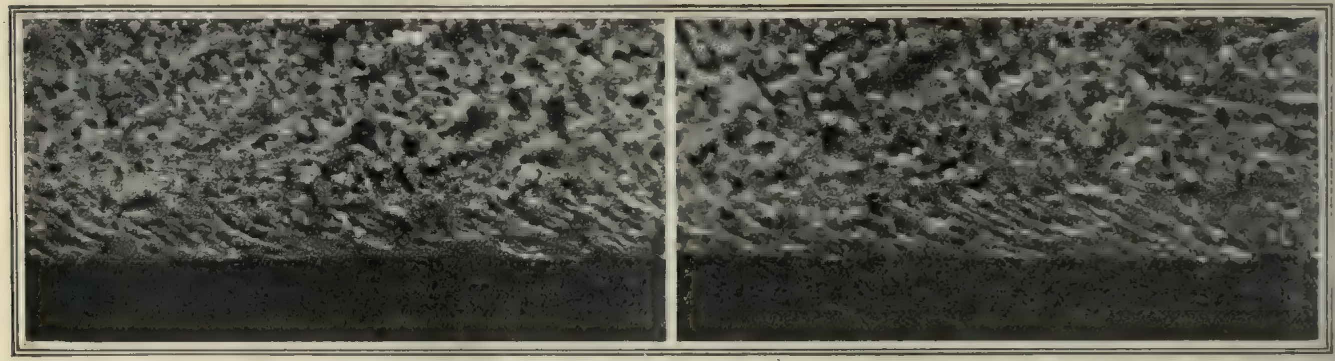


FIG. 2. A SECTION OF TOOTH IN FIG. 1 ENLARGED TO 100 DIAMETERS

The accompanying photomicrographs were made of sections of bearing bronzes marketed by large producers of this material and in a condition ready for service; these views, therefore, give a fair representation of conditions that obtain in every-day service. In each case, for this study, the bronzes were cut in a plane corresponding to that of the direction of cutting and at right angles to the finished surfaces; therefore, they show the maximum displacement of the grain under the conditions under which they were tooled These surfaces were treated in a manner usual for metallographic work.

Figs. 1, 2 and the leading illustration are photomicrographic views of sections of a bronze wheel of a worm gear used for motor-truck drive; the composition of this bronze is copper 89 and tin 11 per cent. Figs. 3 and 4 in the same manner represent sections of a bronze bushing having a percentage composition of copper 83.60, tin 7.31, lead 6.61, zinc 2.32 and iron 0.12.

Fig. 1 is a magnification of 50 diameters showing the distortion of the grain on the face of a wormwheel tooth caused by an excessively dull hobbing tool and the consequent extreme pressure necessary for making the cut. It shows a disturbance of the crystals over one-half its area, beginning at the lower right-hand corner and following a line substantially 30 deg. with the horizontal. Fig. 2 is a magnification of 100 diameters, showing the area indicated in Fig. 1 enlarged Fig. 2 shows the compactness of the grain of the metal, presenting the completeness of the effect corresponding to drawing or cold rolling upon the surface.



FIGS. 3 AND 4. BUSHINGS THE GRAINS OF WHICH HAVE BEEN DISTORTED BY A DULL BROACH

Figs. 3 and 4 are sections of a bushing that had been finished by forcing a blunt broach through the same, in an axial direction. Both views show the result produced by the same element of the broach, since the sections are in the same plane, and the undesirable drawing effect produced by this method of finishing; also, what is equally undesirable, the inequalities that result.

In Fig. 3 a fairly even effect is shown, whereas in Fig. 4, at the extreme right, there is little or none and at the left only slightly; but in the center the effect is excessive. On the other hand, the leading illustration, with a magnification of 90 diameters, shows that in the ordinary way a bearing bronze can be tooled to a smooth surface and not have its natural crystalline structure effected. This is a view of the same material as in Figs. 1 and 2, and shows the edge of a surface made with a heavy cut on a boring mill with the tool set to make a smooth, finished surface.

Dull and blunt tools with excessive pressure should be avoided when finishing up bearing surfaces.

Mechanical Products Requiring License for Export

The Exports Administrative Board has issued a list of articles for which licenses are required for shipments destined to countries other than the enemy or his allies or the neutral countries of Europe.

The board has determined that every article of commerce is included in the list of articles mentioned in the first division of the President's proclamation of Aug. 27 and will therefore require licenses when shipped to Albania, Austria-Hungary, that portion of Belgium occupied by the military forces of Germany, Bulgaria, Denmark (her colonies, possessions or protectorates), Germany (her colonies, possessions or protectorates), Greece, Leichtenstein, Luxemburg, the Kingdom of the Netherlands, Norway, Spain (her colonies, possessions or protectorates), Sweden, Switzerland or Turkey (excluding any portion of the foregoing occupied by the military forces of the United States or the nations associated with the United States in the war) or any territory occupied by the military forces of Germany or her allies.

The Exports Administrative Board has authorized the publication of the following list comprising articles which have already been included under the general headings in the second division of the proclamation.

ARTICLES REQUIRING LICENSES

Export license is required at present for the following articles: Aëronautical instruments; aëronautical machines; aloxite wheels; alloy steels; aluminum and articles made entirely thereof; alundum grain; alundum wheels; ammunition; iron and steel angles; antiaircraft instruments; antifriction metal; arms; babbitt metal; belting, leather; beams, iron and steel, structural, of all sizes; billets, steel; boiler plugs; boiler plates; boilers, steam; boiler fittings; boiler tubes; bolt-heading machines; boring tubes; bronze; carborundum; channels, iron and steel, structural, of all sizes; condensers; copper and articles made entirely thereof; copper bars; copper ingots; copper plates; copper rods; copper scrap; copper sheets; copper tubes; copper wire; corundum wheels and stones.

Diamonds, industrial; drilling implements and machinery with accessories for oil wells; drill press; electrical equipment; electric generators; emery, emery cloth; emery wheels; engines; exhaust pipes; fan belts (if leather); gages for steam boilers; glass reflectors; grinding machines, power driven; grindstones, power driven; iron channels; iron beams; iron angles; iron tees; iron zees; iron, fabricated, structural, including beams, channels, angles, tees, zees and plates, fabricated and shipped knocked down; iron shapes, including beams, channels, angles, tees, and zees of all sizes; iron plates, including ship boiler, tank and all other iron plates ⅛ in. thick and heavier and wider than 6 in. and circles over 6 in. in diameter; knife-grinding machinery, power driven; lathes; machines, aëronautical, and instruments, their parts and accessories thereof; engines, except locomotives, condensers, metalworking, woodworking, oil-well drilling, pumps, turbines; machine tools; metals, babbitt, antifriction; metalworking machinery; mirror iron; motors, steam, gas and electric; oil-well drilling implements and machinery; optical instruments; optical reflectors; pillar press, power driven; planer, power driven; potential transformer; profilers; propeller shaft; pumps, steam and electric driven; primers; radio apparatus, all; reflector, searchlight; sawmill machinery; scrap iron; scrap steel; searchlights; slabs and sheet bars, steel; solder; specular iron; spelter; spiegel; spiegeleisen; steam boilers; steel angles; steel beams, structural; steel, structural channels; steel, fabricated structural; steel-hardening materials; steel ingots; steel plates; steel shapes, structural; steel tees; steel zees; superheaters; tachometer; taps and dies, if for machine use; tees, steel; telephone apparatus; tools, machine; tools, steel; turbines; turret holders; wireless apparatus; woodworking machinery, power driven; X-ray apparatus; zees, steel.

APPLICATION FORMS

To procure export licenses for articles on the "conservation list," shippers must use Application Form A-3 for proposed shipments of pig iron, ferromanganese, ferrosilicon, spiegeleisen, steel ingots, billets, blooms, slabs and sheet bars, iron and steel plates, including ship, boiler, tank (and all other iron and steel plates ⅛ in. thick and heavier, and wider than 6 in., whether plain or fabricated), scrap iron, and scrap steel, when destined to any country in the world.

For all other commodities controlled by the President's proclamation of Aug. 27, 1917, shippers must use Application Form A-1 for proposed shipments to the following countries, or their colonies, possessions or protectorates: Albania, Denmark, Kingdom of the Netherlands (in Europe), Norway, Spain, Sweden and Switzerland.

Shippers must use Application Form A-2 for proposed shipments to the following countries, or their colonies, possessions or protectorates: Abyssinia, Afghanistan, Argentina, Belgium (that portion not occupied by Germany or her allies), Bolivia, Brazil, China, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Egypt, France, Greece, Guatemala, Haiti, Honduras, Italy, Great Britain, Japan, Liberia, Mexico, Monaco, Montenegro, Morocco, Nepal, the colonies, possessions and protectorates of the Netherlands, Nicaragua, Oman, Panama, Paraguay, Persia, Peru, Portugal, Rumania, Russia, Salvador, San Marino, Serbia, Siam, Uruguay and Venezuela.

Helical Springs in Torsion

By H. W. Price

The writer recently found it necessary to design a series of springs of round rod, loads to be applied torsionally; that is, so as to wind or unwind the spring. Various tables of properties of helical springs under axial load (like car springs) were available in handbooks and elsewhere, but nothing more convenient than burdensome formulas was found for torsional loading.

A convenient method was devised for using tables of axial properties for estimating springs to meet torsional requirements.

It seemed that for a series of springs there should exist some definite relation between safe axial and torsional loads and corresponding maximum deflections. Very simple relations were found both for safe axial loads and safe deflections, provided that twisting torque were expressed not in inch-pounds but in pounds acting at the mean radius of the spring. The relations were derived as follows from standard formulas for springs to be found in handbooks and mechanical textbooks:

Helical springs under axial load deflect by twisting of the rod as the spring is compressed. The safe load in pounds is $W = \frac{\pi}{16} \times \frac{sd^3}{R}$, where s is the safe stress in pounds per square inch in the outside fiber of the rod in torsion, d is diameter of rod in inches, and R is the mean radius of the coil in inches. The safe axial compression in inches per turn resulting from the load W is $F = 64\frac{WR^3}{Gd^4}$, where G is the torsional modulus of elasticity for the material.

Helical springs under torsional load deflect by bending the rod as the spring is twisted so as to wind it tighter or unwind it. The safe twisting force in pounds applied at the center of the end of the rod—that is, at radius R inches from the axis of the spring—is $w = \frac{\pi}{32} \times \frac{Sd^3}{R}$, where S is the safe stress in pounds per square inch in tension in the outside fiber of the rod under bending strain. The safe rotational movement in inches per turn, measured at the center of the end of the rod, or at radius R, due to the force w applied at that point, is $f = \frac{64}{\pi} \times \frac{wlR^2}{Ed^4}$, where l is the length in inches of one turn of the spring, or $2\pi R$, and E is the modulus of elasticity for tension or compression.

The convenient result comes from the combination of the foregoing formulas and the insertion of suitable relative values of tension and torsion constants for tempered spring steel. The torsional modulus G is usually about 40 per cent. of the modulus E for tension, and the safe working stress S for tension is about 60 per cent. greater than the safe stress s in torsion. Inserting $0.4E$ for G, $1.6s$ for S, $2\pi R$ for l, and finding w and f in terms of W and F, it follows that:

1. $W = 1.25w$, or in words, a spring required for a twisting force w applied to the center of the end of the rod will with equal safety bear an axial force 1.25 times as great.

2. $f = 0.64F$, or in words, the safe rotational movement of the end of the spring in twisting under force w is 64 per cent. of the equally safe axial compression from axial force W pounds.

Tables in handbooks give safe loads and deflections for springs under axial loads, from which the corresponding torsional values are easily obtained by applying the ratios 1.25 and 0.64 respectively.

Example: Choose a spring of round tempered steel rod, pitch diameter 4 in., to twist 90 deg. under torque 2000 in.-lb.

Determine the rod diameter necessary for strength. Torque 2000 in.-lb. is equivalent to a force 1000 lb. at radius R of the spring, 2 in. A suitable spring will with equal safety carry an axial load of 1000 lb. × 1.25 = 1250 lb. From spring tables under 4 in. pitch diameter it appears that $\frac{9}{16}$-in. rod will be sufficiently strong.

Determine the number of turns for 90-deg. twist under the specified torque. While taking from the tables the necessary diameter of rod, note also that the axial deflection per turn per 100 lb. force is 0.0245 in. The rotational motion per turn per 100 lb. on the end of the spring is 64 per cent. of this, or 0.0157 in., hence 0.157 in. for the proposed 1000 lb. The necessary motion is 90 deg. at 2-in. radius, or $\frac{90}{360} \times \pi \times 4$ in. $= 3.14$ in. The number of turns required will be $\frac{3.14}{0.157} = 20$ turns.

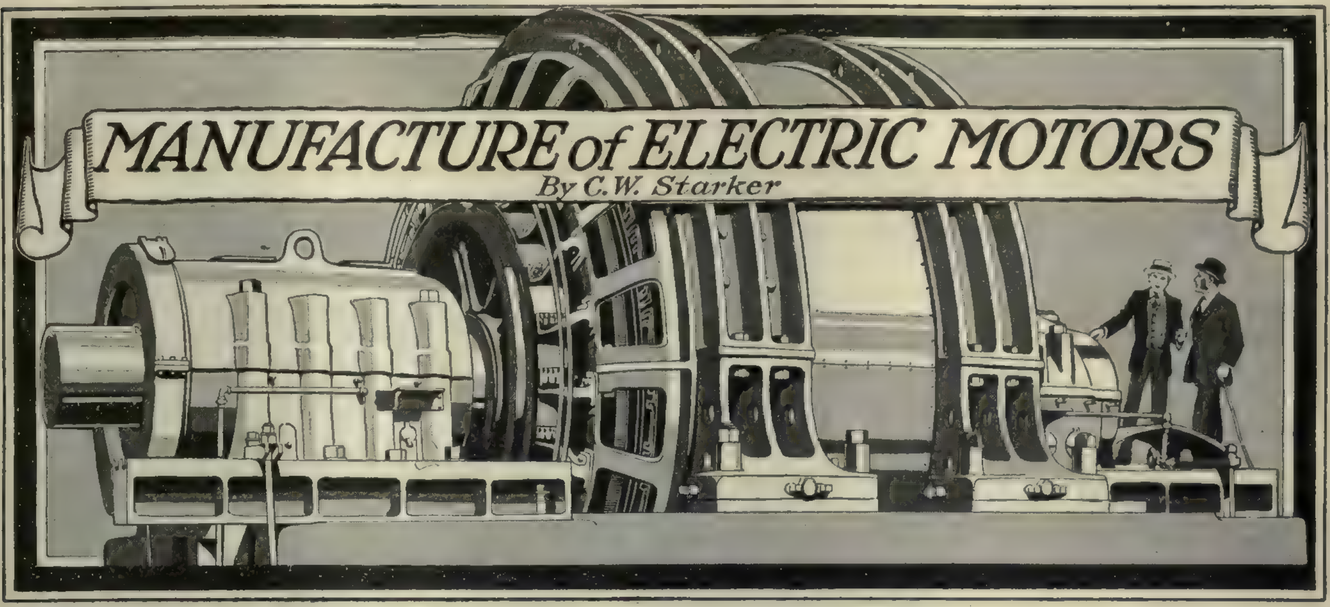
If the diameter of the spring is not settled by space limitations, one can see in the tables a variety of springs of about equal strength, and it is then necessary to work up only that one which promises best to fit into the proposed work. If an extra-large safety factor is required, choose from the tables a spring capable of, say, twice the axial load W and proceed as before.

Hardening High-Speed Cutters

By E. A. Spalding

Having read many of the articles in the *American Machinist* on heat-treatment of high-speed steel, I will give my experience in that line. I have been using high-speed steel with varied results since it was first introduced and have tried a number of compounds recommended to protect the steel from oxidation, with little or no success until I tried coke dust. The coke is ordinary foundry coke, and forming cutters treated in dust made from it come out harder at a lower heat, are free from scale and pitting and will do better work. The coke dust can be procured from the screenings at the foundry or, better, take good clean coke and grind it in an ordinary rattler by adding some scraps of iron. The finer it is ground the better results will be obtained.

Pack the cutters in an ordinary cast-iron box with a layer of coke, then a layer of the cutters, and so on until the box is full. Be sure to use plenty of coke. Heat in a furnace to 1740 to 1800 deg. F. for two or more hours, according to the size of the work, and quench in a light tempering oil. A mixture of 10 to 1 of lard oil and kerosene works well. The coke can be used to good advantage for pack hardening parts of machinery made from low-carbon steels, also cast and malleable iron, that require to be hardened on the surface. It may be necessary to add ground bone or burnt leather for some parts that must have a deeper and harder case than others.



MANUFACTURE of ELECTRIC MOTORS

By C.W. Starker

IV. Operations on Bearing Brackets

SYNOPSIS—*In preceding articles reference has been made to the lack of economical conditions in motor manufacture, due to great variety of product. This condition is strongly illustrated in the large number of bearing brackets required.*

THE large manufacturer of motors must carry in stock six or seven hundred different types and sizes of bearing brackets for motors of between two and one hundred horsepower. This, of course, means a very large investment in patterns and castings, as well as for jigs, fixtures and gages for the various machining operations.

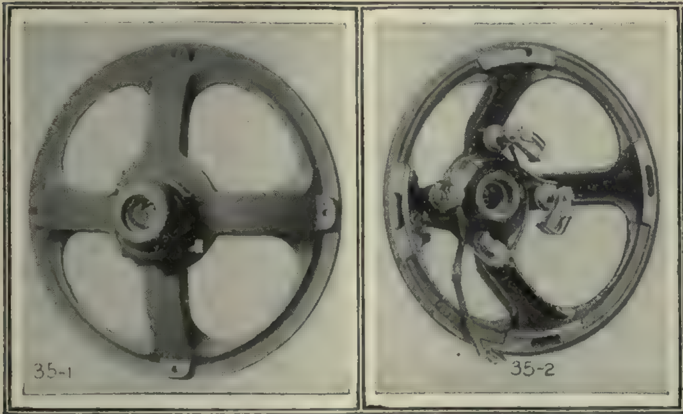


FIG. 35. PAIR OF DIRECT-CURRENT MOTOR BRACKETS

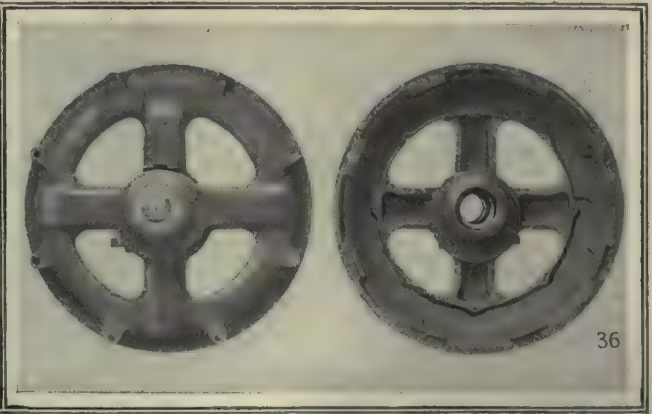


FIG. 36. FRONT AND REAR OF INTERCHANGEABLE MOTOR BRACKETS

The ordinary direct-current motor must have both front and rear brackets, which are similar in construction except that the front bracket is made deeper to extend beyond the commutator. A second front bracket is often required to accommodate the wider commutators on low-voltage motors. A typical set of these bearing brackets is illustrated in Fig. 35.

It is not practical to use the same bearing brackets on alternating- and direct-current motors, for the requirements of coil space, ventilation, etc., are different; and a well-proportioned design for general-purpose open-type motors invariably works out with a larger diameter for the former.

An unwarranted sacrifice in design would have to be made in order to use the same brackets on both types of motors. However, it is possible to standardize on bearings, so that the same core boxes, oil lids and other component parts may be used on both alternating- and direct-current motors.

Viewed from a repair-parts standpoint, it is very desirable to use brackets that are interchangeable on both ends of a given motor, Fig. 36. This is practical on alternating-current motors of the squirrel-cage type, but it is not feasible on wound-rotor motors or single-phase motors, for the extra space required for the collector or commutator necessitates a longer bracket on one end, Fig. 37.

On all these types of bearing brackets the machining operations are practically the same. The first operation is turning the rim for appearance sake. On the same set-up in the boring mill *A*, Fig. 38, the bracket flange is faced and the shoulder that engages the bore of the motor frame is turned. As a perfect alignment of both end bearings is very essential, the diameter of this shoulder is held to limits of —0.000 to —0.005 in. The bracket is then turned over and centered on a suitable fixture, locating by the turned shoulder, and a recess is bored in the bearing housing to engage a shoulder on the bearing to take up end thrust or bearing load in an axial direction, *B*, Fig. 38. The distance from the faced portion of the bracket's rim to this shoulder must be accurate, for it regulates the end play, or distance allowed between the face of the bearing and the shoulder on the shaft, which is usually $\frac{3}{32}$ in. on a side. This allowance for end play is necessary in order to permit the rotating part of the motor to float, or oscillate axially, which not only gives better bearing conditions as to wear and temperature, but also gives better brush action and more even wear on the commutator. End play in the motor shaft is quite important. On account of uncontrollable manufacturing conditions, such as variations in thickness of punchings, the theoretical magnetic center of the rotor does not always coincide with the actual center, and without some end play this condition would result in a permanent set, or pull, against one of the bearing flanges. Such a pressure against an end bearing, in excess of a few pounds, is not allowed by the inspector, for it would result in heating, and excessive wear on the bearing flange.

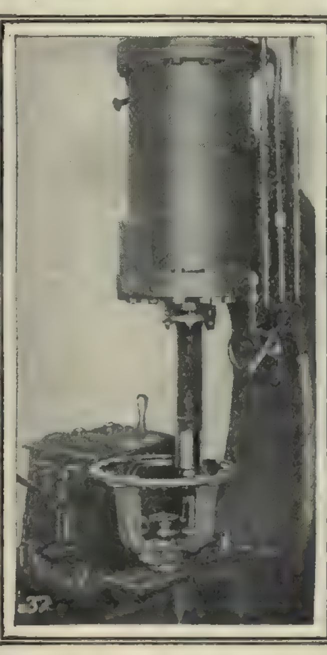


FIG. 37. PRESSING IN RODS

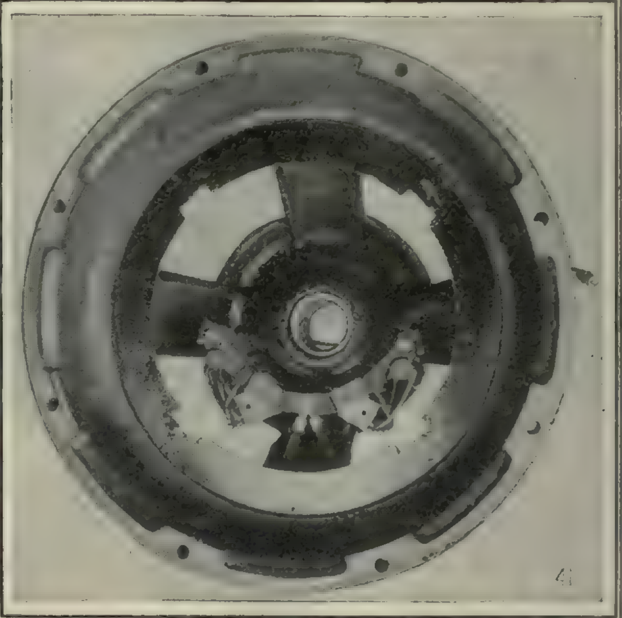


FIG. 41. BRACKET FOR ALTERNATING-CURRENT MOTOR

By careful reaming, the bore of the bearing housing is held standard to —0.001 in. This feature, together with the ample support of the bearing which is pressed into the housing, Fig. 39, is largely responsible for the excellent service shown by these brackets or bearings. The bearings are given a light press fit so that, should occasion arise, they may be driven out with a block of wood and a hammer and be replaced. The drilling of the bolt holes for securing the bracket to the frame is done with the multiple drill and jig shown in Fig. 40, after which the bracket is fastened to the motor frame.

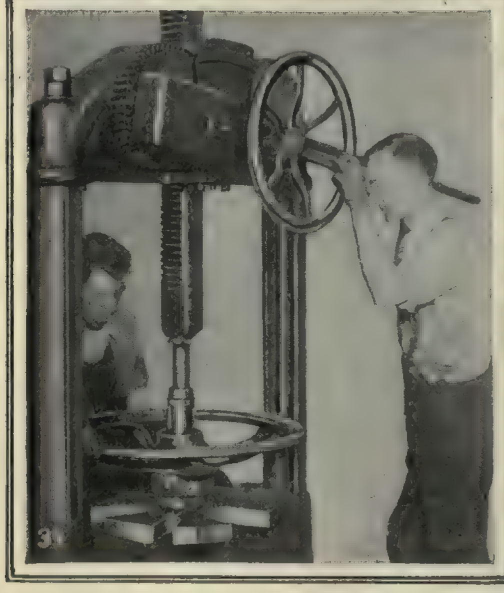


FIG. 39. PRESSING IN BEARING

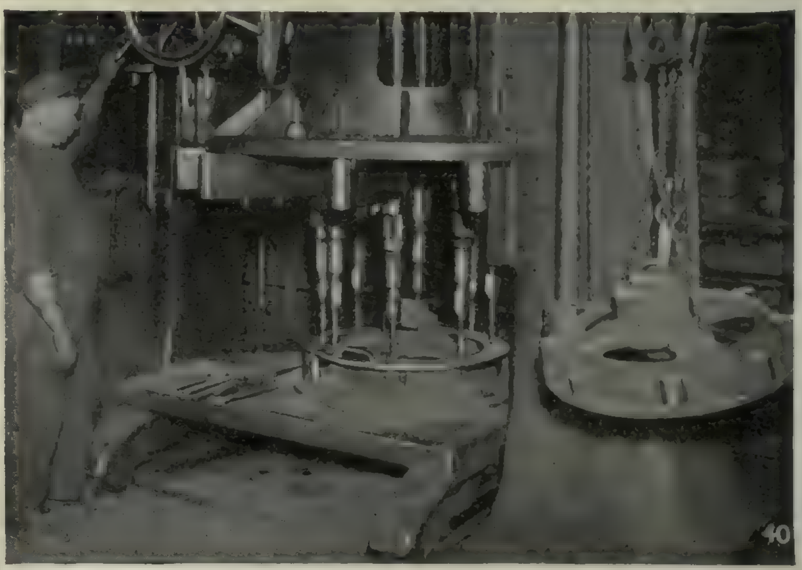


FIG. 40. DRILLING BOLT HOLES WITH MULTIPLE SPINDLES

A number of minor operations, such as drilling for oil drain, overflow plug and bearing pin, do not require description. The fitting of a spring closed, and in large motors a felt-lined oil lid, is among the few assembling operations.

In modern motors of the commutator or collector type, the brush-holder supporting rods are mounted directly in the end bracket in preference to the old-type rocker ring. The reason for this is that, with the modern commutating pole motor, a fixed brush position must be maintained for all loads and either direction of rotation. Any interference with the correct brush position as determined by the manufacturer is undesirable; therefore, no adjustments are provided. More than this, interference with the position of the brushes is prevented by doweling the bracket in place. This involves accuracy in manufacturing all component parts, such as coils, commutators, etc., where more careless workmanship could be permitted if means for adjustment was provided; but it is the only reliable method to follow. The same practice applies to the use of screws on the motor brackets for adjusting the air gaps. It would permit lowering the standard of workmanship, but would prove a source of danger in the hands of inexperienced operators.

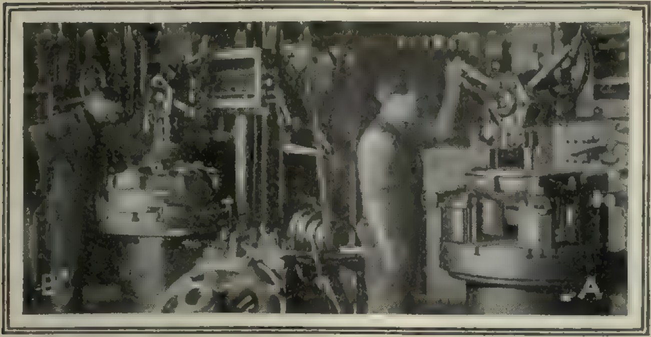


FIG. 38. TURNING AND BORING BRACKETS

The holes for the brush-holder rods are drilled in jigs and carefully reamed. "Micarta" tubes, which are impervious to oil and water, are pressed into these reamed holes, and the knurled ends of the steel brush-holder rods are then pressed into the tubes. Both of these operations are performed under a pressure of about five tons in the press shown in Fig. 41. The end of the hole is then sealed with insulating compound and a steel cap. The limits on the hole, tube and rod are held very close, all parts being accurately gaged, and the assembly is tested to 2500 volts alternating current. These precautions and high-grade workmanship have resulted in splendid success and have shown the reliability of this construction under the most severe service conditions. Split brackets, which were considered standard practice in former years, are now very seldom used, for manufacturers have come to realize that solid brackets and bearings have a number of advantages over the split type. Anything made in one piece is solid, does not come apart and has no bolts to rattle loose, etc. Solid bearings and brackets insure longer life of the bearing and do away with the troublesome feature of oil leaking out through the split, which it will do in spite of ordinary precautions such as wide flanges or oil draining grooves.

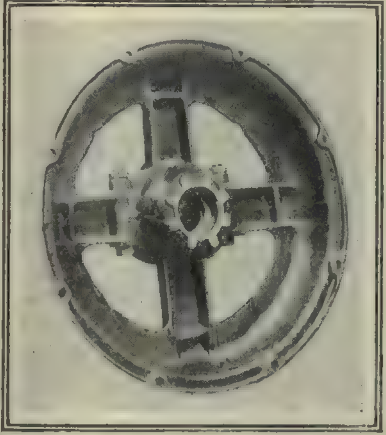


FIG. 42. SPLIT BRACKETS

Motor troubles, to a large extent, can be blamed to commutator or insulation trouble due to a film of oil on the commutator or coils. Some motors have been made with split rear-end bearings and solid brackets on the commutator end, but oil is just as likely to injure coil insulation at the rear end as on the commutator end. Furthermore, the action of the fan on the motor shaft, or of the revolving armature parts themselves, aggravates these conditions. The only point in favor of split brackets—greater facility in dismantling—is reduced in importance on modern motors in proportion as the art of motor design and quality of materials used have advanced. There is a justification for split brackets and frames on machines of a size beyond those now being considered—that is, above 100 hp.—where weights and space requirements are such as to make split construction necessary. A bracket of this type is shown in Fig. 42.

In this article no attempt has been made to enumerate all of the different bracket forms used on the range of motors under discussion. The very adaptability of electric motors to all sorts of drives leads users to demand special brackets suitable for mounting on their machine tools, printing presses, pumps, washing machines or what not. That this demand for special construction in addition to the already large number of standards results in a disadvantage to the industry and eventually reflects itself in the price to the consumer is a point that cannot be too strongly emphasized.

Are Ambitious Young Men Really Wanted?

BY W. OSBORNE

In the issue of Aug. 23, Fred Williams asks, "Are Ambitious Young Men Really Wanted?" The answer is yes or no—take your choice. From what Mr. Williams has to say, it can easily be inferred that he thinks that there is not a very energetic want. As the *American Machinist* is read by many young men who are interested in the future, it would seem as if the matter should not be allowed to rest.

We all have our own ideas as to what ambition is, but we may not all have the same idea. I am not certain that I have the idea that Mr. Williams had in his mind when he wrote his article, but that I may make my meaning clear I will give the definition that I have in mind.

From Webster's dictionary I get as an explanation of ambition, "a consuming desire to achieve some object or purpose," and of ambitious, "having ambition," From these I assume that an ambitious young man is one who has a consuming desire to achieve some object or purpose.

As the mechanical head of "Sammy's shop," I will try to answer the question. It depends entirely on the object or purpose of any given young man's ambition whether or not I want him.

JAKEY'S CASE

Jakey was a youngster who came to work. Ambitious, why Jakey was just full of it, and full of energy. Not a lazy bone in his body, and always on the go. Interested! The interest just fairly oozed out of him. He was interested in everything, almost, within his sight and within his hearing. Jakey is not here now. Jakey does not give our shop a very good name as being a good place for an ambitious boy. His ambition was not given the encouragement that would help it to grow, and still we say that we like ambitious boys.

Jakey was started in as errand boy, and between times he was supposed to do some cleaning up around the shop. As an errand boy Jakey was a dismal failure. His consuming desire was to be where he should not have been and to meddle with things that did not concern him. He wanted more money than he was getting. He had a consuming desire to have lots of money, but he did not have any desire to fit himself for anything that would enable him to give an equivalent for it. I do not know of anyone who really wants that kind of young man.

Sim had lived on a farm. He did not know anything about a shop, but he came in looking for work. He was put to work sweeping the floor and helping the men when they needed a lift. He did the best job of sweeping the shop that we had ever had done. He could see when a man needed a lift and did not hide so that the other helper would have to do it. He was put to running a drilling machine, and he did that as well as he did the sweeping. It was very easy to teach him to run the other machines when he was put on them. The way he took hold of them made you suspect that he had been doing some thinking about them. No, he is not with me now. Another shop needed a good man and somehow heard about him. He is foreman there. I have no reason to think that Sim spent any time trying to get that foreman job.

Bert was one of the best natural mechanics that I ever knew. He was an ideal jobbing-shop hand. Just give him a job that seemed to be a sticker, and he was happy. No other man in the shop could do the work that he did in the time that he did it and with the tools and appliances that he was able to do it with. He always had some mechanical problem on tap to bring out at any leisure time. He is at present in an important position with one of the big "trusts." He is at the head of the emergency repairs.

QUESTION OF TOO MUCH PUSH

Cal had ability, and he was a pusher. He was bound to get up and did not care whom he pulled down in his efforts. Cal was the fellow that he was working for. He showed up the mistakes of all of his superiors and of some of his equals. He worked so unevenly that he could not do teamwork. No one cried when he left, and the shop is still running.

Frank was ambitious. He was ambitious to dance well and dress well and cut a figure with the girls, and he was quite a success, in a small way, at all these things. He ran a lathe, days, and held his job. He did the monotonous repetition work. He could do it without thinking, and he did so.

One day, adjustment of wages was in order, and he came so near being overlooked that his vanity was hurt and he said so right out, to the boss. After the talk that took place he was transferred to another lathe. After another talk he left town to get away from the old dancing crowd. The last letters are typewritten, and General Manager is written under his signature. He transferred his ambition.

After these digressions I will go on with the answer. If a young man wants to work in a machine shop because he likes that kind of work and likes to see the result of his efforts and make them worth while, we "really" want him. If he wants to work in a machine shop because he thinks that he can get more for himself by giving less than he can in any other place, we do not want him. If a young man believes, and practices, that the best way to get along is to help those who are working with him to get along, we "really" want him; but if he thinks, and practices, that the way to succeed is to knife all his working associates, we do not want him.

Just shut your eyes and imagine that you are the owner of a nice little business. Think over all the ambitious men whom you know. Sort them all out. Which of them would you be willing to hire, and which would you refuse to hire? Now think them all over one by one and think why you do or do not want each one of them. If you are still interested, think yourself over as you know yourself and your aims, and decide whether or not you would hire a man that you knew was just like that and put him in a responsible position.

Making Parts to Limits

By H. D. Murphy

It is evident from the number of articles which have appeared on the subject since the manufacture of munitions became general that the necessity of manufacturing interchangeable parts to limits is something new.

When the plant where I am employed entered into a contract to make munitions, the proposition of working to limits was no new one. The trouble that was experienced in doing this work arose not from being held to these limits, but from the practice of continually changing the master gages. That, however, is a story by itself.

A large part of the plant was used for years in turning out work for one customer. This customer had never dimensioned the limits on the blueprints, as suggested by Mr. Bogart in his article on page 667, Vol. 46, but had always supplied, or authorized the making of, gages for essential dimensions. It was thoroughly understood that strict limitations could not be demanded where no gages had been so authorized.

Considerable money could have been saved for this customer, however, if his drafting room had observed some of the points mentioned by Mr. Bogart. There are on hand now, for instance, tools and gages for parts that take the same size thread, but with a difference of one thread to the inch. Also, the expense of a new punch and die has been incurred because the width of a slot in a certain article had been specified an eighth or a quarter of an inch more than on one previously made. These examples, of course, are cited from cases in which these variations were not essential.

It is to be hoped that Mr. Bogart's article will be read by many with profit, as we have had some customers who could not be convinced that there was any oversize or undersize on tools.

Incidentally, on page 669, where the proposed system of specifying external and internal limitations is illustrated, there seems to be an error. The limits on the shoulders and in the recess are shown as plus and minus instead of minus for the shoulders and plus for the recess.

Locomotive Frame Work

By Frank A. Stanley

SYNOPSIS—*The handling of a broken locomotive side frame is here briefly described. As one of these frames weighs from three to four tons, considerable skill as well as special apparatus is needed in its handling.*

BECAUSE of the character of the operations required to put the member into proper condition and the peculiar form of the work and the weight of the part or parts to be handled, the repair of locomotive frames is always an undertaking more or less difficult of accomplishment. Much of the work of this nature is naturally of a kind coming within the province of the blacksmith shop, and oftentimes the facilities of this department in a railroad repair shop are none too complete for the satisfactory overhauling of frames from the big, modern engines such as are used on this division of the Southern Pacific.

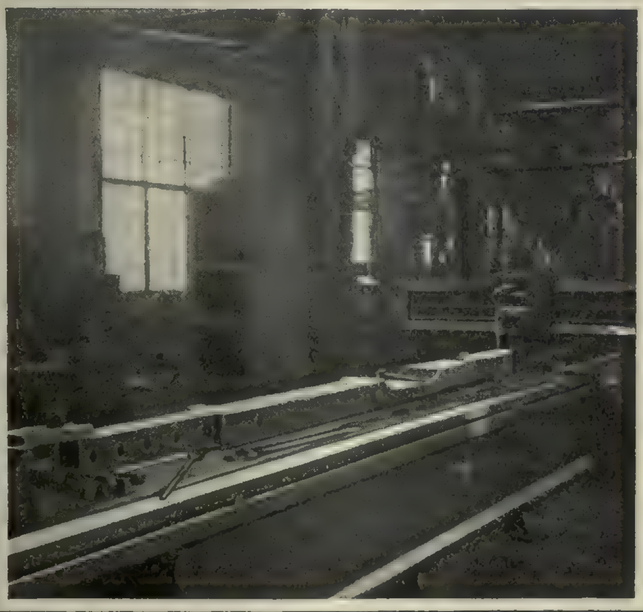


FIG. 2. PLANING A NEW FRAME SECTION

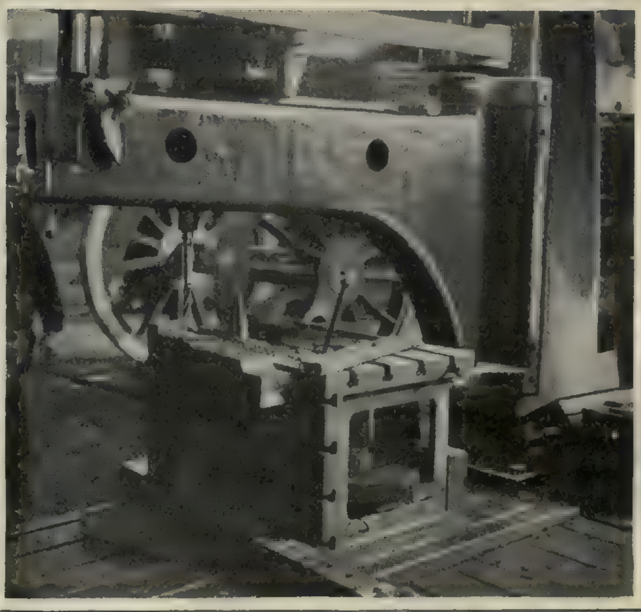


FIG. 3. DRILLING A SECTION TO BE WELDED

In an earlier article dealing with the smithshops of the Southern Pacific plant at Sparks, Nev., illustrations were presented showing something of the important features of this department and conveying some idea of the equipment for handling work of an unusual character as well as the customary run of jobs coming to the blacksmiths for attention. It is purposed in the present article to show some of the interesting apparatus and methods by which frame repairs in particular, no matter how heavy the work may be, are here taken care of with facility.

A typical frame construction is shown in Fig. 1, the general dimensions being of interest as showing the over-all length, the center distance between boxes, etc. The frame shown is one of a pair, right and left, made to uniform dimensions, and it has a total length of 42 ft. 8½ in. The weight of each side member of the pair runs, say, to 3½ or 4 tons, and this fact coupled with the liberal over-all dimensions of the member makes it necessary to use considerable skill and judgment when a new section is to be welded on or when certain portions are to be machined in the shops either before or after welding up the complete frame.

Owing to the great length referred to and to the peculiar form of the member, it is the custom at this shop whenever a new section of any considerable size is to be welded into the old frame to do all the machine work possible on the new portion before it is welded into place. This means that additional care must afterward be exercised in the blacksmith shop to preserve alignment so far as possible and to maintain original over-all lengths and other dimensions.

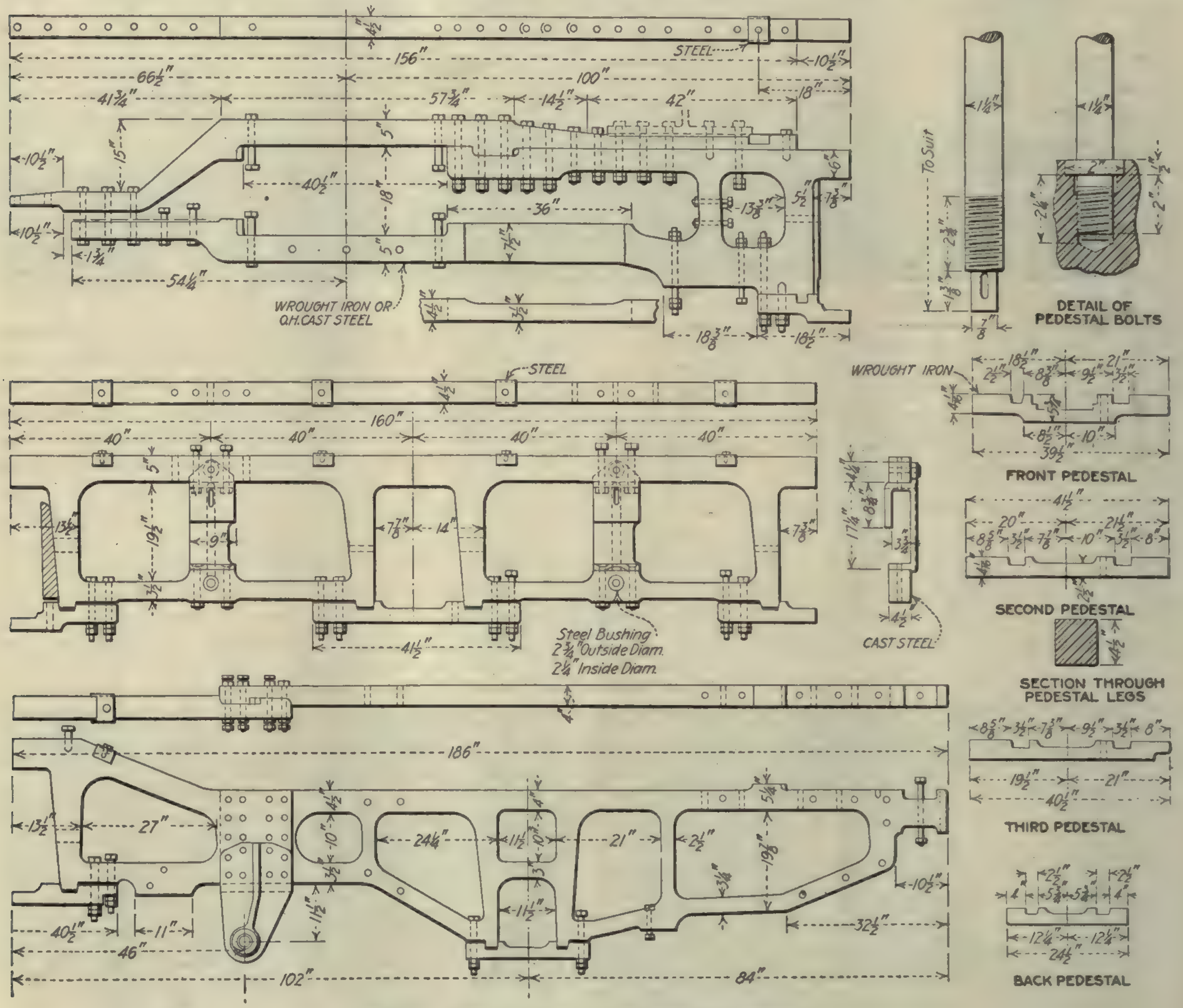


FIG. 1. DETAILS OF A LOCOMOTIVE FRAME

Fig. 2 illustrates the method of planing the forward lower portion of such a frame preparatory to sending it into the blacksmith shop for welding to the frame proper. Fig. 3 shows another frame section under the radial drill where the stud and bolt holes are drilled before this new portion is welded into the body of the frame.

Referring now to the operations in the smithshop, Fig. 4 illustrates a device arranged especially for frame work, which enables such parts to be handled with convenience either on the floor, on the crane hook, on the anvil, or under the power hammer. It consists of a pair of steel sheave wheels divided or split across the center so as to form in each case a pair of semicircular clamps. These, when bolted to the frame as shown, are adapted to receive the endless chains from a pair of small pulleys hung in blocks which are themselves hooked into holes in the equalizing bar suspended from the main crane hook. With the apparatus resting on the floor and the chains off, the entire outfit, frame and all, may be rolled over to any desired angle for laying out, inspection or other purpose, and when picked up by the crane the frame may be rotated in the sheave chains to whatever position may be desirable.

In the work shown the frame is suspended and turned flat with one end resting upon a supporting anvil. In this position a new section to be welded on has been secured in proper place relative to the main frame and clamped for the welding process by a pair of side plates which hold the two members flush with each other and in correct alignment for the operation. These clamping plates are arranged so as to be very quickly applied, and after the heated work has been swung out of the furnace they aid very materially in maintaining the desired conditions of alignment while the work is under the hammer.

It will be noticed upon careful inspection that two sheet-metal plates are attached to the side of the supporting blocks for the sheave chains, and these plates completely fill the triangular openings directly above the sheave wheels clamped to the engine frame. The purpose of these plates is to prevent the workmen from thoughtlessly grasping the chains or the edges of the wheels with their hands, with the attendant possibility of having one or more fingers crushed between chain and wheel. Both shields referred to have the inscription "Safety First" painted upon their faces in conspicuous letters, and there is no excuse for anyone trying to wedge his hand into the danger zone.

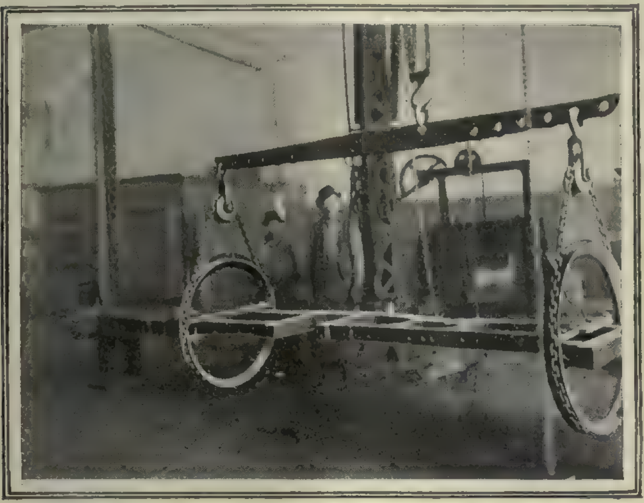


FIG. 4. METHOD OF HANDLING A FRAME

In addition to the welding operations carried on under the hammer extensive use is made of the oxy-acetylene blowpipe; also, more or less welding is done with the Thermit process. An electric welder is also employed for certain classes of work.

Occasionally a frame repair is made without stripping the engine, the weld being made either by the oxy-acetylene or the Thermit process.

Pumping Drill Coolant

By J. V. Hunter

Even in spite of the prevailing high prices, most shops are using high-speed drills for the greater part of their productive work, particularly in the sizes $\frac{7}{16}$ in. and upward. For drilling holes in any quantities at all, the high-speed drill is far and away the most economical when run at the greater speeds at which it is capable of cutting.

For drilling exceptionally hard or tough stock or castings, the edge of a good high-speed drill will stand up for service, although it must be run at about carbon-steel drill speeds, while under the same conditions the edge on the carbon drill will burn up in a minute. For these reasons and particularly for the reason that the drill must be ground less frequently, the "high speeds" are chosen by every good drilling-machine operator when he can obtain them.

In order for the shops to obtain full compensation for the extra cost of these drills, it is essential that they be run fast enough and at sufficient feed to keep them cutting to their full capacity. However, when this is done in such stock as steel, it becomes necessary to furnish some cooling lubricant, feeding it into the drill hole, to keep even a high-speed drill from burning up.

In most shops, for drilling-machine work, there appear to be two common systems of feeding this lubricant. One is the common type of oil can, which the operator fills with pure water, or at the best a solution of water and sal soda to prevent rusting; from this he squirts a few drops at a time down around the drill. This practice aids to some extent in keeping a drill moderately cool; but the first minute that something going on about the shop attracts his attention, he stops feeding water and the drill begins to smoke. Next time, a deep hole is half drilled and the oil can goes empty. Not one in ten drilling-machine hands will stop the drill while refilling the can, and the drill will be smoking in fine shape before it gets any more water; and after that hole, or at the best one or two more, the operator is going to the grinding wheel with the drill to pay for this neglect.

The next step of improvement is seen in a 1- or 2-qt. can suspended somewhere from the frame of the drilling machine and provided with a long extension tube, controlled by a small stop-cock. Down the tube the lubricant solution in the can is fed to the drill hole. An operator with this device is usually more lavish in the use of the cooling lubricant, and the drill is maintained in better shape for that reason and does correspondingly better work.

A study of the best practice in our most modern shops proves that a drill, like the rest of our high-grade high-speed cutting tools, does better work and lasts longer and makes faster time if provided with the same kind of "flood lubrication" that is now in use on semi-automatic and automatic screw machines, millers and various other types of machine tools. Consequently, some of the most modern plants are putting in a more or less elaborate system of piping, through which, from a single source, all the drills and other machine tools can be fed with the proper lubricant.

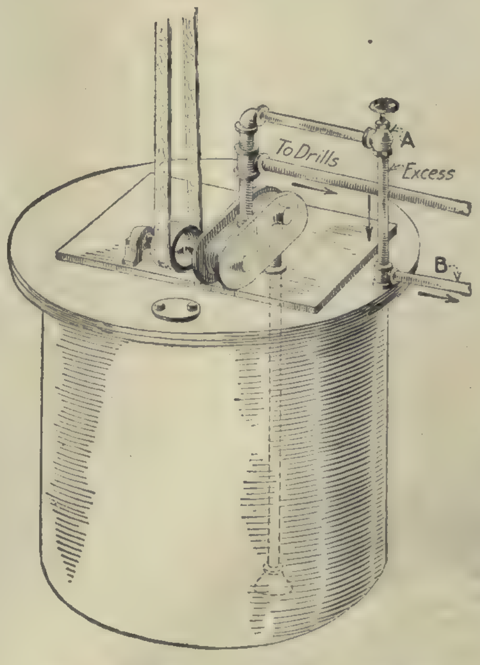


FIG. 1. PUMP, TANK AND PIPING

Large plants can usually afford comparatively expensive installations of this kind, but for the smaller plant the least expensive that will satisfy the conditions is all that the superintendent can hope to get an appropriation to cover. As a matter of expense and serviceability, the arrangements shown in Figs. 1 and 2 have many points of advantage to recommend them.

The rotary gear pump illustrated in Fig. 1 is one of the simple kind ordinarily used for pumping water against low pressures, and it can be purchased for under $10. In the case illustrated, the pump was recovered from among some scrap machinery. The tank should hold at least 15 gal. of solution, which will permit additions of 10 gal. of fresh solution at a time, while 5 gal. yet remains in the tank. Here is another opportunity for the genius of the future builder to exert itself in using up some old scrap tank; or at the best the tank can be made of light-weight new material, for which No. 18 or No. 20 galvanized sheet steel with riveted and soldered joints will be of sufficient strength. A ring of light-weight angle iron, for stiffness, is rolled up and riveted to the top edge of the tank; a $\frac{1}{4}$-in. plate across the top is firm enough for the foundation for so small a pump.

THE SUCTION PIPE

The suction pipe of the ordinary pumps will extend directly from the base of the pump and can be extended to the bottom of the tank, giving a straight vertical suction lift. The bottom opening of the pipe should be provided with a fine wire-mesh strainer to keep chips from being drawn up into the gears of the pump. The strainer is not always necessary if the tank is cleaned regularly, for most of the heavy particles that will be carried back in the returned solution will settle to the bottom of the tank and will not be drawn up unless many of them accumulate.

For from six to eight drill spindles working, the lubricant requirements will probably not exceed a couple of gallons a minute as a maximum; since most of these pumps are rated at a capacity in excess of that amount, they should be run at a speed moderately slow. A good way to avoid the use of a pulley is to run the drive belt over the shaft of one of the drilling-machine countershafts.

Even with this speed-reduction ratio, the capacity of the pump is going to be too great when some of the drill spindles are not working and it becomes necessary to regulate the pressure in the feed pipes to the low pressure required; for this purpose the bypass valve *A*, Fig. 1, is provided. A turn of the handle of this valve will permit a certain amount of the pumped solution to escape down a pipe that leads back to the tank, along with the return drains *B* from the drilling-machine drip pans.

RELEASE VALVES

We have tried using automatic spring-operated release valves at this point and even made up one or two special devices of our own design, but found difficulty in getting effective regulation for the low pressures that it is desirable to use. The pressure required is from 2 to 3 lb. on the supply lines; greater pressure causes needless splashing at the drill, which soon has the operator standing in a pool of water.

In Fig. 2 are illustrated the feed pipes with the pans for collecting the drippings from the table of the drilling machine, so that all the solution not actually lost in absorption by the chips will be returned to the storage tank. The amount of the cooling lubricant fed to the drill is controlled by the stop-cock in that line at *S*. This pipe need be no larger than $\frac{1}{4}$ in.; the final length at *X* is drawn to a taper, to direct the jet to the drill hole. It will be noticed that the length of pipe at *X* is connected up by two elbows, together, permitting an increased amount of swing or play in directing it to the work. This section *X* will be more satisfactory if made of a piece of flexible-steel tubing. This would cost more; the illustration shows the cheapest method.

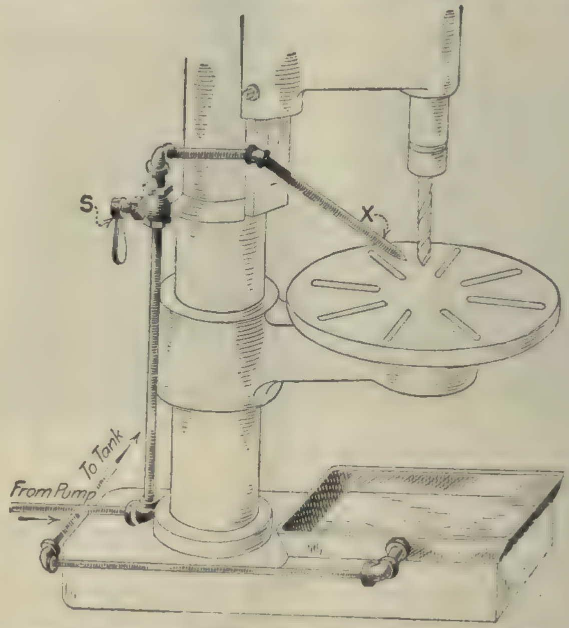


FIG. 2. FEED PIPES, DRIP PAN AND DRAIN

The pan for collecting the drippings should be in size about equal to the base of the drilling machine, with sides about 2 in. high; it is made of No. 20 galvanized steel with soldered joints. A pipe flange for the outlet is provided, and this is screened over with No. 8 wire mesh, to keep out the chips. A bar laid under one side of the pan will drain it to this opening. From the height of the base of the standard drilling machines there will be little fall in level for the return pipe to the tank; but if there is as much as 1 in. in each 25 ft. of the return pipe, there should be no difficulty in having the solution drained away fast enough.

In regard to the matter of the soap or lubricating solution used in connection with this pumping system the choice can be made to conform to the lubricating solutions that a factory has been using for other classes of work. In making up 10 gal. of solution, it has been our practice to add to that amount of water about 3 lb. of sal soda and 1 lb. of soft-soap paste. The two last ingredients are dissolved in a pail of hot water before being added to the remainder of the water.

At one time we attempted to use a greater amount of soap to strengthen the solution; but the greater strength did not apparently aid the cutting power of the tool, while it did have the decided disadvantage that the strong solution foamed so much that the drilling machine and floor were in a continually sloppy condition.

Series for Executives

Four Attributes of Success—or Failure

By J. P. Brophy

Vice President and General Manager, Cleveland Automatic Machine Co.

SYNOPSIS—*It is not enough for the executive to learn when to say yes or no—he must learn also how to say it. This article sets forth the views of an executive on the four qualities—firmness, harshness, indefiniteness and arrogance.*

AROUND four attributes, firmness, harshness, indefiniteness and arrogance, is entwined success or failure. Firmness means stability of mind, minus ridiculous self-pride. To be firm in your convictions on any subject before saying yes or no is one of God's greatest gifts. If your services command $100,000 a year, it means you must be dignified when deciding perplexing questions; an honest manipulator of your tongue; convincing in your arguments to prove you mean just what you say. This is an art that some have and others cultivate, so that those upon whom they depend will carry out their instructions willingly and feel they can make suggestions, without fear, of any new ideas that may flash through their minds. This will apply to the man in charge of from one up to ten thousand men in any line of business.

Firmness also means considering without bias the views of others, leaving an impression of fairness when deciding. This intensifies the feeling of harmony that must exist in every successful organizition and is a power unexcelled.

Stubbornness displaying an inclination to sarcasm might be considered firmness, but it happens that this form of action almost invariably indicates just the reverse of this quality.

We should all be susceptible to a good argument. A bad temper and a feeling of contempt for the views of others end in brain disturbances. It follows that a smart man in your organization who can and will recommend improvements remains passive and never reveals the good things that come into his mind, feeling that the man in charge will not give him a hearing, or if he condescends to do so, is liable to belittle without investigating.

Now imagine such a condition—never in a receptive mood—which is a losing proposition. Such an executive is certainly void of diplomacy. Remember that the brains of more than one man are essential in any business, as a one-man business is bound to topple. Always keep in mind that your superintendent or foreman must command your respect.

To differ, when necessary, shows keen judgment. Be somewhat severe, if you must, but do not be harsh, if you can avoid it, even though the provocation is great. There is nothing worse than the effects of imprudence in dealing with men in any line of endeavor.

REMEMBER, if a man of importance only accomplishes what he is told to do because of timidity, he is not delivering what he is capable of doing; and when this occurs there is something wrong with his supervisors. Do not attempt to take all the credit for the success that comes your way. Encourage rather than discourage the development of the thinking powers of your business associates.

The great inventions of modern times are rarely ever the work of one man. He may get the credit, and he deserves it. It was he who first conceived the idea, but the actual completion that means success, in 75 per cent. of the cases, is due to big things that emanate from his able assistants; and do not forget this.

To be firm, after you have been convinced you are right, and not vacillating means that you are powerful and bound to be respected by your associates; and this, you will understand, is a great asset in life.

Harshness in giving orders means that a great amount of your power is wasted. Human nature leans toward the man who decides on what he wishes done and imparts the information to others, clearly and forcibly. A man who is strong mentally, listens and weighs all the facts and then says: "This is the way to do it"; "I want you to follow my ideas"; "Your plan may be all right, but I am doubtful"; "My judgment differs from yours in this case." Then upon receiving their instructions your men will yield gracefully and do their best to comply.

ONE of the greatest questions from a business standpoint is not to condemn the views of others until you reason sensibly. You may miss something valuable, if you do. Your leading men must be thinkers and deserve recognition. Differ from them, if you will, but do not do it harshly. If they are not competent to advise and suggest, you are incompetent in having such men in your employ.

Harshness does not mean being arrogant. To be too harsh in controlling a business leaves a feeling in the minds of those with whom you are dealing that you are overbearing and belittling in your methods. You can be harsh to a certain extent through over-excitement at times, which is not damaging. When you are aiming to be firm and fair with those to whom you are talking, avoid being harsh, which also happens sometimes in trying to emphasize your arguments. If you go too far, a listless organization is the result; and failure creeps in unwarned. So capitulate when you should, as this is sound judgment.

You will comprehend from this argument that harshness in dealing with human beings is extremely detrimental, and the writer believes that on numerous occasions failure may be attributed to lack of coöperation from this source.

Indefiniteness means changing your mind too often, evading your honest responsibility. Most weighty questions require time to decide, but being too indefinite in your decisions leads to insubordination of the mind. Stubborn contemplation cunningly concealed is a force difficult to combat and often gradually undermines and finally destroys the good things.

THE indefinite individual, in many instances, is quite successful. He is not a bad sort of fellow with whom to do business, because he means well. But many a good thing gets away from him. In any large enterprise this would be a very dangerous condition from a money standpoint. Impulsive decisions are necessary. Sometimes, of course, things require considerable thought, but the really indefinite man looks upon all things as big things. He is bewildered as to what is best to do and he is afraid.

Often a man escapes making a decision by resorting to remarks such as the following: "I will see about it"; "Do not go ahead until I think it over"; "I am not satisfied with this idea or plan, etc."; "I am afraid this won't work, you will have to change the idea"; "You will hear from me later." The trouble in many instances is, you do not hear from him later; he is still thinking, and this interferes with the progress of the work under consideration. Being indefinite in settling a question very often ends in a blunder. This sort of man discourages everyone in touch with him; he is a genuine procrastinator.

Sidestepping responsibility through fear of mistakes, hoping for an avenue of escape from some unexpected source, is time wasted, and your business will suffer irreparable losses. So do not be indefinite; take a chance. All the remarkable leaders of men will risk on hasty decisions. A thousand times better is this than constantly waiting and pondering, which creates a violent unrest in any industry.

An arrogant man is overbearing and unjust in his thoughts and decisions. He is one of those irreproachable characters who aims to be extremely dignified; at least he thinks so, whereas it is not dignity, it is merely displaying his power. Such a man crushes all the good there is in those around him. His arguments are intensified by his very looks. He acts as if being disturbed for the simplest things is unforgivable. Such a man is extremely lucky if born with wealth surrounding him. He has a lofty notion of himself and must be approached cautiously. He is very powerful among the subservient, but a weak brother when dealing with a real man. Without the assistance of able men to curb him, he would be a genuine failure in anything he might try to accomplish. He might do it by dollars and force, but never from a business standpoint.

Arrogance is a sword-like destroyer of great force and resembles a great tornado that rips to pieces everything in its path and leaves behind it pain and stubbornness.

New Combination Course for Engineers

The latest coöperative educational enterprise has been undertaken jointly by the Massachusetts Institute of Technology and the General Electric Co. This is a proposition which on the side of the students gives to them the advantages that an enormous industrial plant with its methods and problems will afford, and at the same time the General Electric will reap the benefit of the services of a group of selected young men.

The object of this course is the training of leaders for engineering and administrative branches of electrical and related industries. The course affords a distinctive training for technical and executive responsibilities with manufacturing corporations, particularly electrical ones. It covers a period of three years of coöperative engineering and administrative training, and the requirements for entrance into the course are the completion of work equivalent to the first two years of the electrical-engineering course at the Massachusetts Institute of Technology.

The three years of the coöperative instruction are equally divided between courses under the faculty at the institute in Cambridge and employment under special foremen instructors at the Lynn works of the General Electric Co. In order to secure continuity of work at both institutions, each group of coöperative students is divided into two sections, one being at the Institute of Technology while the other is at the Lynn works and vice versa. These two groups of students alternate in periods of approximately four months' duration, this period having been selected so as to enable coöperative students to take courses at the Institute of Technology in the regular terms of the institute and with the established classes.

While working in Lynn, the coöperative students receive compensation as regular employees. The first two of the three years of coöperative work include instruction at Technology, which is substantially similar to the junior and senior years of the electrical-engineering course at the institute, and also give important experience in machine work, insulating, drafting, designing, testing and administration at the works. The last year of the coöperative course is given up to special research problems at the works and advanced instruction in the courses leading to a master's degree at the institute; after the course is completed, the students receive the degree of master of science.

The committee under whose care is the new electrical course includes Frederick P. Fish, Professor Elihu Thomson, M. W. Alexander, of the General Electric, and Professors D. C. Jackson and C. A. Adams, of the Massachusetts Institute of Technology electrical-engineering faculty.

Steel Castings for Ordnance Construction*

By MAJOR C. M. WESSON
Watertown Arsenal, Watertown, Mass.

I AM indeed delighted to have the privilege of addressing you on the subject of steel castings for ordnance construction, and I sincerely hope I shall accomplish two purposes: First, to disabuse the minds of some of you of some misunderstandings that I know exist in them; and second, to be of some assistance to others in the very important matter now with us of producing castings for war material. I purpose to deal principally with plain carbon-steel castings, such as can be produced with any commercial installation, using the openhearth, tropenas converter, bessemer converter or electric furnace, provided proper care is given to details, including finally, a simple heat-treatment.

Special heat-treated and alloy-steel castings offer a wide field of endeavor, and our knowledge is rapidly increasing concerning them. The prediction is ventured that eventually they will displace the high-grade intricate forging, just as the plain casting, as we know it today, has in a large measure supplanted the plain forging. We have, however, not time to dwell on them here.

DEVELOPMENT OF MODERN FIELD ARTILLERY BEGAN IN 1900

A brief reference to the situation which resulted in the Ordnance Department of the army undertaking the manufacture of steel castings, instead of relying on the private manufacturer to produce them, may be of interest. The development of modern field artillery, which today has culminated in the glorious French seventy-five, your own 3-in. field piece and the French Schneider 11-in. howitzer, not to mention the engines of destruction used by our adversaries, began about 1900. This departure in type from the artillery carriage, familiar to you all in the public squares of our towns and villages, necessitated, as will be explained later, steel castings of thin sections, of the best quality that could be produced. The inquiries proved that it was impossible to get such castings in this country, with the exception of one concern in New York State, which at that time was able to produce a small number of them. This situation resulted in great delays and hampered our ordnance engineers in their development of the early experimental types of carriages. The large steel companies in Pennsylvania, which were furnishing ordnance material, refused to undertake the manufacture of the thin-section castings, and even at a date very much later than this, took the stand that they were not able to make a steel casting of the distance ring for traversing rollers. This was at a time when, due to trouble with the forged steel rings, it was very desirable to procure cast steel ones. It is only fair to say in defense of the steel-casting makers that the inquiries for small steel castings were not for large lots; hence, the inducement to take up a new line of product was comparatively small. This condition aggravated the difficulties, and in the public files there is voluminous correspondence relating to the delays caused by inability to procure small castings. Quoting from a paper dated Feb. 19, 1899, the commanding officer of Watertown arsenal reported: "Shot trucks have been completed and issued. They were all completed except the steel trucks some months ago. Steel-casting companies will not take small orders at this time." It was not long after this that a small converter plant was installed at the Watertown arsenal, due to this situation as regards the small thin casting, which plant has been in continuous operation since then. But why castings of this character? Why should the Government ask for an article not demanded by the trade? I dare say the conclusion was reached in various quarters that the specifications were ill-advised and were the offspring of ignorance and impracticability.

Let us consider for a moment, very briefly, the various classes gun carriages in use, in the construction of which the large majority of castings under discussion are used.

Gun carriages may be divided into two distinct classes: (1) Carriages for mobile artillery and (2) carriages occupying a permanent or fixed position. It is evident that mobility of gun and mount will necessitate factors in design which are not necessarily considered in a carriage of the second class.

The question is often asked, "Why, for example, is the caliber of a certain gun set at 3 in. or 4.7 in.?" The answer to this is quite simple. The degree of mobility demanded of any piece will depend entirely on its character, being less for heavy siege guns where rapidity of movement is not so essential and greater for field guns which may by necessity have to be moved from place to place with great rapidity, as the progress of an engagement demands.

POWER OF A TRACTOR

The power of any tractor or of draft horses must be taken for artillery purposes as less than that which would generally be taken in commercial work. This is due to the fact that on occasions considerable distances might have to be covered at high speeds; and secondly, the roads encountered generally will be inferior.

Given, for example, the power of a tractive force (six-horse team) at 3900 lb., the problem was to design a gun and carriage of the greatest possible power, with the requisite mobility to meet the tactical requirements of artillery operating in support of field armies. Considerations such as these led to the adoption, in our service, of the 3-in. field gun and, in the French service, of the 75-mm. gun. Both of the types referred to are direct-fire guns; that is, they are designed for firing at relatively small angles of elevation. If the evolution of the horse had resulted in an animal with the strength of an elephant and the speed of a deer, the modern light field gun, instead of being 3 in. in caliber, would probably be many inches greater, with a corresponding increase in power.

There is also provided in our service a howitzer of equal degree of mobility for each gun. The howitzer is a short gun, designed to fire at high angles of elevation and is utilized for shelling protected positions or, in other words, employs curved fire to accomplish what direct fire would not do.

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*Extract from paper given at recent Foundrymen's Convention, Boston, Mass.

On the old-type carriage, no provision was made for the recoil of the gun on the carriage. Upon firing such a gun, the carriage would jump to the rear many feet, and before the gun could be again fired, the carriage had to be laboriously returned to its original position, and the gun re-aimed. Modern carriages permit of relative motion between the gun and carriage, and are fitted with a recoil system for absorbing the energy of the recoil. After the spade is once firmly embedded in the ground, no motion of the carriage to the rear will occur, and in this way the rapidity of fire is greatly increased over that obtained by the old method.

MODERN RECOIL APPARATUS

The modern recoil system consists of a hydraulic recoil brake and counter recoil springs or compressed air, these latter being for the purpose of returning the gun to battery after recoil has occurred. The recoil brake consists of a cylinder filled with oil, in which moves a piston. An aperture having a constant or varying orifice is provided between cylinder and piston, one of which is attached to the gun, and the other to the carriage.

The relative motion of the cylinder and piston when the gun recoils develops a pressure in the recoil cylinder due to the resistance offered by the liquid passing through the orifice between piston and cylinder. The braking action of such a system is very widely varied by the design and is always adjusted so that the moment of this resistance with respect to the end of the trail is less than the moment of the weight of the gun and carriage with respect to the same point. This condition prevents the wheels from being lifted from the earth during recoil and thereby disarranging the laying of the piece.

The recoil system outlined above is also applied to heavy seacoast guns and carriages, and it might be of interest to refer briefly to some of their main features. These mounts may be classified in general as either barbette or disappearing carriages. On the former the gun is always exposed above the parapet, while for the latter it is withdrawn behind the parapet by the force of the recoil after each round. As mobility and in consequence lightness of construction is not a primary consideration in seacoast carriages, the designer has greater latitude in weights of materials employed, and such mounts can readily be constructed which will absorb the energy of recoil of guns of a much higher power than commonly used for mobile artillery. Guns mounted on barbette carriages are sometimes protected by turrets.

These machines form a group which throw projectiles from 12 lb. to two tons, to a distance of from 6000 to 21,000 yd. The tremendous energy of the recoil must be absorbed by the gun carriage, which at the same time stores up a sufficient amount to return the gun to its original position on the carriage. This cycle must be accomplished without resultant disarrangement of the carriage; otherwise, the aim will have been disturbed and rapid fire accurately placed cannot be delivered, and finally, no part of the carriage must be overstrained. The failure of a single part may, and probably will, put the piece out of the action. The painstaking care in the production of the 999 parts may be vitiated by the indifferent quality of the one part.

The force created by the explosion of the charge which sends a projectile on its way, the reaction from which has to be absorbed by the carriage, is sufficient, if uncontrolled, to demolish the gun, the carriage and the personnel which serve them. Further statement to prove that the ordnance engineer must demand material of good quality appears unnecessary, except it may be added that considerations of mobility in the field pieces require the least possible weight, which condition reduces the designer's factor of safety to limits far less than is ordinarily permitted in commercial construction.

PHYSICAL REQUIREMENTS

The accompanying table, taken from Form 434, "Instructions to Bidders and General Specifications, Etc.," gives the physical properties required of the various materials employed in carriage construction. Particular attention is invited to the cast steel Nos. 1, 2 and 3.

PHYSICAL QUALITIES OF METAL

Metal	Elastic Limit	Tensile Strength	Elongation After Rupture	Contraction of Area
	Lb. per Sq.In.		Per Cent.	
Cast steel No. 1	25,000	60,000	16.0	24.0
Cast steel No. 2	35,000	75,000	15.0	20.0
Cast steel No. 3	45,000	85,000	12.0	18.0
Forged steel No. 0 *	....	....	....	....
Forged steel No. 1	27,000	60,000	28.0	40.0
Forged steel No. 2	35,000	75,000	20.0	30.0
Forged steel No. 3	42,000	90,000	16.0	24.0
Forged steel A	53,000	93,000	18.0	30.0
Forged steel B †	65,000	95,000	18.0	30.0
Forged steel C †	75,000	110,000	14.0	30.0
Forged steel D †	100,000	120,000	14.0	30.0
Nickel steel Pl	63,000	100,000	18.0	....
Tool steel A	75,000	125,000	16.0	35.0
Tool steel B	95,000	140,000	12.0	20.0
Tire steel	50,000	100,000	17.0	30.0
Flange steel ‡	40,000	64,000	20.0	45.0
Wrought iron	22,500	50,000	25.0	35.0
Cast iron No. 1	....	22,000	....	....
Cast iron No. 2 §	....	28,000	....	....
Bronze No. 1	....	28,000	....	....
Bronze No. 2	....	35,000	....	....
Bronze No. 3	....	45,000	....	....
Bronze No. 4	....	60,000	20.0	....
Extruded bronze	....	50,000	12.0	....
Instrument bronze	....	38,000	....	....
Tobin bronze	....	52,000	30.0	....
Copper	....	32,000	22.0	....

* No physical test. † Nickel-alloy steels. ‡ Physical requirements of commercial flange steel not indicated here. § Cast iron No. 2 must not show a tensile strength of more than 39,000 lb. per sq.in.

No. 1 castings are of very mild steel in which the presence of blow-holes may be permitted when, in the inspector's judgment, they are not serious enough to affect the value of the casting for the purpose intended. Little trouble is encountered in manufacturing castings of this grade, as the ductility requirements, 16 per cent. elongation and 24 per cent. contraction, are exceedingly reasonable. Cast steel No. 1 is used only on unimportant parts where the allowable section permits the use of a material having a low elastic limit.

Cast steel No. 2 with 35,000 lb. elastic limit, 75,000 lb. tensile strength, 15 per cent. elongation and 20 per cent. contraction is a better grade than No. 1 and must be free from blow-holes. The American Society for Testing Materials on a grade of steel known as "class B, hard," calls for 36,000 lb. elastic limit, 80,000 lb. tensile strength, 15 per cent. elongation and 20 per cent. contraction.

The society quoted above expects a higher elastic limit and tensile strength, as will be noted, for a given ductility than is demanded by the United States Army. Attention is invited to this fact, as there seems to be an opinion in some quarters that the ordnance specifications, U. S. A., are unreasonable.

Cast steel No. 3 with 45,000 lb. elastic limit, 85,000 lb. tensile strength, 12 per cent. elongation and 18 per cent. contraction is a similar grade to No. 2, with the exception that the elastic limit and tensile strength have been increased and the ductility lowered. Both grades, Nos. 2 and 3, are used for important castings demanding good physical properties.

Proper design will limit the use of No. 3 to parts where the allowable section is limited and the stresses which must be endured demand the use of a material having a high elastic limit.

It is considered advisable to use No. 2 in preference to No. 3 for all members which can be made of a cross-section that will allow the use of a material having an elastic limit of 35,000 lb.

Cast steel No. 3 is produced by a higher carbon content than is required for No. 2, and the heat-treatment is in general different.

As to composition, the only limitation imposed by the specifications is that the phosphorus shall not exceed 0.05 per cent. and the sulphur 0.07 per cent. Even under present conditions, there is no difficulty in complying with these requirements, which are reasonable, less exacting than demanded by the American Society for Testing Materials or the specifications for American railways, and are being met daily at your Government arsenal at Watertown, Mass.

I desire to emphasize this point, as some casting makers recently have declined to produce castings for the Government, on the grounds of the unreasonableness of the chemical specifications. The *Iron Trade Review* in an editorial on July 12 expressed its opinion on this question in connection with another subject. I may say here that I have been informed that issue has been taken with them on that editorial, and (Aug. 22) I await its appearance in that estimable journal.

The endeavor thus far brings us to the conclusion of the first part of our topic, which is, to bring out that the specifications for Government castings are reasonable and not more difficult to meet than the requirements on which commercial engineering practice is based, and further that there are sufficient and proper reasons for exacting the reasonable qualities prescribed for them.

HARD TO GET SATISFACTORY SMALL CASTINGS

I previously referred to the earlier difficulties in procuring steel castings some 17 years ago. Today the situation as regards the larger castings of the lower grades is satisfactory, but as regards the small higher-grade castings it is still far below what it should be. The Rock Island arsenal and the large private ordnance manufacturers have been having great diffiulties in securing satisfactory small castings. I learned recently that a number of large howitzer carriages, which are being manufactured by a large private corporation, have been greatly delayed in completion, because two separate subcontracts, which it placed for the small castings involved, had been canceled on account of failure to deliver them.

In connection with this subject, I quote from an official letter of recent date as follows: "A reply to preceding indorsement has been delayed with a view to determining what success we would have in obtaining steel castings on existing contracts placed with steel casting manufacturers. . . . The results, except for cast steel No. 1, are very discouraging. Practically all of them make 'steel castings,' generally without regard to physical qualities. Cast steel No. 3 and No. 2 are almost beyond their ability. Many of them with whom the subject has been taken up knew nothing about physical qualities. We had expected to obtain satisfactory results from the ——, but they are having much trouble with a large order for steel castings No. 3. It is apparently due to their inability to obtain coke with a low sulphur content." As regards this question of sulphur, I personally believe that if the sulphur difficulties are not sufficient to prevent the production of the No. 2 grade, there should be no reason why the No. 3 grade could not be made.

Satisfactory small steel castings of both the No. 2 and No. 3 grade can be made, and by any of you who possess ordinary foundry equipment, if you will take the precautions to procure suitable material and exercise the proper care as to details. These latter extend not only to the production of the metal itself, but include the essential items of mold treatment, molding sand, gates, risers, etc. The best metal that can be produced will result in porous or cracked castings, if the mold which receives it does not measure up to certain requirements. This problem of the mold you are meeting every day in castings demanded for the motor-car industry, and others where intricacy of pattern equals or is greater than that encountered in ordnance work.

Huge Shipbuilding Plant To Be Erected at Fore River

Considerable interest to the iron and steel interests is the Government's appropriation of $80,000,000 for the construction by the Fore River Shipbuilding Corporation, Quincy, Mass., of a new $9,000,000 plant and of 46 destroyers, the latter to cost approximately $1,500,000 each. The construction work on the plant itself will be done by the Aberthaw Construction Co., Boston.

Not only will tremendous amounts of steel be necessary for the construction of the reinforced concrete plant and for the gantry cranes, but also for the destroyers themselves, the minimum number of which is to be 46. Furthermore, the fitting up of the manufacturing buildings, with the necessary quota of machine tools, is no small task, particularly since the collection of buildings to be erected have an aggregate floor space of more than 2,000,000 square feet.

This is by far the biggest undertaking of its kind ever attempted in the United States, particularly in view of the fact that the end of the present year should see the work nearing completion.

To gain some idea of this tremendous undertaking, compare it with the building of the great army cantonments, the largest of which contracts was two million dollars less than the job just awarded. It should also be noted that the present development is a permanent proposition, the work being almost entirely reinforced concrete; whereas, the cantonments were temporary structures, built mostly of wood.

After the completion of the plant the program calls for delivery by the Fore River Shipbuilding Corp. within two years of at least forty-six destroyers.

The construction of the plant will require more than 4000 men. For the construction of these ships the

Fore River Shipbuilding Corp. will need from 8000 to 10,000 men at Quincy, 3500 at Buffalo, and 1000 at Providence. They will endeavor to obtain part of the necessary quota by offering positions to men working on the construction of the plant.

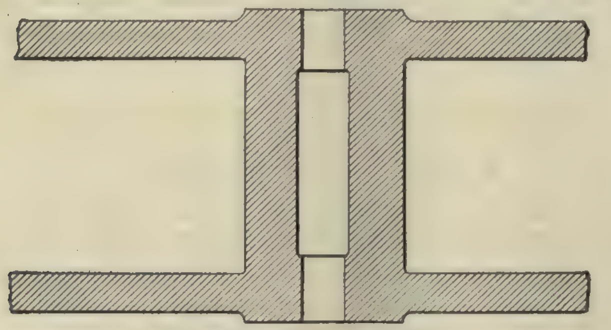
Material for the ships will not be lacking since the priority board has given the destroyer builders preference over all other concerns working for the government, even over shipbuilders constructing the merchant fleet. Furthermore, it is possible to have the steel rolled by the large Pittsburgh mills in plenty of time for the construction of the destroyers.

Allowance for Clearance in Cored Holes

By B. Kahn

The clearance necessary between certain parts of castings, the conditions that determine the differences in the amount of clearance allowed, can be learned only by blunders in the shops. Very seldom a hard and fast rule can be formulated; experience is the only sure guide.

One of the commonest cases is that of "black" bolts and the holes. It is more costly to drill holes through a considerable depth of solid metal than to core them; hence, the reason of using more often cored holes in preference to black, or turned, bolts in drilled holes. There are sometimes exceptional cases noted of special machines and special work. The general objection to cored holes is that the inaccuracy makes it impossible to fit the bolts closely in the holes and therefore the holes must be made larger in diameter than the bolts, figuring by the amount of expected inaccuracy. The clearance will vary between $\frac{1}{32}$ and $\frac{1}{8}$ in. or even more, depending entirely on the circumstances.



CHAMBERED CORED HOLE

Length of Cores Important in Castings

The length of the core and the direction of it always have to be considered in deciding the amount of clearance to be given in cored holes; these are the most essential two points. It is easier to core a short hole true than a long one, and to insure exactness of a core set vertically in a mold than that of one laid horizontally and obliquely. For a short core set vertically and stayed with a top print, a slight allowance for clearance will suffice. But even then, with the core box made correctly to size and shape and the prints carefully fixed, the molder must insert the cores very accurately. For these conditions the clearance allowance will be from $\frac{1}{32}$ to $\frac{1}{16}$ in.

For cores of 3 or 4 in. in length, the increase of the allowance must be from $\frac{3}{32}$ to $\frac{1}{8}$ in.; from 4 to 5 in. long would need $\frac{1}{8}$ in. to compensate for inaccuracy of fixing; and when 5 or 6 in. are exceeded, cores of small diameter cannot be depended on with even $\frac{1}{8}$ in. of clearance, on account of inaccurate setting and the liability of the core to be bent by the flow or pressure of the liquid metal. In cases of long, slender cores the holes should be given a large amount of clearance, or they should be preferably chambered as shown. The diameter of the chamber need not be much greater than that of the clearance hole. If the core becomes bent by the liquid pressure, it will cause no trouble, because it will not affect the short length of the clearance holes at the end. It also lessens the cost of drilling deep holes, as only the end portions need be reamed out.

Horizontal Cores

When holes are cored in horizontal positions, there is a general probability of greater inaccuracy, due to both the setting of the core and its bending, than when they are placed vertically. A horizontal core is almost always placed in pocket prints; and if the diameter does not correspond with the semi-diameter of the lower portion of the print, then the amount of the difference is always on the top side, and the core is set out of truth by that amount. The core will often become moved slightly in the print by reason of the sand having been broken and mended, or pressed and pushed out of place. To insure accuracy in cores set in drop prints, it is well to make a special core box, which will fill up the print impressions over the core, as well as core the actual hole, and to see that the dimensions of print and core coincide exactly, thus leaving to the molder nothing but to insert the core. Horizontal cores of considerable length are more liable than vertical cores to be curved lengthwise by the liquid pressure, as the curving is upward. Therefore, there is more reason why such cores should be chambered.

Reaction from Oslerism vs. Necessity

By Frank H. Jennings

The article by N. E. Hildreth, on page 407, proved very interesting to me; and while I agree with him heartily as to the stability and perseverance of middle-aged men, I differ from him as to the real cause of so many advertisements at the present time calling for middle-aged men.

The real reason so many firms are not wanting men under 31 years of age is because they know these men have to run the gantlet of the draft army. If they hire them today, they run a good chance of losing them tomorrow, so they try to play safe and hire a man past the military age, which consequently reverses the settled and hard rules of the past of hiring men up to 35 years of age first and making the men above that age play second fiddle.

Now that the demand for these older men has become so distinct, I do not doubt in the least that there will be lots of employers telling these men how they have always had the best wishes and full confidence of the company, but that there were no vacancies until now. It is not strange how well we can get along with some people when we have to.

Oxyacetylene Repairs

By CHARLES SHAEFF

SEVERAL gear boxes on engine lathes, as shown in Fig. 1 at *A*, had the tips for holding the lever pins in place, broken and mislaid. To repair these with plates would have taken considerable time, besides not making a very neat job. It was decided to cast and weld tips to the broken parts.

Fireclay was packed around the part of the gear box to be welded and a pocket was formed in the clay against the broken surface—the same shape, but a trifle larger than the old tip. The broken surface was cleaned of all foreign matter. The torch was then played around the part of the box to be welded, until the metal around the broken surface started to run. Filler rod was melted into the pocket, at the same time allowing it to fuse to the gear box. Flux was applied freely to the weld during this operation.

After the gear box was cool enough, the excess metal was chipped off, finishing the recast part to the size of the old one. The hole for the pin was drilled with an electric drill. These jobs were worked without removing the boxes from the machine.

Again, the lug on the chucking arm of a Gridley automatic was broken, the smaller piece being broken into too many little fragments to weld. The arm was placed in a bed of sand, and a pocket was formed in the sand, around the place where the old lug was broken off. The pocket was the same size and shape as the old lug.

The flame was then played around the arm until it was a dull red. The surface to be welded was cleaned well with a flux. When the broken surface began to melt, ½-in. cast-iron filler rod was melted into the pocket, at the same time fusing it to the broken arm. After the pocket was filled, the arm was allowed to cool slowly until it was solid enough to remove from the sand. The arm was turned over. The metal around the old break was melted away to where the metal had made a solid weld, leaving a V-shaped groove. The weld was then made on this side, giving a solid weld clear through. Flux was used very freely while running the new lug. The arm was then covered with sand to prevent it from chilling and becoming hard. The size of the lug was 2 x 2 x 1½ in. After it was cold, the sand scale was knocked off. The arm was then drilled and tapped. The weld was hardly noticeable when completed.

A fork arm *A*, Fig. 2, on a double-action press was broken within 1½ in. of the fork. The thickness of the cast iron at the break was 1¼ x 2¼ in. The broken parts were ground to an angle of 45 deg. parallel to the 2¼ in. thickness and about ½ in. deep. This was done on both sides of both pieces. The pieces were then clamped to each other in their old position on a welding plate. The weld was completed, using plenty of flux. The clamps were removed before the weld was finished.

Welding One End of a Broaching Machine

The head of a large broaching machine was broken from the main body. The break was from 3 in. to 1 in. from the end wall. Two pieces of flat steel ¾ x 2 x 24 in. were drilled with a 49/64 in. drill, 1 in. from each end. Two pieces of ¾-in. round cold-rolled steel, about 2½ ft. long, had a thread cut 5 in. on each end. The one flat piece was passed through a hole in the body of the broach; the other piece was placed against the broken head. The two flat pieces were then drawn together with the ¾-in. cold-rolled rods.

Four gas flames were used for preheating. There was no chipping done on this job. After the body was preheated to a dull red, the welding torch was used to melt the metal from the crack, leaving a V-shaped groove. The outside of the broach was welded, as shown in Fig. 3, at *A*, after the groove was cut halfway through. The inside was grooved the same way and then welded. The flux was used freely during the operation. Working the weld this way, it was found, would give a solid weld. The thickness of the cast iron varied from ⅞ to 2 in. The gas flames were checked during the welding operation. They were checked slowly until about eight hours after the weld was finished; then it was found that they could be checked altogether.

Repairing a Bracket

The bracket *A*, Fig. 4, of a large four-spindled automatic was broken. This bracket was a hollow cast-iron arm 4 x 8 in. outside and 2½ x 6½ in. inside. A piece of flat steel ⅝ x 4 in., bent at right angles, was used for a clamp, and fastened to the inside of the bracket with ¾-in. capscrews. The machine was welded in its regular position. The part was preheated with the welding torch. The metal was cut away from the crack on the top and both sides, leaving a V-shaped groove. After the bracket was welded in several places, the clamp was released to prevent it from recracking the weld when cooling.

After the weld was finished on top, it was found that fireclay would have to be used to prevent the metal from running away while welding the sides. The weld was worked this way on both sides, due to the vertical position of the two side welds.

The bracket was welded on the two sides and top, as it was found impossible to weld the bottom with the machine in its regular position. However, there was strength enough with the steel clamp, which was drawn up after it was cold. The side welds were rough when the clay was removed. The torch was used to run off the metal and finish the weld off smooth.

Welding Small Tanks

Several small tanks, Fig. 5, used for heating oil for drawing hardened steel had started to leak in spots *A*, due to heat strains. There was one that had the bottom replaced and was leaking at the seam. Due to market conditions, it was found that the tanks could not be replaced in less than two months. These tanks were welded and the metal around the cracks was melted until it fused together.

A welding torch becomes very useful, not only for welding, but also for heating parts of machines, while in place for straightening.

A shifting lever *A*, Fig. 6, on an automatic gear-cutting machine was bent, throwing the automatic indexing levers out of line. The bent lever prevented the head from indexing, besides throwing the forward and reverse feed. The lever was of ⅞-in. cast steel. To take it off, it would be necessary to take off all the levers besides taking apart the gear box. The lever was heated with the torch until it was a cherry red, wrenches were placed on it and it was bent back in line. The machine was running in 25 min. from the time the job was begun, saving not less than two hours' time necessary to take it down.

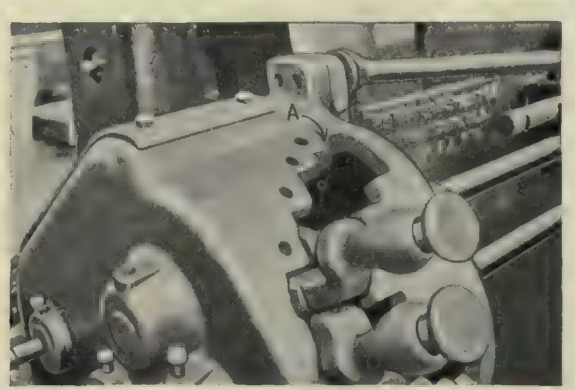


Fig. 1, Gear-Box Repair

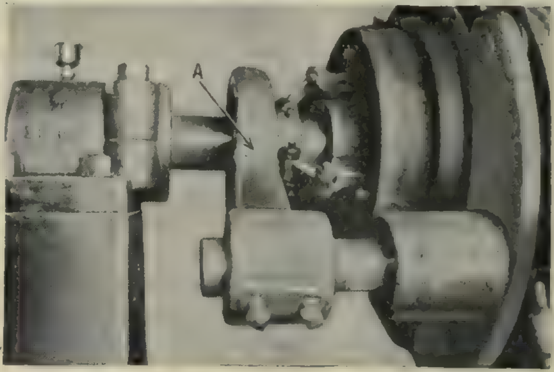


Fig. 2, Repair of Clutch Arm

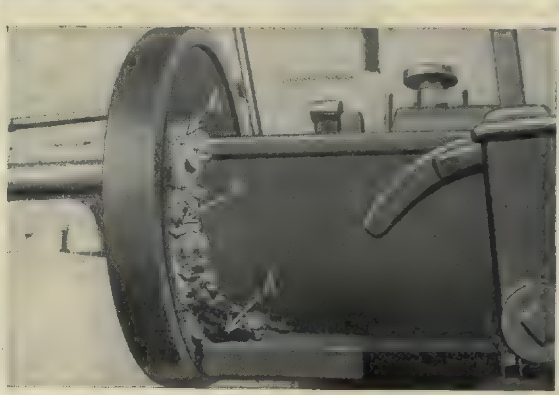


Fig. 3, Repair of Broaching Machine

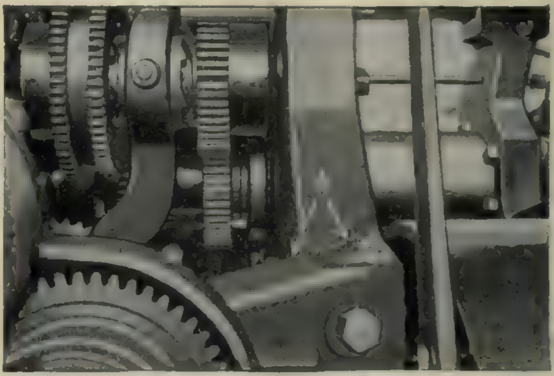


Fig. 4, Repair of Bracket

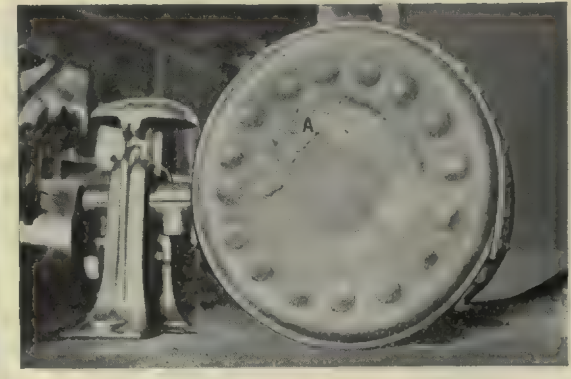


Fig. 5, Tank Repair

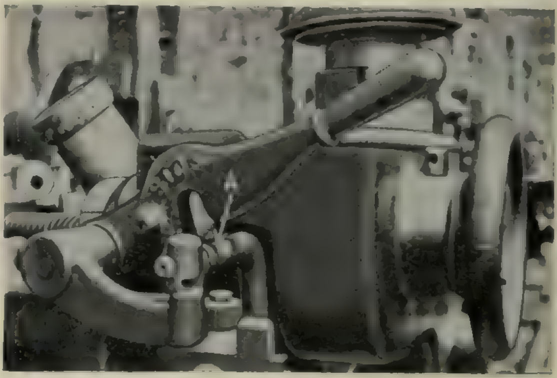


Fig. 6, Shift-Lever Repair

There are three points that should be considered in choosing a flux for welding cast iron, iron and steel. The first is to have a flux to clean the weld; second, to help the metal to fuse properly; and third, to help to keep the weld soft by carrying off the excess oxygen. It is difficult to keep the torch burning with the proper mixture of gases. The oxygen that escapes the torch, together with that in the air, will harden a weld and make it brittle.

A cheap, simple flux that can be obtained anywhere is a mixture of salt, 66⅔ per cent., and powdered borax, 33⅓ per cent. This flux, under proper conditions, has proved that it will cover the three points referred to above. In addition it is not as expensive as some of the other compounds.

Keeping Notes on Grinding

By Robin Duff

An expert grinding-machine operator, whom I know well, went to another city to take charge of a grinding department in a hustling shop. In about a week I received an urgent letter from him requesting me to send a formula that he could use in figuring piecework prices on some new grinding jobs. The answer I gave was to send him sketches of work I had ground, with all dimensions, including the stock to be removed, the limits of inaccuracy, the finish desired and the grinding and handling time. I chose a variety of sketches from my notebook, and strange enough some of them were sketches of work that he had also ground when we were shopmates together, but of which he had made no written note. There was nothing else I could do other than to apply some home-made rules I had formulated from my grinding observation. If he had sent sketches of his work, I might have given him further help; but the chances are ten to one that if I had attempted to aid him from memory alone of similar jobs, my suggestions would have been of little value.

Somewhere I have read, or have heard, that, provided enough steadyrests are used, it makes no difference whether or not the piece of work to be ground is long or short, solid or hollow—the same amount of stock can be removed per minute; but my own mind is far from being satisfied on this point. For one, I cannot grind long, slender work or thin tubing with anywhere near the same degree of rapidity that I can grind a solid bar. If it were possible to remove say ¾ cu.in. of stock per minute in the roughing operation from any piece, regardless of its length, tensile strength or cross-section area, and to remove ⅛ cu.in. of metal per minute in the finishing operation continuously, then the keeping of performance notes would be a useless task and the matter of establishing piecework prices would resolve itself into the formula for finding amount of stock to be removed, $\frac{\pi L}{4}(D^2 - d^2)$, times the amount to be allowed the operator per cubic inch.

As things stand with me now, I sometimes am at a loss whether to estimate ½ cu.in. a minute, less or more, and in all cases I make sure to verify my figures by looking through my notes of past performances for a sketch that most nearly approaches the one on which I am figuring.

My notes tell me that conditions must be very favorable to permit the operator to remove 1 cu.in. of stock per minute, except the operation by a draw-in cut, as in the rough grinding of crankshaft bearings made of soft drop forgings. In this I find that I can remove 1½ cu.in. of stock per minute day in and day out, plus the handling of the shaft.

Notes Should Be Profitable to the Operator

Notes on grinding should not be kept by the operator solely for the purpose of being able at some indefinite date to estimate the grinding time for others, but should be kept in a manner to enable him to profit daily by that which he has recorded. For instance, suppose that at a periodic interval of about every three weeks (long enough for him to forget the details of the job) some machinery steel shafts 26 in. long, 3 in. in diameter, and with 0.025 in. of stock to remove should come along for him to rough and finish grind at the rate of seven an hour, what wheel should he use, what work speed, what table traverse, and what depth of cut per pass? To find the most efficient combination he would have to juggle these variables until he hit upon the correct assortment to turn out his seven shafts per hour, but in the meantime valuable time (which means money to him if he is on piecework, and money to the company if he is on either piecework or daywork) would be lost. If notes on each shop job were kept, how easy it would be for him to set his machine approximately right the first time. For example, let us take this shaft on a 10 x 50-in. Norton plain grinding machine:

Shop Order Number—8454.
Article—Vertical shaft.
Material—Machinery steel.

Rough Grinding

Wheel—24 combination N, Norton.
Work Speed—Cone pulley sixth step, fast lever.
Table Traverse—Cone pulley first step, fast lever.
Depth of Cut—0.002 in. per pass.

Finish Grinding

Wheel—24 combination M, Norton.
Work Speed—Cone pulley fourth step, slow lever.
Table Traverse—Cone pulley second step, slow lever.
Depth of Cut—0.0005 in. per pass.

Such notes could not help but prove of value, all the more so if accompanied by a sketch of the work with diameters and limits.

Use of Speed Tables

In my work as a cylindrical grinding-machine operator I wrote into my notebook a list of all work speeds and table traverse speeds for each pulley and then, when a new job came along, I was able to test out intelligently different combinations of speeds. In figuring work speeds I used a constant that aided greatly in making the computation a simple mental example. It would have been possible to have made it more simple by the use of a graphical chart, but this was an afterthought that came much later. My method of determining pulley speeds and the use of the constant is worth illustrating. Taking a 10 x 50-in. Norton plain grinding machine on which I worked for several months, my notebook gave me the following speeds, together with the constant:

10 x 50-IN. NORTON, MACHINE NUMBER 988

R.p.m of Work Drive

Step on Pulley	R.p.m. Fast Lever	Constant*	R.p.m. Slow Lever	Constant*
Fastest	193	50.5	76	19.9
2	137	35.9	56	14.7
3	110	28.8	46	12
4	95	24.9	38	10
5	82	21.5	33	8.6
6	74	19.4	29	7.6

$$^{*}\text{Constant} = \frac{\pi \times \text{r.p.m.}}{12}$$

TABLE TRAVERSE IN INCHES PER MINUTE

Step on Pulley	Fast Lever	Slow Lever
Fastest	148	50
2	120	40
3	100	33
4	88	29
5	75	25
6	67	22
7	60	20
8	55	18

Suppose that the 3-in. shaft mentioned should come to me for the first time and I decided, on looking it over, to try a rough-grinding work speed of 60 ft. per min. Sixty feet divided by the diameter 3 gives me

20. Looking at my list I find that the nearest constant to 20 is 19.4, and that I must run the work at the revolutions per minute the constant indicates, or 74 r.p.m. This is the sixth pulley step, using the fast lever. Now, with a grinding wheel 2 in. wide, it is correct to rough out with the full face of the wheel to each revolution of the work; therefore the revolutions per minute of the work times 2 in. will give the table traverse in inches. Then 74 times 2 equals 148 in. as the table traverse, or the first pulley step, according to the list of speeds, using the fast lever.

Assuming 30 ft. per min. to be a good work speed in the finish grinding of such a shaft, I divide 30 by the diameter 3 and, looking at the list of speeds for the constant nearest to 10, I find that the belt for a work speed of 38 r.p.m., as indicated by the list, should be on the fourth pulley step, using the slow lever. In finish grinding using one-half the width of the wheel (1 in.) I have a table traverse of 38 in., or the second pulley step, and the slow lever.

Tables like this, on different machines, were of great help to me in my grinding.

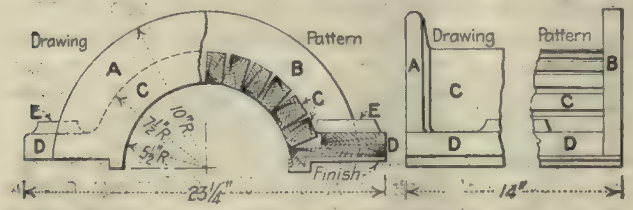
Innumerable details only casually impressed on a person's memory cannot be considered a future asset. In the keeping of notes there is a feeling of a sense of reliance on one's own ability, backed up, not alone by a varied experience, but by positive, recorded, demonstrable facts.

A Quickly Made Pattern

By M. E. Duggan

The making of the pattern and the producing of the casting for the cap shown in the sketch is a very good example of speed and practical mechanics in both the pattern shop and foundry.

At 10 a.m. the cap broke. The pattern was made and a casting produced that same day. The drawing showed the flanges as at *A*. The pattern was made as at *B*, and shaped and finished on the bandsaw. The shell *C* was made of strips cut to the exact length from a board and ripped on the circular saw. The clamping lugs *D* were made the same way. The bosses *E* were shaped and finished on the bandsaw. The parts were assembled together and secured with wire nails, no glue being used. The V-spaces between the strips *C* were taken care of by the molder. These he filled with molding sand and slicked off even with the pattern in less time than it takes to tell it.



A QUICKLY MADE PATTERN

No hand tooling was done or sandpaper used in the making of the pattern, and the job was done by one man. The casting was produced, machined and assembled in place and the "big shears" again started. The result was quite satisfactory. The casting lacked beauty, style and finish, but this would never be noticed by a man passing on a train running 50 miles an hour.

Why Special Micrometers are Necessary for Making Cartridge Tools

By Adolph Starr

I have read with much interest the article by A. R. Whittle on the "Cartridge-Punch Templet," page 322, Vol. 47, which no doubt is a good idea for ordinary drawing of parts where close limits are not essential, but for military-rifle cartridges this kind of gagework would never do.

The piece of sheet steel No. 14 B. & S. gage, which Mr. Whittle speaks of as having the outline of the punch scribed on it and then filed to size, would not be close enough to figures used in cartridge work.

The more accurate way of making a templet, as shown by Mr. Whittle, is also behind the times, as no templet can be hardened without some distortion, and the accuracy would be destroyed.

In making the reamer spoken of in the article, it would be almost impossible to get the profile the right shape and size to figures, unless some measuring tool similar to the special micrometer mentioned on page 651, Vol. 46, was used for this purpose.

In making cartridge punches or bullet-cover punches, it is essential to have a perfect model; by this I mean as nearly perfect as our modern measuring tools, together with human skill, will permit. Such a result can only be accomplished by a first-class gagemaker who is familiar with this grade of work in this particular line, as it requires the best nerves and eyesight, together with the finest touch in handling the tools.

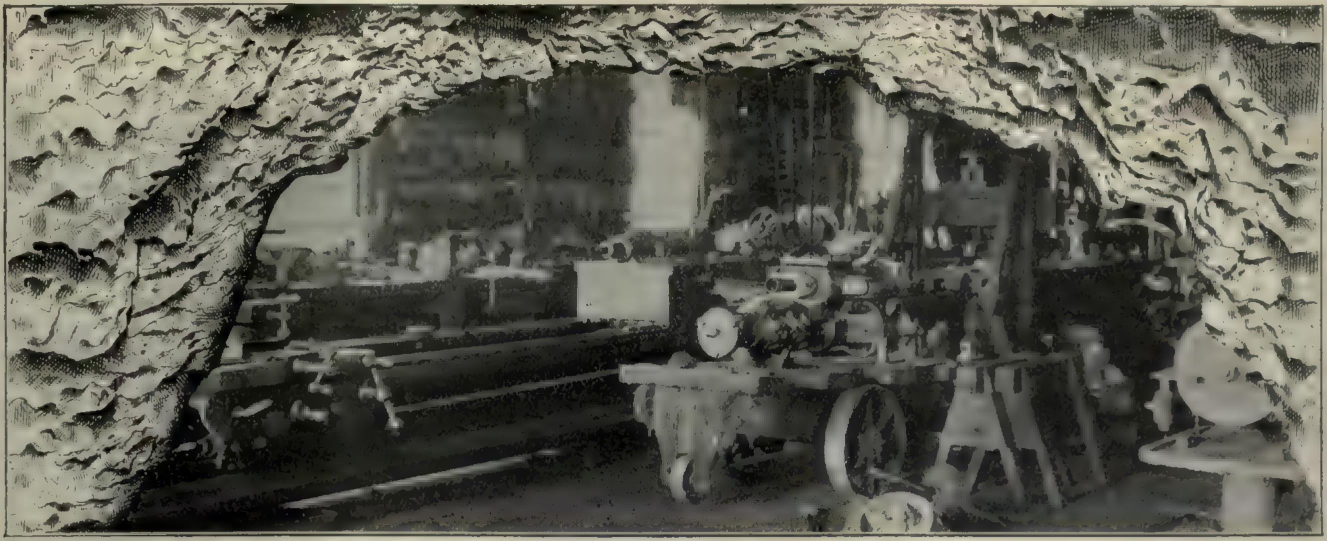
In studying the manufacturing of military cartridges, I find that this class of work is held to the closest limits possible for quantity production. In making bullet-pointing punches for the drawing of bullet covers, it is essential that they be made to figures as close as possible on shape and size; and in order to accomplish the result required, it is necessary to have a model made as nearly perfect as possible by measuring with the special micrometer in question. Then a profile gage or templet is made and fitted to the model so that it will close out the light. This templet is hardened, and any distortion can be corrected by stoning the templet with a fine pencil stone to fit the model and again closing out the light on the profile. Now the templet is ready for use in the manufacturing of production punches. When the gage wears, another is made in the same manner from the model; and if the model wears from constant use, we have the special micrometer in question to make another model, which is made to the figures called for on the drawing.

I wish to say that there are very few mechanics outside of those who are in this particular line of business who know very much about the close working limits that are required in making cartridge tools.

Machinery Club of Chicago Opens Clubrooms

The Machinery Club of Chicago opened its new club quarters on Sept. 29, with a banquet. Over one hundred members were in attendance, and Henry E. Rathbone, a prominent Chicago attorney was the speaker of the evening. The membership list now includes 522 names.

Equipment Repairs in a Gold and Silver Mine



SYNOPSIS — *Wherever extensive mining operations are carried on, repair shops are essential, even though they are sometimes restricted in their work to the handling of moderate-sized undertakings. Many of the machine parts about a mine are of such proportions as to make it impossible to overhaul or replace them except in plants doing very large and heavy work and having an equipment that is rarely found in communities located a long way from engineering centers.*

THE greater part of the work required in a mine repair shop is of such a nature as to make it feasible to handle it with moderate-sized tools. Occasionally, if the work is apparently beyond the capacity of the machine equipment, the foreman with his gang of skilled mechanics may devise some rough-and-ready method of doing the job satisfactorily where in the fully equipped establishment a big boring mill, planer or lathe would be considered essential to the undertaking. If no such tools are available, the combination of machine and hand processes has to serve instead.

A typical mine shop, which is of interest because of the world-wide notoriety in former times of the mines in this section, is that of the C. & C. Co., at Virginia City, Nev., which is still operating and producing gold and silver on the old Comstock lode. A general view of this shop is given in the leading illustration. It shows some of the lathes and planers that have long performed service on repairs of all kinds in this region. As will be understood, common repairs jobs in such places include the cutting and threading of pipe, the handling of fittings, overhauling of pump parts, reseating of valves, etc.

In connection with the handling of pipe work, Fig. 2 should be of interest, showing as it does some special equipment for the threading of all sizes of pipe that are too large to be cut with the usual hand stock. This apparatus consists of a substantial two-jaw vise attached to the carriage of a 36-in. lathe and sufficiently large to hold pipe up to 16 or 18 in. in diameter. The jaws are independently opened and closed by heavy screws at front and rear, and they are provided at the inner end with gripping surfaces that seize the pipe and prevent it from turning under the action of the threading chasers. These chasers are really the important feature of the equipment. They are four in number and are held in adjustable blocks carried by steel guide shoes, tongued and bolted to the faceplate of the lathe. Originally, the base blocks in which the chasers are operated were made of cast iron, but this material was later displaced by solid steel blocks that were secure against breaking.

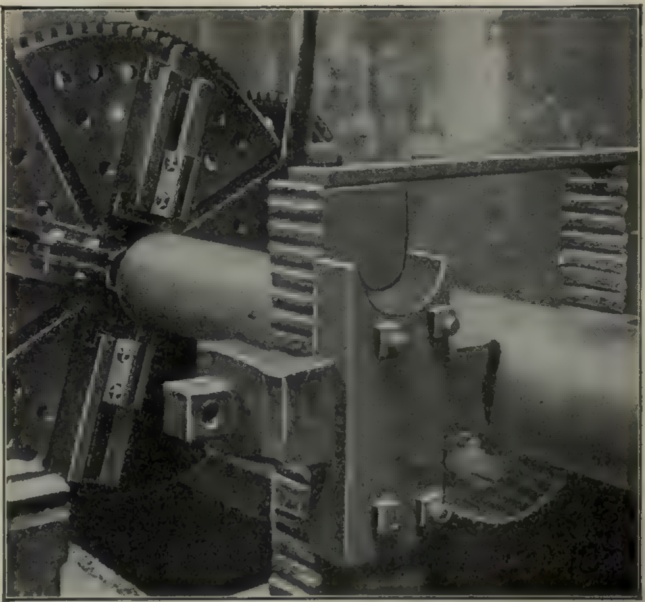


FIG. 2. PIPE VISE FOR USE IN A LATHE

The chasers are fitted up in the form of rectangular blocks about $\frac{3}{4}$ in. thick, which are fastened into their immediate holders by dowels and a pair of bolts and nuts. They were threaded to the desired pitch by placing in position on the lathe the blanks being numbered 1, 2, 3 and 4, so that throughout their life they might retain a definite position in their holders, which were numbered to correspond. In threading the chasers with a single-point tool in the lathe, the chaser blocks were opened out to a diameter large enough to provide clearance; and in sharpening, all cutting of the wheel is done upon the leading face of the chaser, so that the life of the set of four is limited only by the thickness of the chaser blanks, which are gradually thinned down by grinding across the flat face in the resharpening process.

This set of chasers, as shown in the illustration, was made from an old bar of steel that had lost its brand and identity, and there is no assurance, therefore, that it was originally the finest product of any particular steel plant. The fact remains, however, that the one set of chasers has threaded over 1600 pipe ends, all of large diameter, and there has been so little regrinding of the cutting faces that the chasers may still be considered, after all this service, quite as good as new.

When the lathe is not in operation on a pipe job, it is a simple matter to remove the work holder from the carriage and the four chaser jaws from the faceplate, thus permitting the machine to be used for its customary work. To set up the pipe-threading equipment in the lathe requires but a short time, and it is safe to say that the apparatus constitutes one of the handiest and most effective pieces of equipment in the shop.

PUMP AND VALVE WORK

The pumps of various types used about a mine necessarily require more or less attention from the repair shop, and a good many mining plants are in the habit of replacing certain parts of such equipment without waiting for new members to be shipped from some far-away point. Thus, in Fig. 4 are shown a number of pump rotors that have been cast in the foundry and machined in this repair shop. They are here represented assembled on their shafts and made ready for service with a minimum of delay in the process. The disks constituting these rotary members are of brass, the castings being made sufficiently oversize to allow a perfectly clean, smooth finish when turned up and faced in the lathe.

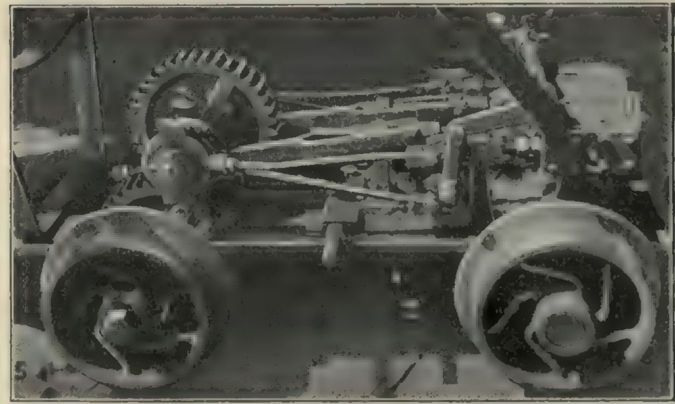
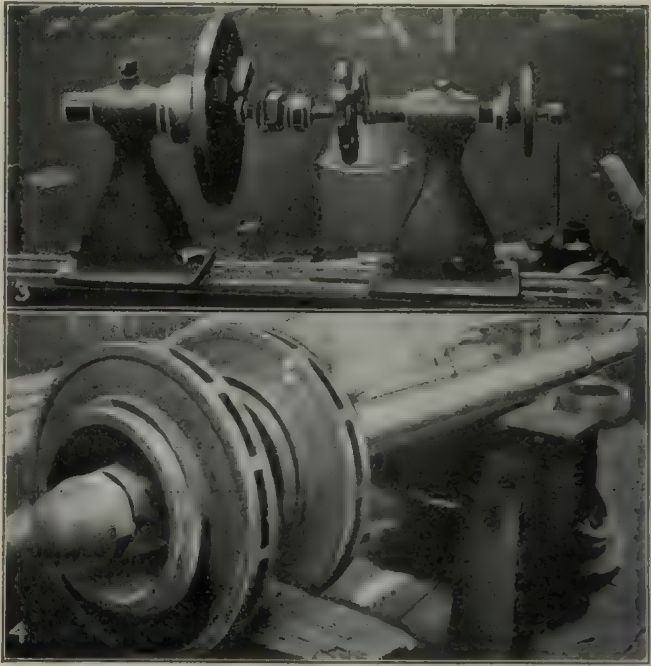


FIG. 5. A COMPRESSED-AIR "GO-DEVIL" PULLS CARS

FIG. 6. REPAIRING HOIST CABLE IS IMPORTANT

Fig. 3 represents a bench machine for valve work such as reseating and grinding in of valves. The valve body is here attached to the faceplate, and the valve itself is actuated in the grinding process by the driver on the tail spindle of the machine. A number of reseating tools that are used on larger valves requiring handling on the power machines are shown on the bench at the back of the hand machine illustrated.



FIGS. 3 AND 4. TURNING AND GRINDING

Fig. 3—An improved but effective valve-grinding machine. Fig. 4—Centrifugal pump motors are cast and machined completely

Of course, there are always a number of mine cars to be built or repaired and new wheels or axles to be made. The machine in Fig. 5 is of interest in this connection, as it is the motor used for hauling the small ore cars on the industrial tracks underground. This motor is known as a "go-devil" and is operated by compressed air contained in a receiver carried by two brackets at the end of the machine. One of these brackets is seen at the left in the view; the other has been removed and, like the air tank, is not visible in the photograph. The drive is by means of a pair of pistons and connecting-rods that operate the main gear shaft, which in turn is geared to one of the axles. The machine has link motion reverse and in the size illustrated is sufficiently powerful to haul two or three loaded cars over the grades that are encountered on the mine tracks.

The hoisting cable used about mines must be watched and inspected constantly, and usually two or three men put in most of their time examining old cable, splicing and repairing here and there and practically remaking the whole thing from beginning to end, the cable length often reaching 3000 or 4000 ft. Figs. 6 and 7 are two views in a department at this mine showing the overhauling of a flat rope. This rope or cable is made up of 22 strands of $\frac{5}{16}$ twisted wire, and every bit of its 3000-ft. length has to be inspected for sections requiring new splices, resewing, etc. A chart of the cable is kept throughout its entire life. On this chart each section is designated by number, and a record is inscribed thereon showing the date and character of each item of repair, so that the history of the rope extending over many years of service is always available for accurate reference. Fig. 6 shows various strands spread out on carriers for freedom of inspection, and Fig. 7 shows more clearly the appearance of the separated strands as they come from the reel. The second reel seen at the rear receives the repaired cable as it is wound back after being resewed.

The advantage of flat hoisting cable is readily appreciated. This form gives a compact and strong section, and in winding it over the drum of the hoisting engine it obviates any possibility of kinking or of winding out of lead, an advantage well brought out by Fig. 8, which shows distinctly the neat and methodical action in coming off or returning to the reel where the opening is just wide enough to admit the flat cable.

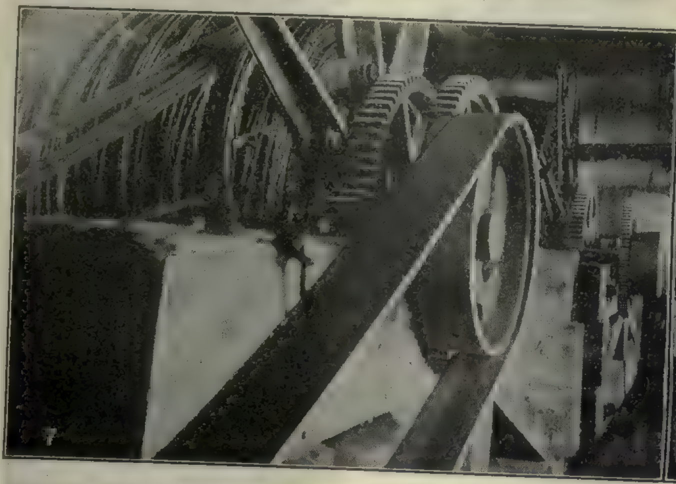


FIG. 7. THE "SEWED" CABLE IS REWOUND UPON A SECOND REEL

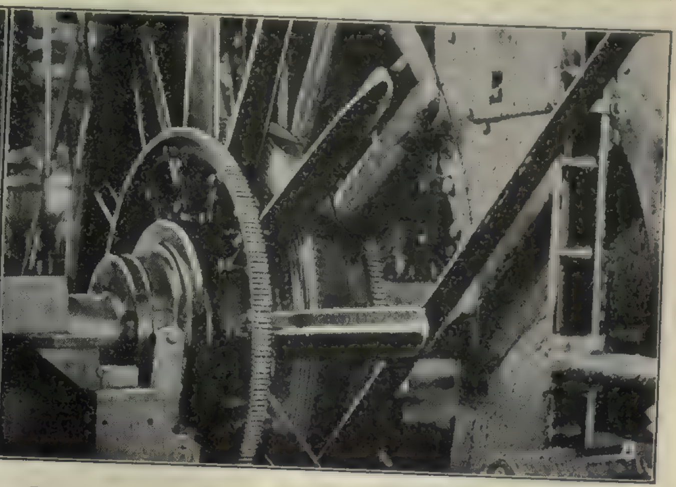


FIG. 8. FLAT STEEL CABLE RESEMBLES A BELT IN ITS APPEARANCE

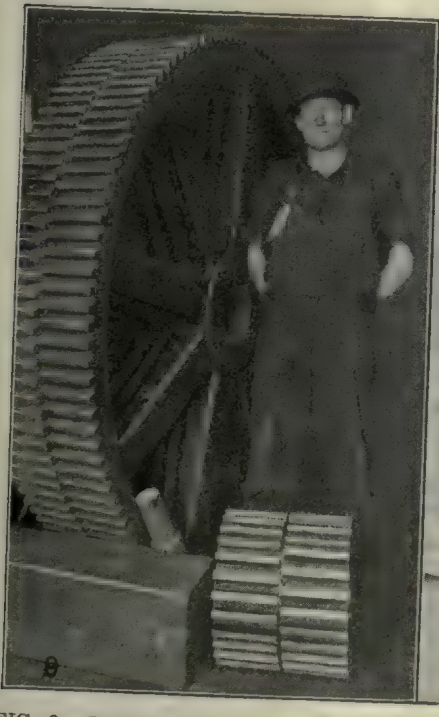


FIG. 9. LARGE STAGGERED GEAR FOR MINE PUMP

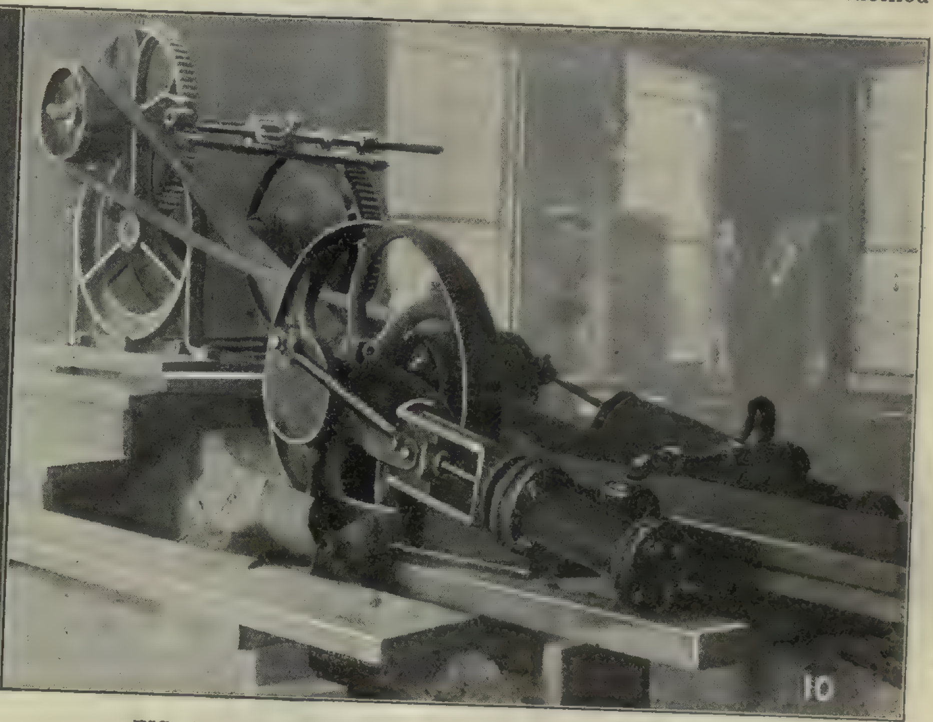


FIG. 10. AN APPARATUS RIGGED UP FOR REGROOVING SHEAVE WHEELS

Referring again to the subject of pumps, the view in Fig. 9 is here shown as illustrating a set of staggered gears for a big pumping unit. The main gears, which are over 6 ft. in diameter, are made in a pair and staggered one-half tooth to give smoother and more effective action. This staggered effect is seen here more clearly in the case of the pinion on the floor at the right. The pitch of these gears is about 2½ in. circular pitch. Once in a while a tooth is broken out, and it then becomes necessary to cut it out completely and dovetail the seat below the root to allow a new tooth to be fitted into place. This is one of the heavy pieces of work that tax the capacity of the shop equipment and the skill of the mechanics.

The apparatus in Fig. 10 was arranged and set up for the express purpose of enlarging the groove in a number of sheave wheels. These wheels had been carrying a ¾-in. round cable, and it was necessary to regroove them to receive a cable ⅞ in. in diameter. There was no lathe or boring mill large enough for the work, and so they were set up with a shaft in pillow blocks on a special foundation. Provision was made for rotating the work by means of a rope passed two or three times around the drum of an old hoisting winch, the winch itself being driven by a pulley belted from an old engine seen in the center of the illustration. The necessary speed reduction was obtained by selecting pulley sizes suitable for the operation and taking the final drive to the work from the small center of the drum on the winch. The tool for the grooving operation was carried in the slide removed for the purpose from one of the regular machine tools in the shop and secured by suitable blocks at the front of the sheave to be regrooved.

A New Tool Steel

British papers contain an announcement, on behalf of Darwin & Milner, of Sheffield, of the discovery of a tool steel stated to be equal in durability and hardness to high-speed steel, yet of which tungsten is not a component.

The new steel is called cobalt-crom and is based on a discovery that by adding cobalt to chromium carbon steel the latter is converted into a steel which has red-cutting hardness.

Tungsten high-speed steel has not been used to any large extent for milling cutters, taps, reamers, etc., and Darwin & Milner estimate that at least 90 per cent. of this latter type of tools are still being manufactured from carbon steel, which is probably mainly due to the difficulty which the toolmaker experiences in hardening such tools. Tungsten high-speed steel requires hardening at from 1250 to 1350 deg. C., if the best results are desired. To try to obtain this heat for milling purposes is very risky, and to harden at a lower heat gives less satisfactory results.

It has been found, on the other hand, that the maximum heat necessary for the hardening of the new steel is only 1000 deg. C. It is stated that hardening is satisfactory nearly always when the tool is allowed to cool naturally in air free from drafts and currents, and it is claimed to be possible with the new steel to get absolutely the same standard of hardness throughout.

It is also stated that the cutting efficiency of the new steel is quite equal, even in the form of castings, to that of tools made from forged or rolled bar, in which high-speed steel is supplied commercially, and as the material in the molten state is much more liquid than high-speed steel, it lends itself to all forms of tool-casting.—*A. S. M. E. Journal.*

Classifying Workmen

By L. M. Thorn

On page 1044, Vol. 46, H. P. Murphy has an article, "Classifying Workmen." Some of Mr. Murphy's statements may be true, but I have used a system with fairly good success in hiring toolmakers. Under this system, I have been able to judge if a man has really done any toolwork at all.

When a man asks me for a position as toolmaker, I ask him where he has worked and take a chance on his mentioning some shop I know of and the class of work done there. As my second question I ask him what he is used to working at. The applicants almost always answer jigs, fixtures, gages and sometimes dies. Now if our shop has a good deal of gagework to do, I make a sketch of a simple snap gage and ask the man how he would proceed to make it. The measurement is always to the tenth part of a thousandth, and the answers some men give are surprising. Of course, a man used to the work will smile and tell me right away.

Next, I make a sketch of a piece of square stock and explain that I want two holes in this piece a certain distance from the center, this distance also to the fourth decimal. The answer to this problem is also very ridiculous at times. While these questions are very simple, I have found that over 50 per cent. of applicants for positions, since the war, are unable to give satisfactory answers, proving that they have not had any experience along that line. Although the questions do not keep all bluffers out of a shop, they make a fellow think that he must be able to do a decent job. Then if he is not sure of himself, he will say, "All right, I will come to work," but almost always stays away.

Ethyl Alcohol from Wood

There is no reason for discriminating against ethyl alcohol made from wood in favor of that from grain or molasses, according to the Government chemists of the Forest Products Laboratory at Madison, Wis. The amount of impurities in commercial ethyl alcohol, they say, is very small, and the impurities are probably less objectionable when wood is used as a base than when grain or molasses is used.

The prejudice against the use for some purposes of ethyl alcohol made from wood is probably accounted for, the experts say, by a confusion with methyl, or "wood," alcohol, which is poisonous. Both products are derived from wood, but are radically different. The ethyl, or grain, alcohol is made by reducing the wood to sawdust, treating the sawdust with an acid to produce chemical sugars and converting the fermentable sugars into alcohol by fermentation, as in the case of grain or molasses. Wood alcohol, however, is obtained by condensing certain gases that are liberated when the wood is heated in air-tight retorts.

Ethyl alcohol has, it is stated, been commercially manufactured from wood for several years in this country. It is suitable for any use to which ethyl alcohol from any other base is put. Improvements in the processes which have been developed at the Forest Products Laboratory have decreased the former cost.

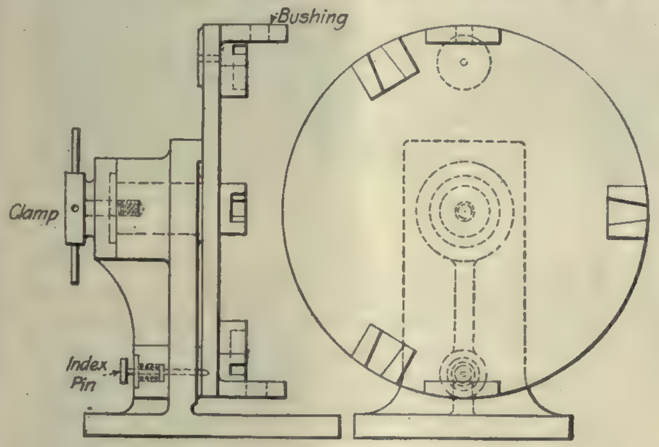
IDEAS FROM PRACTICAL MEN

Camshaft Facing Fixture

By F. E. Mason

A quick finish on the ends of a camshaft is obtained by the use of a special device consisting of a cast-iron base to hold a revolving fixture for the camshaft.

The shaft is fastened to the fixture with V-blocks and toe clamps. At each end of the fixture are bushed holes to guide the spot-facing cutter centrally with the shaft. The base is supplied with an index pin and clamp to allow the fixture proper to be revolved so that both ends of the shaft can be milled without removing it from the fixture. A feature of this device is the method of equalizing the stock longitudinally. This is accomplished by a block in which a tapering slot is milled so that a slight turn of the shaft before clamping causes the oil-pump eccentric to centralize itself in the tapering notch, thus equalizing the stock as well as taking the thrust of the cutter.



CAMSHAFT FACING FIXTURE

Warring on Wasted Materials and Supplies

By A. J. Chamberlain

It is becoming evident in some industries that the cost of materials is a greater factor than the labor cost. Heretofore, the opinion has been prevalent that it was generally unprofitable to work up small pieces of material in some lines, due to the additional labor offsetting the lower first cost.

The direct proportion of material cost to that of labor cost has increased on account of the greatly advanced prices of material, and hence many methods that were proper two or three years ago, owing to their labor-saving qualities, are very improper these days, on account of the material waste involved.

Manufacturers of sheet-metal products are saving scrap pieces of metal in their operations, in order to utilize them for other parts of their products or to sell the material. Stamping dies that were formerly considered money makers because of the speeds at which they could be operated have been set aside and replaced by dies that operate at slower speeds, but are more economical than the labor savers, being adapted to the cutting of small scrap pieces left over in other operations.

In these war-price days the great essential is the economical use of materials and supplies. In small plants even, it is well for the management to appoint one or more economy men, who can be constantly on the lookout for material or supply waste.

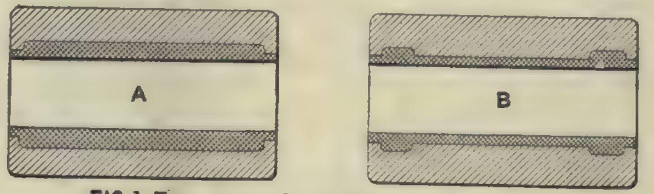


FIG. 1 Two ways of babbitting a Bearing

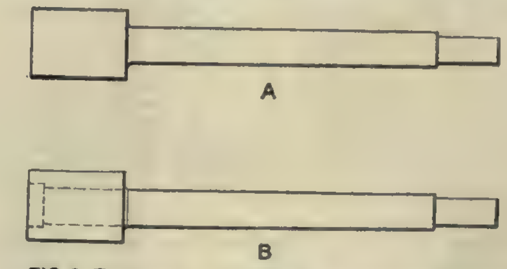


FIG. 2 Two ways of making a shouldered Shaft.

FIGS. 1 AND 2. BABBITTING AND SHAFT-MAKING METHODS

Factory supply waste is generally composed of a multitude of unnoticeable leaks that are hard to detect sometimes, but are worth the effort, as they will sum up to a considerable item in the course of a year.

By small leaks in the machine shop I refer to such practices as the use of high-grade lard oil where cheap cutting compounds would answer the purpose; the use of large solid reamers instead of adjustable reamers where accurate sizes must be maintained; or even the practice of filling small oil holes with large oil cans, until oil has run all over the surrounding surface of the machine, and then wiping it off with clean waste. Such practice materially increases the cost of oiling.

Another good field to attack in our "war on waste" is the tool-steel supply, particularly that of high-speed steel tool bits. These should be watched carefully to see that they are not ground off wastefully.

Give each man enough bits, however, so that he will not find it necessary to regrind a round-nose tool into a threading-tool shape, or vice versa, when he wishes to change bits. Also provide enough cutoff bits of the different necessary widths so that he will not grind them on their sides when narrow slots are required. However, I believe the most effective way of reducing the tool-bit account is to discourage the practice of sharpening tool bits by grinding them on their tops instead of on the cutting ends only. Another way to keep down the tool-bit expense is to heat the short bits that can no longer be held in toolholders, flatten them out and weld them to carbon-steel shanks.

The economy man will find that the more important savings can generally be effected by more economical use of the materials required for the product. For instance, why are so many brass machine screws being used these days because of their noncorrosive qualities when electro-galvanized iron screws would answer the purpose nine times out of ten?

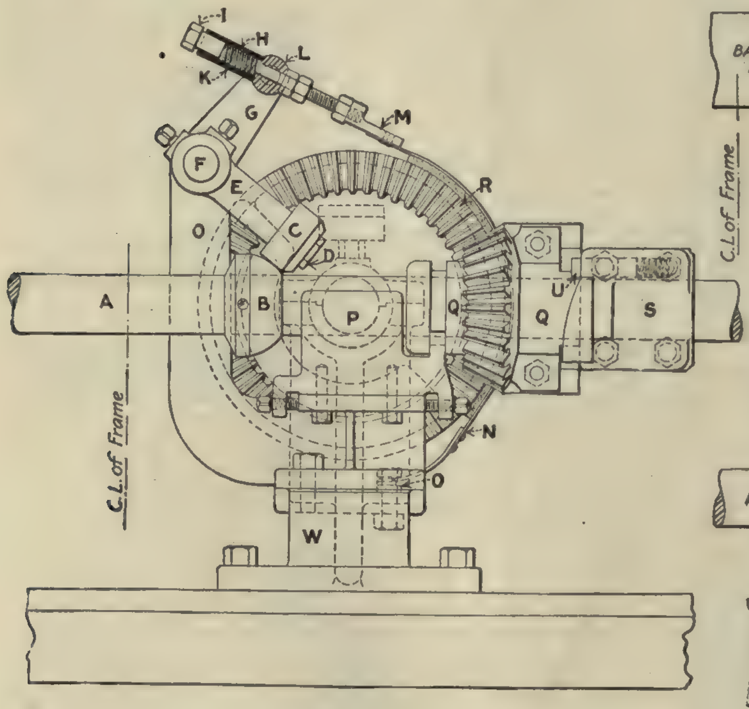


FIG. 1

FIG. 1. FRONT VIEW OF CLUTCH AND BRAKE DEVICE

Another extravagant and wasteful practice is that of pouring journal babbitted boxes in such a casting as that shown at *A*, Fig. 1, when a slight change in the pattern would give a journal as shown at *B*. The latter is just as durable and requires less babbitt metal to fill it.

In Fig. 2, *A* illustrates a large shouldered shaft turned from a solid bar. It can be produced more economically if made with a collar shrunk on, as at *B*.

I find it necessary here to go back to supply savings, as I do not wish to omit the important leather-belting problem. I often wonder whether the average mechanic, who perhaps grumbles over the high cost of shoe leather these days, ever realizes the cost of a new belt to run his machine. Much leather belting is wasted through improper lacing, machinery being out of line and oil running on belts at loose pulleys.

We read much these days of the importance of preserving our food supplies, because of the shortage that prevails. It is surely just as essential for us to use our manufacturing supplies judiciously.

Clutch and Brake for Textile Machine

By C. F. Meyer

The illustrations show the so-called Coulier brake motion of a certain textile machine. *A* is the main-shaft, to which the cam *B* is fastened. A bearing *W*, mounted upon the two rafters of the machine, holds another shaft *X*, at right angles to the shaft *A*. A bevel gear *R* is keyed to this latter shaft in the manner shown by the illustrations. This bevel gear is in mesh with a pinion *Q*, which is made in two halves and revolves loosely about the shaft *A*. It is held in its place by a suitable bracket *P*, which is fastened to the bearing *O*. The latter in turn is mounted upon the bearing *W*.

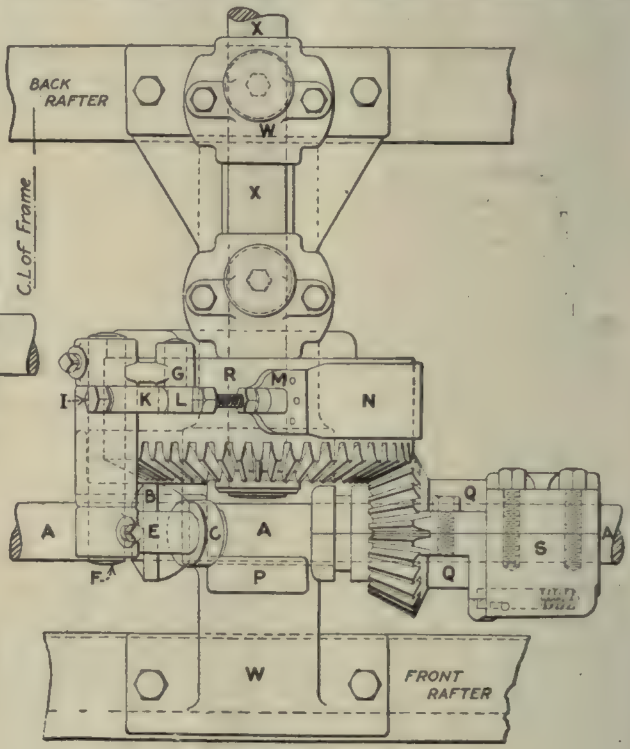


FIG. 3

FIG. 3. PLAN VIEW OF MECHANISM

The upper part of the bearing *O* carries a loose shaft *F*, which is held in place by two levers *E* and *G*. The lever *E* is provided with a roller *C* held by the stud *D* and resting upon the cam *B*, as shown. The lever *G* is, by means of the studs *L* and *I* as well as the spring *H* and the bracket *M*, connected to the brake band *N*, which acts upon the level gear *R*.

The other side of the pinion *Q* is shaped to form a straight-toothed clutch coupling into which fits a corresponding coupling *S*. The latter is, for the sake of easy repairing, also made in two halves and securely fastened to the shaft *A*. It is clear that the pinion *Q* will be taken along with the shaft *A* when the latter revolves, as long as the coupling *S* is coupled to the pinion. The pinion *Q* in turn revolves the bevel gear *R* and the shaft *X* with the large cam *Z*.

The action of the machine demands now that the revolving of this cam *Z* must be interrupted at certain intervals and for a certain number of revolutions. This is accomplished in such a way that at the proper time the shaft *A* is shifted to the right, taking the coupling *S* with it and thus disconnecting the latter from the pinion *Q*. Simultaneously, the roller *C* and the lever *E* will be lifted by the cam *B*, the latter being moved with the shaft. That will also turn the lever *G* and consequently bring the brake band *N* into action, thus stopping the gear *R* and, therefore, the cam *Z* immediately. The shaft makes the desired number of revolutions and is then shifted back again. The clutches of *S* and *Q* must fit into each other perfectly to prevent any lost motion when the machine is turned backward. It is therefore clear that the pinion *Q* must remain in the exact position which it had at the moment of disconnection in order to meet the returning coupling *S* properly. That, however, is very difficult, as a little oil under the brake band will cause the gear *R* to slip somewhat after disconnection. Thus, the edge of the returning coupling *S* will strike against the edge of the too far advanced pinion *Q*, and something is sure to break. As this happened quite frequently a device was made as follows:

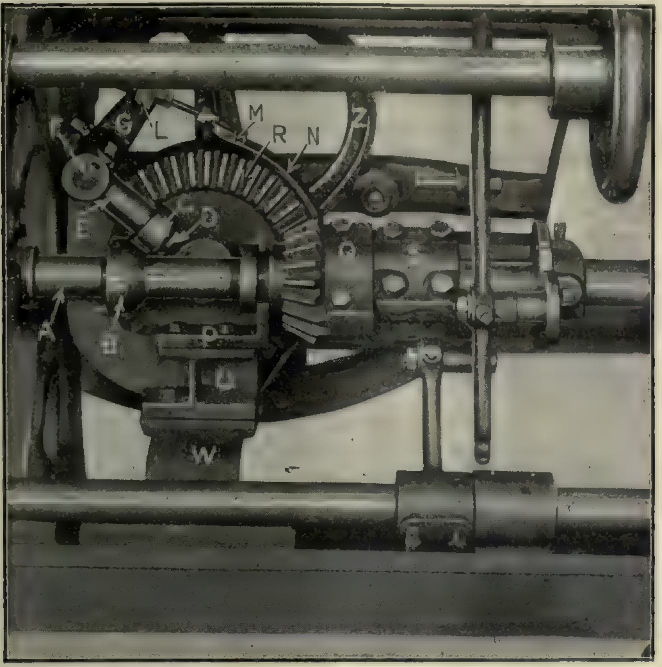


FIG. 2. GENERAL VIEW OF MECHANISM

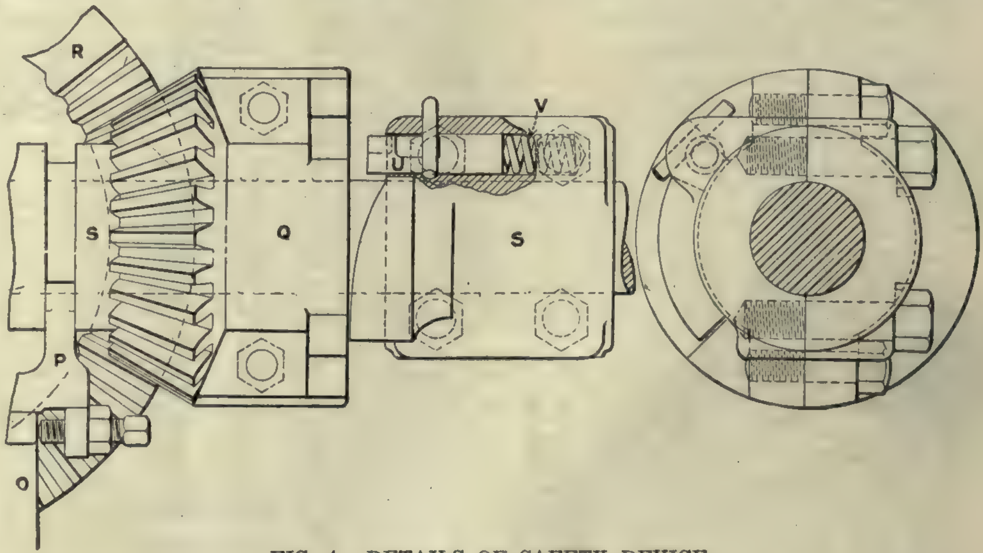


FIG. 4. DETAILS OF SAFETY DEVICE

The device is shown in Fig. 4. It consists of a hardened-steel stud *U*. The edge of the coupling *S* is taken away, and the bolt *U* is put in its place in such a way that the one flattened side of *U* takes the place of that edge. The bolt *U* is adapted to move easily in a hole drilled into *S* for that purpose. A spring *V* is always pressing *U* out of *S*, but the stud is held by a pin working in a flat surface filed on *U* for that purpose. This pin also prevents *U* from turning. It is clear that the returning coupling *S*, if the shaft is too far advanced, will strike the edge of *Q* with the pin *U*. The latter is simply pressed back until the couplings are in their proper respective positions. The pin *U* is then free again, the spring *V* presses it forward, and thus the space for the clutch of *S* in the coupling *Q* is entirely filled out, preventing any lost motion. The device works very well and may be found exceedingly useful for similar constructions.

Meaning of Co-operation

By Entropy

The greatest indoor sport indulged in in manufacturing establishments at the present time is known by the euphonious name of "passing the buck." It differs from "having an alibi" only in degree.

Two plausible reasons may be advanced for the popularity of this game. One is that human nature is pretty much the same now as it has been for the last few thousand years, which makes it easy to see the other fellow's faults; the other is that margins of profit, as a whole, are constantly growing less, and therefore men must be held more strictly accountable than ever before.

To the first of these suggestions we might say that human nature may be the same, but that human action is getting to be a mighty sight more charitable. Human weaknesses were never so leniently dealt with in the past, and there never was a time when more effort was put into trying to give the failure the glad hand and help him to his feet. That can hardly be the reason.

The second suggestion that this is something which goes with modern organization is much more likely. A shop with a hundred or two hundred men can run on either ancient or modern lines and succeed or fail, not on system, but on personality. There are very few men who can make their personality pervade an organization of five hundred, and still fewer can reach a thousand. We cannot imagine one that could reach some of the really large organizations that are becoming an accepted factor in industry.

The moment a man, whether he is superintendent, foreman or workman, feels that he is merely a detached unit of the machinery, he has no reason to care what happens to anyone but himself. If, too, he finds that his income and his very tenure with the company depend on the approval of some official who does not know him and does not want to get acquainted, he cannot be blamed if he covers his own mistakes at the expense of whoever will accept the burden.

The trouble seems to be that our organization is too often made up without thinking of whether each unit is complete in itself. If we are designing a new lathe, we make the apron a complete unit that can be assembled and inspected at the bench. When it is done and passed on, then the responsibility of the apron gang is over; but in our office and sales departments there is seldom this complete correlation of authority and responsibility. When one department is working with another and both are doing parts of a job that must fit nicely together to make a complete job, there is sure to be backbiting and disorganization. We can talk about diplomacy and coöperation all we please, but self-preservation is the first law of nature; and the kind of men that we most desire in our shops want to hold their jobs for long periods.

It seems as if many organizations could to advantage look over their charts with an eye to discovering whether there are places where dollars can be saved by making each of the things which are done in a department complete within that department. For example, if there is a timekeeping department, let it have the entire job of timekeeping and not be dependent on foremen for information. Let its authority be shown and be final. If there is a timesetting department, let it be complete in itself without having to depend on making time studies upon men while they are working under the direction of some other department. If a man's work or that of a department is thus a complete unit, then its work may be readily defined and responsibility may be placed. This does not in any way do away with coöperation, but simply takes off its back one of the burdens that is now breaking it down.

Coöperation is dependent on definition of duties. A man must know whether to do a thing himself or to help someone else do it. Without some such check it is inevitable that the desirable work will gravitate to the men who have the least coöperative and the most selfish spirit, while the real coöperators, who are the men who should carry the greatest burden of the valuable work, will share among themselves the leftovers.

Coöperation does not mean to live closely within the lines of a defined job. It means helpfulness to others, even when that help consists in minding one's own business in faith that the other man will work out his own problem in an original way unhampered by our superior knowledge. It means patience with beginners. It means the promotion of good company spirit, which builds and broadens men. Like every other vehicle of human progress, it breaks down if too heavily overloaded; hence the necessity of using it mingled with definite system.

Dimensions of Standard Metric Machine Screws

In response to requests for information regarding the sizes of metric machine screws, the following translation from *Zeitschrift für Instrumentendkunde* has been prepared. The formulas are based on the diameter of the screw D in millimeters, and the table is figured out from these proportions to the nearest appropriate value. The illustrations show the different types of heads referred to and also give the dimensions. No threads are given.

d = Diameter of screw shank;

$D = \frac{1}{3}(5d + 1)$ = Head diameter of cylindrical and hemispherical heads;

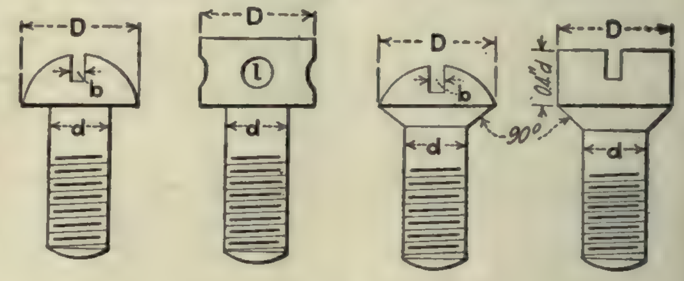
$D_v = 2d$ = Head diameter for countersunk heads, rounding off to the nearest whole or half millimeter when d exceeds 3;

$h_s = 0.6D$ = Height of head for all forms of slot-head screws;

$h_l = 0.8D$ = Height of head for all forms of capstan screws.

In countersunk screws the head is made with a countersunk taper of 90 deg.; the top of the head is given a spherical contour of radius $2d$, or else the side of the head is made cylindrical at the upper edge to the height of $0.4d$.

FORMS AND DIMENSIONS OF METRIC MACHINE SCREWS



d Mm.	D Mm.	D_v Mm.	h_s Mm.	h_l Mm.	b Mm.	t Mm.	l Mm.	L Mm.
10.0	17.0	20.0	10.2	13.6	1.2	5.3	4.0	31
9.0	15.5	18.0	9.2	12.3	1.1	4.8	3.6	28
8.0	13.5	16.0	8.2	11.0	1.0	4.3	3.2	25
7.0	12.0	14.0	7.2	9.6	0.9	3.8	2.9	22
6.0	10.5	12.0	6.2	8.3	0.8	3.3	2.5	19
5.5	9.5	11.0	5.7	7.6	0.8	3.0	2.4	17
5.0	8.5	10.0	5.2	7.0	0.7	2.8	2.2	16
4.5	8.0	9.0	4.7	6.3	0.7	2.5	2.0	14
4.0	7.0	8.0	4.2	5.6	0.6	2.3	1.8	13
3.5	6.0	7.0	3.7	5.0	0.6	2.0	1.7	11
3.0	5.3	6.0	3.2	4.3	0.5	1.8	1.5	10
2.6	4.7	5.2	2.8	3.8	0.5	1.6	1.4	9
2.3	4.2	4.6	2.5	3.4	0.4	1.4	1.3	8
2.0	3.7	4.0	2.2	3.0	0.4	1.3	1.1	7
1.7	3.2	3.4	1.9	2.6	0.4	1.1	1.0	6
1.4	2.7	2.8	1.6	2.2	0.3	1.0	0.9	5
1.2	2.3	2.4	1.4	1.9	0.3	0.9	0.9	5
1.0	2.0	2.0	1.2	1.6	0.3	0.8	0.8	4

$b = 0.1d + 0.2$ = Width of slot;

$t = 0.5d + 0.3$ = Depth of slot;

$l = 0.35d + 0.45$ = Diameter of capstan hole;

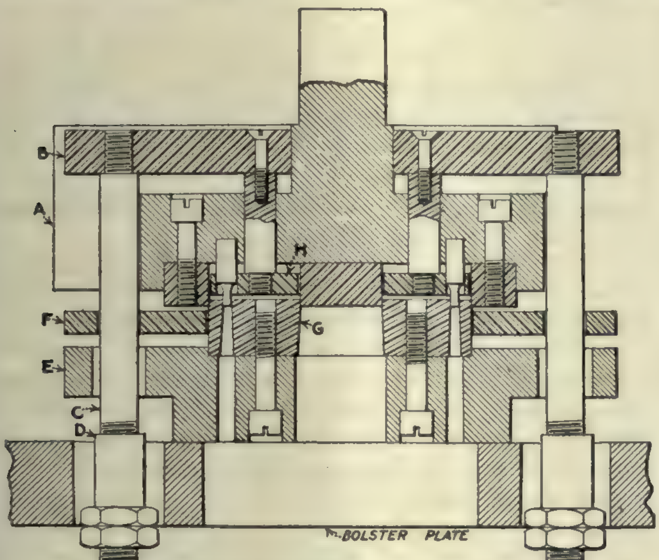
$L = 3d + 1$ = Length of threaded portion of shank.

Length of neck (unthreaded portion of shank) is an integral multiple of $0.5d$.

Combination Blanking and Piercing Die

By Fred Rauter

Die designers are often confronted with the problem of designing a large combination blanking and piercing die where the stock is of heavy gage and there is insufficient space for springs or rubber to eject the blank from the die. The die shown was designed for piercing and blanking an oblong shape 9 x 4 in. by 0.187-gage stock. The total pressure required for piercing and blanking is approximately 200 tons without shear, and the pressure required for knocking the blank from the die and stripping it from the punches is approximately 14 tons, which is 7 per cent. of the total pressure. This could not be obtained with springs or rubber, and the mechanical knock-out and stripper were designed for the die.



COMBINATION BLANKING AND PIERCING DIE

The die is shown at the bottom of the stroke. The knock-out and stripping arrangement work as follows: The punch holder *A* and the knock-out carrier *B* ascend, carrying the rods *C* and the sleeves *D* along. Sleeves traveling through the holes in the die base *E* contact with the stripper *F*, carrying the latter upward, stripping the scrap from the die *G*. Hexagons of sleeves then strike against the lugs on the die base, stopping the movement of the knock-out arrangement. The punch continues its upward course for ½ in. (it then has reached its maximum height), the knock-out *H* ejecting the work from the punch.

Scoop-Shovel Methods

By Elmer W. Leach

The word passed from desk to desk that the boss wanted to see everyone in his office at once.

"We're in for it now," whispered a new stenographer to the billing clerk. But the billing clerk was an old-timer in the office, so with perfect confidence in her presumption she remarked, "No, this is Friday; it's probably the weekly 'Efficiency talk'!"

We slunk into the boss' office like dogs expecting to be whipped; but his first words to us were, "Well, folks, I don't want you to fear you're being brought in upon the carpet for a calling-down; for I called you in rather that I might tell you a story which I trust may send you back to your work in a somewhat better and more earnest spirit."

Now, when we're in for a calling-down, the boss doesn't start in as passive as that. Consequently, we breathed in unison a sigh of relief, knowing that we were to receive, not a calling-down, but an efficiency talk. The story we heard was one which illustrated so aptly a fault common to many manufacturing plants that I am sure it is both interesting and instructive enough to bear repetition.

"Here is a complaint letter," he began, "from an Eastern customer who has recently received one of our machines. I have the order and the correspondence here, and I shall tell you the whole story. The electric current in the city where this particular customer lives necessitated sending him an odd type of motor, one we do not carry in stock. Knowing that much time would be saved by having the motor shipped direct, the order was handled in that way.

"When we sell a machine without a motor, we of course do not supply a motor belt or pulley. The order clerk merely wrote up an order for one machine without motor—consequently, the first letter of complaint. It reads:

" 'I have my machine and my motor, but you have failed to provide any means for connecting the two. I must delay the opening of my new shop until this matter has received your attention.'

"This meant that the letter had to be answered. A new order card was made out for the belt and pulley, and the shipment made by parcel post at our expense. Now, this morning I have received a second letter of complaint. The man says he has received the belt, but no pulley. I have just looked up the order-card file. The pulley item has never been checked by the packers, so I assume that through an inexcusable oversight on their part the pulley was forgotten. Now a third order card will have to be made out.

"Do you see all the inconvenience and expense which has resulted merely because the order clerk was satisfied to use 'scoop-shovel methods'? If he had taken time to give the order the attention it deserved, to study each detail, even though it may have seemed insignificant, our customer would have been spared all his annoyance, and we would have been saved considerable expense and the probable loss of future orders.

"Rushing things through in a hurry without giving each individual situation reasonable thought is an evil which is not confined to this shop alone, but it is one which at times is bound to creep into every factory, whether large or small. If one department is behind in its work, and it manages to catch up only by putting another department behind, the condition of the organization as a whole is no better. Nothing is gained by cleaning up delays only by throwing them onto the next fellow. It is only by conscientiously analyzing each situation that the business of the shop can be handled expeditiously and satisfactorily."

The boss closed his little talk with a few bits of encouraging and stimulating advice; and we all went back to our work, each one determined to do his individual best toward putting an effective taboo on "scoop-shovel methods."

Editorials

How the New War Profits Tax Affects the Manufacturer

THE NEW war revenue tax is probably one of the most involved and unintelligible pieces of legislation that has ever been placed on our law books. It is admittedly, unfair and over drastic in places and it is freely predicted in Congress that it will be greatly modified at the next session which opens in December. But both for the purpose of showing just what it means and just how it is applied to a machine business, we have worked out a few typical examples.

* * *

The first taxable year means the twelve months ending Dec. 31, 1917, or in the case of a partnership or corporation having its own fiscal year, it is the year ending during 1917.

The "prewar" period is the calendar years 1911, 1912 and 1913, or such part of them as a new firm has been in business. If, during this prewar period the firm earned 7 per cent. or less on its investment, 7 per cent. is the allowed deduction for prewar profits. If, however, it earned 9 per cent. or more, during the prewar period, it may deduct 9 per cent. as the prewar earnings. But should it not be easy to determine just what the earnings were in the prewar period, then an allowance of 8 per cent. may be deducted.

Invested capital, as interpreted by the act, means the average invested capital for the year. It does not include stocks, company bonds, nor money or property borrowed. The earnings are based on the capital actually invested and not on any nominal capitalization. Patents, copyrights and trade-marks can be counted as capital at the actual cash paid for them.

* * *

There are few machine builders who have not put a large share of their earnings back into their business during the past two years, and they naturally wonder whether this investment will be recognized in reducing the amount of the new taxes. All surplus which has been used in the business of the company adds to the actual investment, and in that way lowers the percentage of earnings which are taxable. If, for example, $100,000 of earnings has been invested in a plant they would make a total investment of $200,000, a profit of $100,000 this year would make only a 50 per cent. dividend instead of a dividend of 100 per cent. as would have been the case without this reinvestment. This makes the tax $17,400 instead of $47,400.

* * *

It is next necessary to bear in mind that we must consider four separate taxes, which are: First, the existing tax of 50c. per $1000 of invested capital, known as the capital tax. Second, the profits and income tax of 1916, in which corporations can exempt $3000. Third, the new 1917 income tax. Fourth, the new war profits tax.

Having determined the capital invested, and the prewar profit, the first step is to deduct the existing Federal tax of 50c. on each $1000 of actual capital invested. So, assuming a concern with an invested capital of $100,000, we must first deduct the 50c. per $1000, or $50.

* * *

If the business paid more than 9 per cent. during the prewar period, we deduct a 9 per cent. dividend or $9000 and the allowed exemption of $3000, a total of $12,000. Assuming a profit of only 10 per cent. on the invested capital, or $10,000, there is no war profit tax to pay, nothing but the $50 capital tax, as the exemptions more than cover the profits.

Considering the profits as $20,000, the exemptions remain the same, leaving $8000 to be taxed by the third and fourth laws of 1917, just mentioned.

The first tax is 20 per cent. on the amount by which 15 per cent. of the invested capital exceeds the exemptions allowed, which are $12,000. As 15 per cent. of $100,000 is $15,000, this deduction leaves $3000 to be taxed at 20 per cent., making this tax $600.

This leaves $5000 of the profits still to be taxed by the next provision which takes 25 per cent. of the next 5 per cent. earned; and as $5000 is just 5 per cent. of the invested capital, the 25 per cent. of this, or $1250, completes the taxation schedule. Summed up this gives the results shown in the accompanying table:

Deduction for prewar profit at 9 per cent	$9,000
Income allowance of 1916	3,000
Total allowance	$12,000
Fifteen per cent. of capital	$15,000
Total deductions allowed	12,000
Difference	$3,000
Taxable at lowest war profit tax of 15 per cent	$3,000
First tax of 20 per cent. on $3,000	600
Balance of profit, $5,000 at 25 per cent	1,250
Total taxes	$1,850

* * *

With a $50,000 profit in the same company the deductions remain the same as before, so that the taxable dividend is $38,000.

The first tax is the same 20 per cent. of $3000, or $600. Then comes the tax of 25 per cent. on the next 5 per cent., which is $5000 or $1250, and at 35 per cent. on the next $5000. The next 8 per cent. of the dividend, which is in excess of 25 per cent. of the invested capital, is taxed 45 per cent., while all over 33 per cent. is taxed at 60 per cent.

Summing this up shows how much more heavily the large earnings are taxed than the small dividends:

20 per cent. of $3,000	$600
25 per cent. of $5,000	1,250
35 per cent. of 5,000	1,750
45 per cent. of 8,000	3,600
60 per cent. of 17,000	10,200
	$17,400

This leaves a net income of $50,000 less $17,400 = $32,600, which is taxable at 6 per cent. (4 per cent. more than last year), or $1956. This added to $17,400 makes a total tax of $19,356.

Profits in excess of 33 per cent. on the invested capital are taxed at 60 per cent., so that a dividend of 100 per cent. or $100,000 would add $30,000 to the $17,400, making $47,400, on which 6 per cent. or $2844 must be paid. This makes a good total of $50,244, or over 50 per cent. of the total.

In a partnership the deduction is $6000 in addition to the 9 per cent. or $15,000 (or 7 or 8 per cent. as previously described). This, with a profit of $50,000 as before, leaves a taxable income of $35,000.

Tax of 25 per cent. on first $5,000 excess over 15 per cent	$1,250
Tax of 35 per cent. on the next $5,000	1,750
Tax of 45 per cent. on the next $8,000	3,600
Tax of 60 per cent. on the remaining $17,000	10,200
Total excess tax	$16,800

With these examples it will be easy to work out any specific case, taking care to get the exemptions straight in the first place. After that it is comparatively easy.

The Duty of Every Shop—Large Production

THE watchword for all shop men, from owner to apprentice boy, is "production and yet more production" of everything that can be called necessary for the vigorous prosecution of the war. And this means not only shells, rifles and munitions of war, but machine tools, drills and cutting tools of all kinds and everything that does not come under the head of luxuries.

Whether or not we approve of the way certain departments are conducted, whether or not we feel that some decisions are unjust and unnecessary, it is our job to increase production as much as possible—not by special occasions of crowding or overtime work, but by so improving methods, and by rationalizing specifications and inspection that we can supply serviceable articles at a greater rate than before.

We must feel this as an individual responsibility and not attempt to shift it on inefficient executives in some other departments. We must do the best work possible under the circumstances and not wait for the conditions to become ideal. We must remember that the delays are due to the inability of the old organization to handle the gigantic problems that were thrust upon it; that the lack of knowledge of modern manufacturing conditions rather than any desire to obstruct or delay the work is responsible for whatever conditions may not be as we would wish. We must also remember that this puts it up to us to do more than would otherwise be necessary and that we must do the seemingly impossible, if need be, to place us where we belong in the present struggle.

Old ideas of shop management may have to be modified to get and to hold men for the shops—it is no time to stand on precedent that may have little foundation except that it has always been the custom. Men may get exaggerated ideas as to the profits that are being made and quite naturally demand a share in them. If they are mistaken, it is much better to show them the situation freely and fully than to risk a delay in production by adhering to the old-time policy of not discussing such questions with them. When this is done, when we sink our older individualistic ideas and realize that we are one link in a great productive chain that is necessary to win the war, we can justly demand that labor coöperate to the same extent.

One point to be carefully watched in the matter of production is the small, but intentional, delays which are so hard to detect, but which greatly affect production. It is comparatively easy to delay the output of any shop by methods that are difficult to detect, and this matter should receive greater attention than has yet been given to it. The breaking of a tool at a critical time on an important job, sidetracking work or devising unusual and difficult methods of accomplishing it are among the favorite methods of the German sympathizer, and they are not easy to detect. That they are a real menace is indicated by a recent raid which took about a hundred men out of one shop engaged on vital Government work.

Nothing must stand in the way of production, as in that direction lies the end of the war. Employers and employees, designers and engineers, men of military training and production managers must get together for the good of the whole. Whatever stands in the way must be eliminated; whether it be prejudice and precedent, unnecessarily severe specification and inspection or even the slightest trace of sabotage, it must be swept aside. No one can shift his own responsibility in this matter. Unless we are doing our best to help production, no matter if we know someone else is falling behind, we cannot claim to be doing our full duty at this time.

The country demands, and has a right to demand, the best that is in every one of us.

The Second Liberty Loan

WHILE there is no question as to the success of the new Liberty Loan, the subscriptions should be made quickly and as generously as possible. We should all be glad of the opportunity for investing our money safely and at the same time doing what we can to help win the war. We could far better afford to *give* the money than to fail to do our share of the work, which must be done, and we should all be glad to make some real sacrifices in order to do so. Cutting out a few luxuries, denying ourselves some of the things which are not essential, will not only allow us to invest in Liberty Bonds but help develop our will power.

Many of the foreign born within our borders are setting us good examples in this. The Pennsylvania Railroad makes some astonishing returns as to the amount of bonds taken by their employees who first saw light in foreign lands. Do we want to acknowledge that they appreciate our institutions more than we do ourselves?

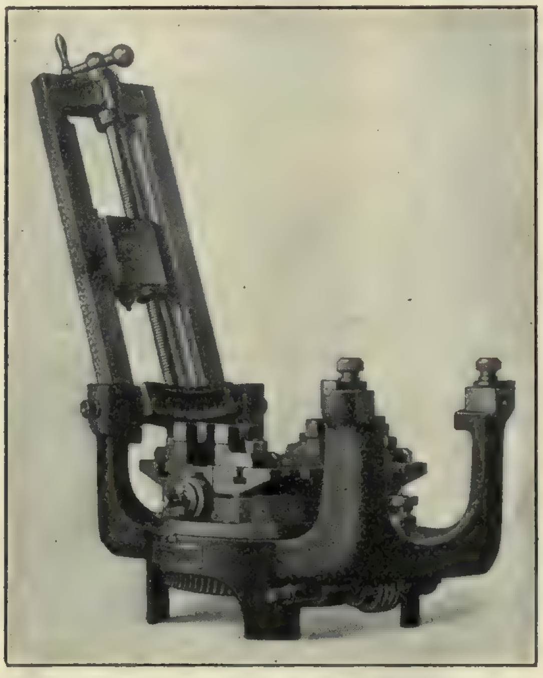
The success of the Liberty Loan lies not in the ultimate getting of the money, but in a prompt, generous and universal response. Numerous small contributions are better than a single one of the same aggregate amount. The money invested is safer than in a savings bank, will draw interest until it is paid back, and the bond can be reconverted into cash or used as a security at any time. The limit is so small that anybody can get in. You can get one of your bank, at the post office or of your employer. Buy one today, and show the boys who are going to the front that there is no lack of willing and earnest support behind them.

SHOP EQUIPMENT NEWS

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Lapointe Drilling Jig

The universal master jig illustrated has been placed on the market by the Lapointe Machine Tool Co., Hudson, Mass. The device consists essentially of movable guide bushings, securely fitted to a bushing in the slide which is operated longitudinally by a ⅝-in., 10-pitch acme screw. The work is held between two stationary and two adjustable gripping jaws, fitting in slots in the table, which may be moved transversely by a similar screw as that used for the bushing slide. The table is fitted to a circular base, which may be rotated through the entire circle by means of a worm and wheel, and which may be clamped in any desired angular position. Graduations are provided, indicating movements of ½ deg. As a tally for the number of turns of the spacing screw on the bridge, a pointer and steel scale are provided. Both adjusting screws are provided with dials graduated in 0.0005 in. All bearings are so made that wear may be taken up, and are equipped with dust-proof oilers. The illustration shows the bridge open for insertion or removal of the work. Equipment includes gripping jaws, wrenches, guide bushings, reamers, parallels, adjustable die clamp, and test plug.

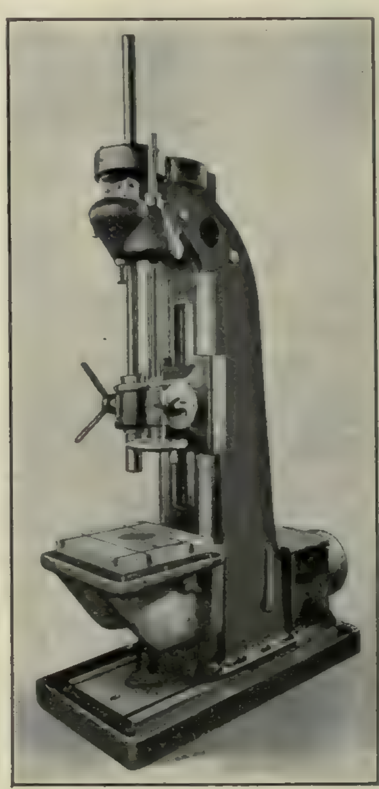


NO. 1 UNIVERSAL MASTER JIG

Size of work accommodated with table gripping jaws, 5 x 1¾ x 10 in.; size of work accommodated with adjustable straps, 6 x 1¾ x 10 in.; size of circular work accommodated up to 10 in. in diameter; travel of slide, 9 in.; travel of table, 4½ in.; weight, 100 pounds

"Telsmith" Drilling Machine

A 24-in. heavy-duty high-speed drilling machine that is now being marketed by the Smith Engineering Works, 32nd and Locust Sts., Milwaukee, Wis., is shown in the illustration. Ten different speeds are obtained, through a system of gearing, which vary from 30 to 446 r.p.m. Gears are also used for the feeds, six of which are available, the greatest being 0.07081 in. and



"TELSMITH" DRILLING MACHINE

Capacity, work up to 24 in. in diameter; floor space, 6 ft. 1 in. by 2 ft. 4 in.; height, 7 ft. 9⅞ in.; speeds, ten 30, 40, 54, 74, 101, 132, 178, 238, 335 and 446 r.p.m.; feeds, six 0.0072, 0.01102, 0.01766, 0.02848, 0.04624 and 0.07081 in. per spindle revolution the smallest being 0.0072 in. per spindle revolution. An adjustable automatic stop is provided for use where it is desired to drill holes to a given depth. The machine is equipped with a lubricant circulating system.

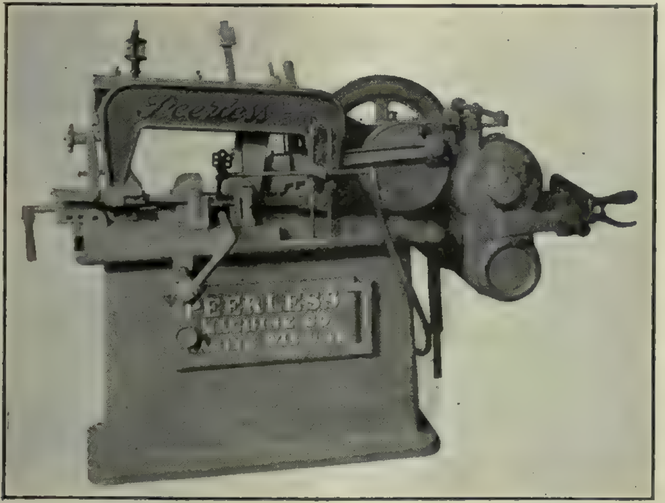
Reliable Revolving-Grip Plug and Ring Gages

The Reliable Machine Works, 48 Lafayette St., Ridgewood, Long Island, are now manufacturing a line of plug and ring gages equipped with revolving grips. Two of these gages are shown in the illustration. The idea is that with this arrangement the gages may be used for testing the size of the piece being machined without stopping the machine. The revolving portion runs on ball bearings and is held in place on the plug gage by means of a screw while a spring ring serves this purpose on the ring gage. The gages are ground and lapped to size and are furnished in a large number of sizes.

REVOLVING-GRIP RING AND PLUG GAGES

Peerless High-Speed Metal-Saw

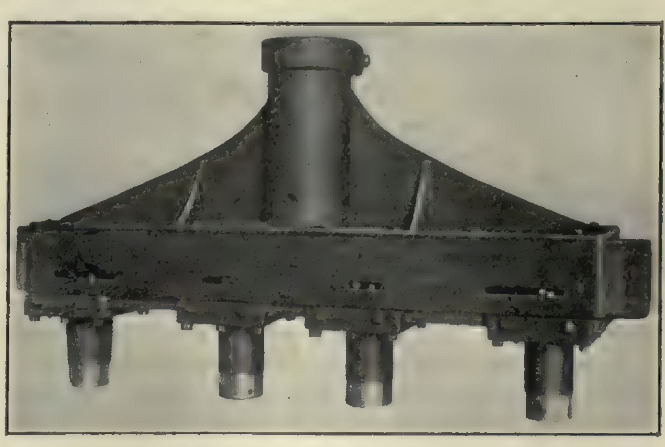
The illustration shows a high-speed metal-saw that is being marketed by the Peerless Machine Co., Racine, Wis. This machine is now made with six speeds ranging from 50 to 150 strokes per minute. These speeds are obtained by means of gears operating in a gear box attached directly to the machine. If desired the machine can be furnished with a motor drive, the motor in this case being mounted above the machine in order to reduce floor space required. Where motor drive is used the machine is equipped with a set of reducing gears. The capacity of the machine is work up to 6 x 6 inches.



HIGH-SPEED METAL-SAWING MACHINE

Hoefer Adjustable Drilling Head

The illustration shows a heavy-duty, four-spindle auxiliary drilling head manufactured by the Hoefer Mfg. Co., Freeport, Ill. It will handle drills up to 1 in. in diameter. The head is clamped to the spindle nose and the drive is from a taper shank toothed driver through hardened helical gears. The helical gears extend the length of the head in order to provide for lateral adjustment of the individual drilling spindles. End thrust on the horizontal shaft is reduced by making half of the helical gears with a left-hand lead while the others are cut right-hand. Ball thrust bearings are used to take up the remaining end thrust. The individual spindles run in bronze bushings and ball thrust bearings in the lower spindle nut carry the end thrust. The adjustable spindles slide on scraped bearings and are locked in proper position by means of set screws. Lubrication of the lower spindle bearings is through oilers that may be seen projecting through the side of the head, while the gears run in an oil bath in small oil pockets.



HEAVY-DUTY FOUR-SPINDLE DRILLING HEAD

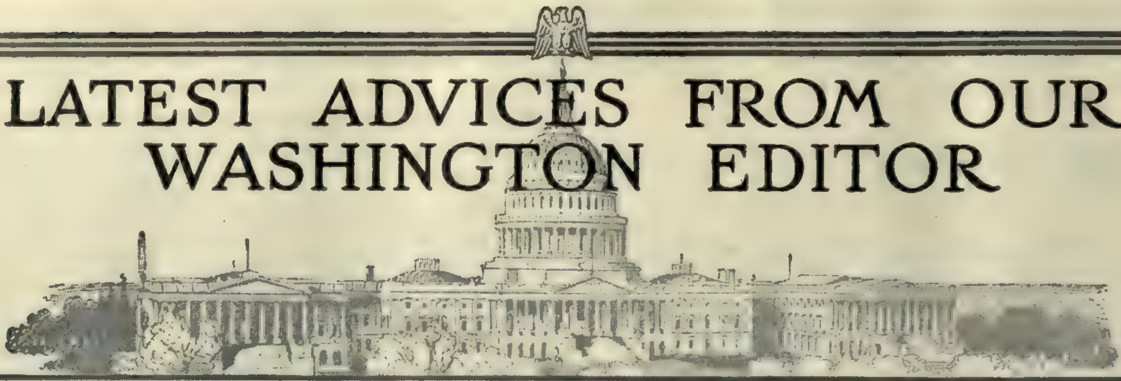
Layouts Versus Computation for Obtaining Angles

By Henry Ginsburg

The article on "Layouts Versus Computation for Obtaining Angles," by Mr. Koontz, on page 186, interested me, because I have had frequent occasion to use large-scale layouts for obtaining dimensions not as easily computed as those of angles. An error seems to have crept into Mr. Koontz' figures, since it is obvious that a measurement of 0.005 in. in a 100 to 1 layout will mean only one-half a ten-thousandth, not one-half a thousandth.

In enlarged-scale layouts, I have rarely found it necessary to use anything larger than 10 to 1. This is a very convenient scale, as it permits the use of an ordinary steel scale graduated to hundredths, which gives practically a direct reading in thousandths and is close enough for all ordinary work. With ordinary care in making the drawing, the maximum error should not exceed 0.001 in., while the chance for errors in reading the scale or in converting the readings to full scale is almost entirely eliminated.

LATEST ADVICES FROM OUR WASHINGTON EDITOR



Washington, D. C., Oct. 13, 1917—One of the difficulties under which the men of the Council of National Defense labor was brought out, inadvertively I presume, in a recent statement of Representative Britten of Illinois, in connection with the proposed Central Purchasing Board for all war supplies. Mr. Britten compared the purchasing efficiency of the Army and Navy, much to the latter's advantage, and objected strongly to putting it in the hands of a board composed of members of the Council which has no legal status. When the real history of the Council comes to be written, if it ever is, it will probably show more self-effacement on the part of men who are powers in their respective fields than we might think possible. These men give their time and their experience early and late, but can act only in an advisory capacity.

But no matter whether it is composed of members of the Council or not, there is no question as to the need of such a Central Purchasing Board for all supplies and equipment for all branches of the service. The present arrangement induces competition as to deliveries, and also as to price in some cases. The better organization of the navy, according to Mr. Britten, enables it to secure supplies at once, supplies which may perhaps be more urgently needed by the Army. If the proper priorty of machine tools and their outputs is of sufficient importance to have a committee formed for determining this, there is surely need of some similar apportioning of material to places where it is most needed by men in the active service of the country, either on land or sea.

WHAT THE RAILROADS ARE DOING

As an example of what may be accomplished by coöperation between departments there is perhaps no better illustration than that given by the railroads of this country since they have been practically welded into a single unit by the Railroads War Board, under the leadership of Fairfax Harrison, President of the Southern Railway System. Instead of the former competition, the new methods have resulted in such close coöperation that cars are transferred from one road to another to avoid congestion at one point and idle cars at another. This, in addition to the more careful loading of cars, has enabled the railroads to move approximately 25 per cent. more freight than before, with the same equipment. By increasing the loading from 50 bales per car to 70 bales per car the estimated saving in moving the 18,000,000 bales for the season is given as anywhere from 83,000 to 125,000 small cars.

The direct bearing of this on the war can be seen when it is known that from now on 2500 cars a day will be required to move food and supplies to men in training at the national camps, while the demand of the allies for cars to move goods to the seaports will be practically doubled.

EXEMPTING MEN FOR INDUSTRY

The question of securing exemption for drafted men is still puzzling many employers, and seems to be another case where there is lack of coöperation between governmental departments. Knowing the necessity of maintaining a supply of munitions, of airplane engines, and of other supplies, as well as of the machinery with which they are made, it seems incredible that we are likely to make the same mistakes as were made in England and in France earlier in the war. And yet we seem destined to make these same mistakes unless some method be found whereby the final question of exemption shall be settled by men with a broader knowledge of manufacturing requirements, and better able to determine where a man will be of the most service to his country, than seems to be possessed by the average local exemption board.

The general assumption seems to be that every claim for exemption is to avoid service and, while this is too often the case, there are many instances where it is simply the earnest desire of a man to serve in the capacity in which he will prove of the greatest value, and not to avoid the hardships of active military life.

It is also another case where there seems to be too little coöperation between the Army and Navy, several instances having arisen where even those very high in authority seem unable to have a drafted man transferred from the Army to the Navy even when it must be apparent to all that he would be of far greater service in some special work in connection with naval developments.

It is, of course, an enormous task, and even if one were gifted with the wisdom of Solomon, it would still be difficult. It would seem, however, as though the whole matter might well be handled from the same point of view as the inspection system of a large manufacturing establishment. The local examining board could well act as the first inspection, working to fairly definite rules and regulations, just as the preliminary inspection in a large shop must be of an arbitrary character. Final inspection, however, upon which depends the acceptance or rejection of a valuable machine or part, requires very careful judgment on the part of those who are thoroughly familiar with all the requirements of the case, and a somewhat similar arrangement might well settle the question of exemption, just as the Priority Board determines where certain machines and supplies are most needed.

We must not expect perfection in any line of endeavor, and we must be prepared to overlook many mistakes which are honestly made, just as we do in running any sort of a business. We should, however, strive to reduce the number of errors to the lowest possible minimum, so as to secure the greatest efficiency in the utilization of men and of machines, as both are important factors in the conduct of the war.

Iron Industry in Chile

The National Congress of Chile during the special session convened May 9 adopted measures for the establishment of the iron industry.

The iron and steel imports of Chile during 1913 amounted to 266,000 metric tons, which would indicate an actual consumption of 65 kg. per capita. This consumption is considerably less than that recorded in countries where the development of manufactures is further advanced than in Chile. The per capita consumption in Germany, for instance, was 380 kg. prior to the war; that of the United States, 250; of Great Britain, 170; and of France, 150. There has begun an era of industrial progress in Chile, and it is probable that the per capita consumption of iron and steel will increase.

The absence of good coking coal will be a handicap to the new industry. It is at present planned to use charcoal in the furnaces, and the government is planning to secure the services of Swedish and Belgian experts who are familiar with this industry. The forests of southern Chile will supply an abundance of charcoal for many years to come, and the rivers of the same region can be made to produce the horsepower required for the new industry.

Loose Pulleys

By Herbert S. Davis

I saw on page 1045, Vol. 46, P. C. Shepherd's article on bushings and keeping in order loose pulleys. I might add that, while we have had no trouble with loose pulleys in our machine shop, we have had great success in fitting mule pulleys on a woodworking machine that we build with treated wood bushings made by a regular manufacturer of such goods. These pulleys run on a ¾-in. stud at about 2000 r.p.m., and some have been in service 10 years.

The bushings must be used on a perfectly smooth shaft to start with, and the directions of the manufacturer as to outside diameter, etc., should be followed.

LIBERTY LOAN MEETING OF EMPLOYEES OF McGRAW-HILL PUBLISHING CO., INC., AT WHICH THERE WAS UNFURLED A SERVICE FLAG WITH 42 STARS, SHOWING THAT 42 MEMBERS OF THE COMPANY HAVE ENTERED MILITARY SERVICE. SINCE THE MEETING FOUR STARS HAVE BEEN ADDED

Threading Dial

By C. Ross Lewis

Although the lathe is generally regarded as the simplest of all machine tools, it is doubtful if any mechanical feature is as little understood by the average mechanic as the lathe threading dial. If used according to the directions, it generally produces the desired result; but how and why is to most machinists a hidden mystery.

In order to explain fully the mechanism, certain things must be emphasized: First, most lathes have 6-pitch lead screws; next, the threading dial is divided into ten parts by five long and five short lines. By counting the number of teeth on the worm gear that meshes with the lead screw at the bottom of the dial shaft, it will be found that there are 38. Therefore, 30 turns of the lead screw will cause one revolution of the dial; or six turns of the 6-pitch lead screw, which is 1-in. travel, will move the dial one-fifth revolution, or from one long line to the next long line. The space between any two long lines or any two short lines on the dial represents 1-in. travel of the lead screw. The space between a long and a short line would consequently mean ½-in. travel of the lead screw. Therefore, when chasing threads which are an even number per inch, as eight, for example, the carriage can be moved from one line to the next, or ½ in., which equals four threads of the eight on the work, thus allowing the threading tool to enter the work thread properly. Hence, the rule on the dial, "When chasing even threads, engage nut at any line."

For chasing odd threads, such as 13, it will be plainly seen that by moving the carriage one division of the dial, or ½ in., the threading tool will be moved ½ in. along the work, or 6½ threads. If the nut is engaged at this point, the threading tool will enter the work at 6½ threads, thus splitting the thread; but by moving the carriage from a short line to a short line, the carriage is moved 1 in., or 13 threads, which allows the threading tool to enter the work thread properly. Hence, the rule on the dial, "When chasing odd threads, engage nut on short lines only," or on the long lines only, if that threading was started on a long line.

By observing the dial again, it will be seen that the long lines are numbered 1, 2, 3, 4 and 0. The following will explain why: Suppose the pitch of the work thread is 4½. By moving the carriage one mark, or ½ in., we get 2¼ threads on the work. This will not allow the tool to drop into the work thread. By moving the carriage from a long line to a long line, or 1 in., we get 4½ threads on the work, which still will not allow the tool to engage the work thread. But by moving the carriage two long lines, or 2 in., we get nine threads on the work, which allows the threading tool to engage the work thread properly. Hence, the following rule, which I have never yet seen on a machine, but which is generally to be found under the hat of a good mechanic: "When chasing threads of a pitch involving one-half of the thread in each inch, as 4½, engage the feed nut at line 1 for the first cut; for the second cut, skip one long line and engage on line 3; for the third cut, engage at 5, and so on until the thread is finished.

New Publications

Munition Makers—By Amy Hewes and Henriette R. Walter. One hundred and fifty-eight 5¼x7¾-in. pages. Published by the Russell Sage Foundation, New York City. Price, 75c.

This little book is the result of considerable investigation in the endeavor to point out the problems presented by rapid congestion in cities having large munition plants, the dangers of overtime and long hours, and the general effect on the workers and the community. It tells the story of Bridgeport since the expansion due to war orders, gives interviews with women as workers, takes up cartridge making and its dangers, the hours of labor, night work, wages, the women at home, and outlines the program of both the city and the state in handling the situation.

The next section deals with munition workers in England and a third section on the work in France. Included are the different phases of the work, health and hygiene, welfare provisions, juvenile and women workers, industrial relations, technical instruction of workers and other points of a similar nature.

Those who are interested in the general welfare of industry, after the war as well as at present, will do well to study some of the points brought out by these writers. While increased production is highly desirable, we must think of the future as well as the present and conserve the workers, which means the productive capacity of the country.

Business Items

The Cleveland Planer Co. has recently been incorporated and will continue the business of the Cleveland Planer Works. Mr. Ford has disposed of his interest.

The Cramer-Kay Machinery Co. has been organized at Salt Lake City, Utah, to handle a general line of machinery. B. S. Cramer is president and C. A. Kay vice president. The new offices are located in the Newhouse Building.

The Worthington Pump and Machinery Corporation announces the opening of a new branch sales office at the American Trust and Savings Bank Building, Birmingham, Ala., to take care of a portion of the large territory formerly controlled at the Atlanta office. Edward Stanverman is in charge.

American-Blakeslee Manufacturing Co., Birmingham, Ala., announces its formation after the purchase of the White-Blakeslee Manufacturing Co. by D. B. Dimmick. The new concern will pursue a more aggressive policy in the manufacture of the "Blakeslee" line of veneer-cutting machinery, engines and special contract work.

Trade Catalogs

"Roco" Circulating Pump. C. F. Roper & Co., Hopedale, Mass. Circular. Illustrated.

Napier Band Saw Machine. Napier Saw Works, Inc., Springfield, Mass. Catalog. Pp. 8; 5½ x 8½ in.; illustrated.

Universal Master Drill Jig. The Lapointe Machine Tool Co., Hudson, Mass. Catalog. Pp. 12; 6 x 9 in.; illustrated.

Whiting Cupola. Whiting Foundry Equipment Co., Harvey, Ill. Catalog No. 118. Pp. 31; 6 x 9 in.; illustrated.

Whiting Converter. Whiting Foundry Equipment Co., Harvey, Ill. Catalog No. 129. Pp. 16; 6 x 9 in.; illustrated.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn Howard Evans, secretary, Pier 45 North Philadelphia, Penn.

The National Machine Tool Builders Association will hold its sixteenth annual convention at the Hotel Astor, New York City, on Tuesday and Wednesday, Oct. 30 and 31.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Chuck, Quick-Change Keyless

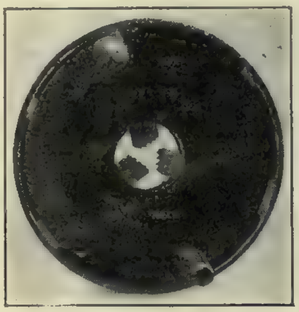
Steel-Art Tool Co., Elgin, Ill.

"American Machinist," Oct. 4, 1917

Made in six sizes to accommodate drills up to 1 in. in diameter. Is a strictly hand-operated chuck and permits changing drills while the machine is in operation without danger to the operator. The chuck is always open to its full capacity, but can be reduced instantly to any size within its range by holding the knurled sleeve, the gripping being done by three tool-steel jaws that are hardened and ground to size

Dog, Lathe, Screwless

Steel-Art Tool Co., Elgin, Ill.



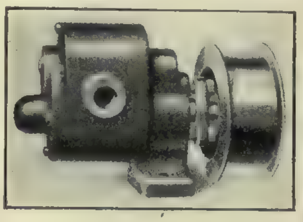
"American Machinist," Oct. 4, 1917

Made in seven sizes, which cover all sizes of work up to 8 in. in diameter. The device may be put on and removed without the use of keys, wrenches or screws of any kind and is claimed to admit of a great saving of time where repeat work is being handled as well as insuring safety to the workman

Pump, Gear (Roco)

C. F. Roeper Co., Hopedale, Mass.

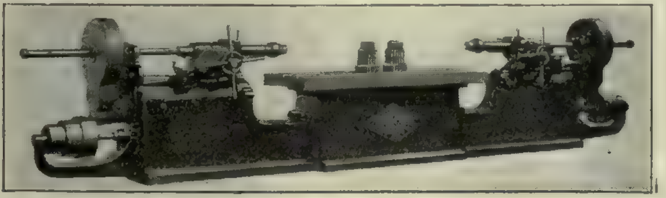
"American Machinist," Oct. 4, 1917



For circulating cutting lubricant or other liquids. The gears, instead of having their end surfaces in the same plane, are so placed that one gear extends past the other. This arrangement makes it possible to cover one end of each gear with a nonturning spring-controlled piston, which presses against the end of the gear and pushes it against the opposite surface of the body. This makes a tight fit at the end of the gears and takes up end wear. Will deliver either a large volume of liquid at low pressure or at a pressure of from 20 to 60 lb. per sq.in. Made in four sizes with capacities per minute at 100 r.p.m. of 1, 1.6, 3 and 8 qt.

Boring and Drilling Machine, Horizontal

Rockford Drilling Machine Co., Rockford, Ill.



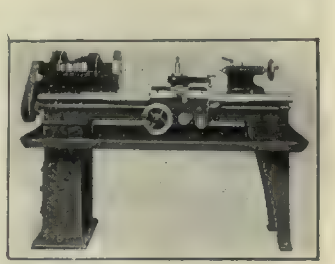
"American Machinist," Oct. 4, 1917

Capacity with high-speed drills in steel, up to 2½ in.; distance from spindle to table and between spindles, to suit customer's specifications; length of feed, 20 in.; diameter of spindle sleeve, 3⅜ in.; Morse taper in spindle, No. 5; width of rack, 2 in.; diameter of spindle-driving gear, 18 in.; size of regular table, 24 x 72 in.; height of table from floor, 30 in.; feed changes, four, 0.010, 0.015, 0.022 and 0.030 in. per revolution; driving pulleys on countershaft, 14 x 6½ in.; speed of countershaft, 500 r.p.m.; gear ratio between drive and spindle, 5 to 1

Lathe, 12-Inch Screw-Cutting (Hercules)

Himoff Machine Co., Astoria, N. Y.

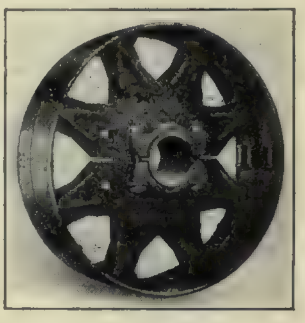
"American Machinist," Oct. 4, 1917



Swing over bed, 12½ in.; swing over carriage slide, 7½ in.; length of bed, 5 ft.; distance between centers, 30 in.; front spindle bearing, 1¾ x 4 in.; rear spindle bearing, 1⅜ x 3 in.; taper centers, Morse No. 2; diameter of hole through spindle, 1 in.; spindle nose threaded 1¾ x 10; ratio of back gears, 8.52 to 1; diameter of lead screw, ⅞ in.; threads cut, 3 to 72; diameter of tailstock spindle, ½ in.; movement of tailstock spindle, 4½ in.; opening in steadyrest, 3¾ in.; length of carriage, 13½ in.; top slide movement of compound rest, 4 in.; diameter of faceplates, 6 and 10 in.; size of tool, 1⅛ x ⅝ in.; weight, 760 lb.; horsepower required, 1 to 2

Pulley, Split Steel

American Pulley Co., 4200 Wissahickon Ave., Philadelphia, Penn.

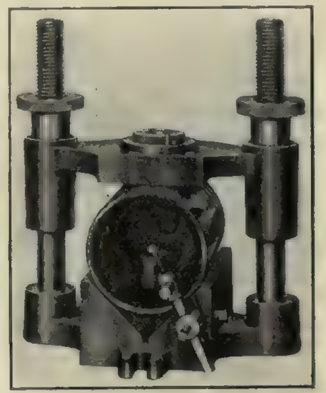


"American Machinist," Oct. 4, 1917

Pulleys of this special heavy-duty type can be furnished from 36 to 84 in. in diameter and with either a 6- or an 8½-in. bore. They are particularly intended for driving drop hammers or other machinery subject to heavy intermittent loads, such as air compressors, rock breakers, crushing rolls, etc.

Piston-Boring Jig

B. L. Schmidt Co., Davenport, Iowa

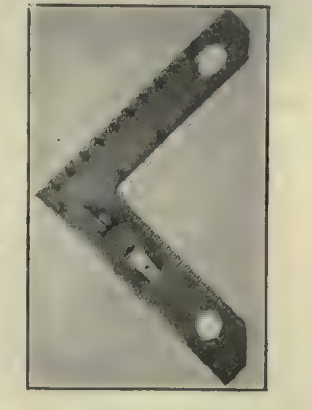


"American Machinist," Oct. 4, 1917

Consists of a V-block to which are attached two uprights serving as guides for the sliding yoke that carries the guide bushings. Upper ends of the two uprights are threaded, and clamping nuts are knurled. A gage is attached to one end of the V-block for setting the piston to the proper position. The V-block is also provided with two lugs or ears for clamping to the machine table. Is fitted with any desired size of slip bushings and is adjustable to all sizes of pistons up to 6 in. in. diameter.

Triangle, Draftsman's

R. B. Ware, 101 Northampton Ave., Springfield, Mass.



"American Machinist," Oct. 4, 1917

This square is of the 45-deg. type, but it is also manufactured with the corners cut at 30- and 60-deg. angles. A number of sizes are made. The elliptical hole at one corner is intended for rounding the ends of shafts or other such work on a drawing. With the two corners of the square resting on the T-square, the sides of the hexagonal hole in the corner give the usual 15-deg. slant for lettering. With the square placed with its side against the T-square, the sides of the hexagonal hole are at 60 deg. A feature of the square is the knuckle-jointed handle, which folds flat when not in use

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices, which went into effect Sept. 24, will have little effect on the general market for some time. Present warehouse stocks—bought at the old mill price—will probably be sold out before the present warehouse prices to ordinary consumers are reduced. The Government prices are: Pig iron, $33 per gross ton; steel bars (Pittsburgh-Chicago), $2.90 per 100 lb.; shapes, $3; plates, $3.25. New Government prices expected within two weeks.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Oct. 12, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	....	$47.00	$16.00
No. 2 Northern Foundry, Chicago	33.00	55.00	22.00
No. 2 Northern Foundry, Chicago	....	55.00	22.00
*Bessemer, Pittsburgh	†$36.30	52.95	24.95
*Basic, Pittsburgh	33.00	50.95	20.90
No. 2X, Philadelphia	33.75	53.00	21.00
*No. 2, Valley	33.00	53.00	21.00
No. 2, Southern Cincinnati	....	49.90	18.90
Basic, Eastern Pennsylvania	45.00	50.00	21.50

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.
†Subject to revision.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Oct. 12, 1917	One Month Ago	One Year Ago	Oct. 12, 1917	One Year Ago	Oct. 12, 1917	One Year Ago
Structural shapes	$5.25	$5.25	$3.35	$5.00	$3.40	$5.00	$3.25
Soft steel bars	5.00	5.00	3.40	4.50	3.40	4.50	3.25
Soft steel bar shapes	5.00	5.00	3.35	4.50	3.40	4.50	3.25
Plates, ¼ to 1 in. thick	10.00	9.00	....	7.00	....	9.00@10	....

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Oct. 12, 1917	One Year Ago
Pittsburgh, mill	$4.75	$2.50
Warehouse, New York	4.75	3.35
Warehouse, Cleveland	4.45	3.35
Warehouse, Chicago	4.50	3.25

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Oct. 12, 1917	One Month Ago	One Year Ago	Oct. 12, 1917	One Year Ago	Oct. 12, 1917	One Year Ago
*No. 28 black	8.00	10.00	10.50	3.65	8.50	3.75	10.00	3.90
*No. 26 black	7.90	9.90	10.40	3.55	8.40	3.65	9.90	3.80
*No. 22 and 24 black	7.85	9.85	10.35	3.50	8.35	3.60	9.85	3.75
No. 18 and 20 black	7.80	9.80	10.30	4.45	8.70	3.55	9.80	3.70
No. 16 blue annealed	8.20	10.20	10.20	4.45	8.70	3.90	10.20	3.70
No. 14 blue annealed	8.10	10.10	10.10	4.35	8.60	3.80	10.10	3.60
No. 12 blue annealed	8.05	10.05	10.05	4.30	8.55	3.75	10.05	3.55
No. 10 blue annealed	8.00	10.00	10.00	4.25	8.50	3.70	10.00	3.50
*No. 28 galvanized	9.50	11.00	12.00	5.00	10.00	5.00	11.50	5.25
*No. 26 galvanized	9.20	10.70	11.70	4.70	9.70	4.70	11.20	4.95
No. 24 galvanized	9.05	10.55	11.55	4.55	9.40	4.55	11.05	4.80

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Oct. 12, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Oct. 12, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	15.30	6.30
Chicago	14.00	5.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

* Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Oct. 12, 1917	Cleveland Oct. 12, 1917	Chicago Oct. 12, 1917
Tire	5.00	5.00	4.50
Toe calk	5.70	5.50	4.75
Openhearth spring steel	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

BUTT WELD

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
⅛, ¼ and ⅜	42%	15½%	¾ to 1½	33%	17%
½	46%	31½%			

LAP WELD

Inches	Black	Galvanized	Inches	Black	Galvanized
2	42%	29½%	2	26%	12%
2½ to 6	45%	32½%	2½ to 4	28%	15%
			4½ to 6	28%	15%

BUTT WELD. EXTRA STRONG PLAIN ENDS

Inches	Black	Galvanized	Inches	Black	Galvanized
⅛, ¼ and ⅜	38%	20½%	¾ to 1½	33%	18%
½	43%	30½%			
¾ to 1½	47%	34½%			

LAP WELD. EXTRA STRONG PLAIN ENDS

Inches	Black	Galvanized	Inches	Black	Galvanized
2	40%	28½%	2	27%	14%
2½ to 4	43%	31½%	2¼ to 4	29%	17%
4½ to 6	42%	30½%	4½ to 6	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	37.9%	23.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	41.9%	26.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Oct. 12, 1917	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	26.00	29.00
Tin, in 5-ton lots	62.00	61.75	42.00
Lead	8.50	10.50	7.00
Spelter	8.50	8.00	11.00

*Nominal; no market until Government intentions are known.

ST. LOUIS

	Oct. 12, 1917	One Month Ago	One Year Ago
Lead	8.00	10.75	7.00
Spelter	8.25	8.25	11.00

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Oct. 12, 1917	One Month Ago	One Year Ago	Oct. 12, 1917	One Year Ago	Oct. 12, 1917	One Year Ago
Copper sheets, base	35.00–37.00	39.00	37.50	33.00	38.50	34.00	38.00
Copper wire (carload lots)	38.50	38.50	32.00	33.00	33.00	36.00	33.25
Brass pipe, base	43.00–45.00	43.00	46.50	41.00	46.00	42.00	46.00
Brass sheets	40.00	40.00	44.50	33.00	43.00	37.00	39.00
Solder ½ and ½ (case lots)	39.25	39.25	26.62½	37.00	27.00	39.00	25.75

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Oct. 12, 1917	One Year Ago
Mill	$29.00	$42.00
New York	35.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Oct. 12, 1917	One Year Ago	Oct. 12, 1917	One Year Ago
New York	20.00	18.00	20.50	19.00
Cleveland	21.00	16.75	21.25	17.50
Chicago	21.50	17.00	22.00	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Oct. 12, 1917	One Year Ago
New York	15.00	13.50
Cleveland	16.00	13.00
Chicago	16.00	13.50

WOMEN in AIRPLANE PRODUCTION

By I. William Chubb

SYNOPSIS—*A large proportion of the work on British airplanes is performed by women. That their work has been satisfactory is proved by the fact that the number of women on this work has been doubled since the beginning of this year.*

It is no secret that all belligerents in the world war are engaged as actively as circumstances permit in the production of flying machines of the heavier than air type. Great Britain herself has more than one thousand factories employed one way or another on this work and, according to the figures given recently by Dr. Addision while still minister of munitions, the output at the end of the current year in Great Britain alone will be more than six times what it was in the middle of 1916. In about the first five months of the year the number of workpeople employed in British airplane factories increased by 25 per cent., the increase being largely woman labor, for it was stated that the percentage of female labor has risen from 19 to 37.

THE SCHOOLS FOR WOMEN

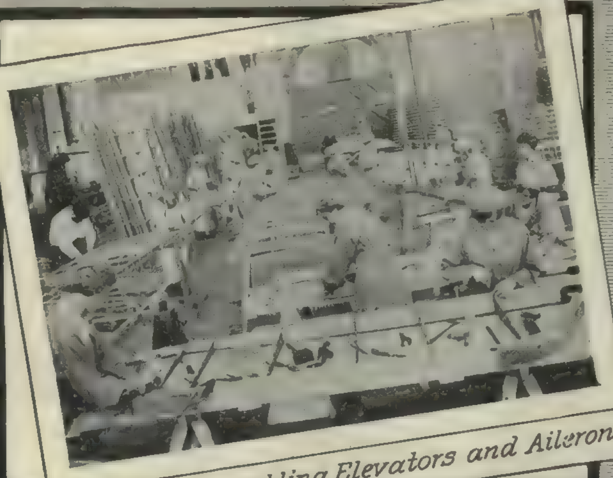
Great Britain has schools in which women are trained, and with the work simplified by subdivision of operations, there is no limit except physical strength to their employment. As recent exhibitions have shown, the work of the women ranges over the whole of aircraft, from the production of cylinders and machined parts for Clerget, Hispano Suiza, Le Rhone, Gnome and other engines to the metal and wood parts and the assembling and testing of the planes themselves. Except possibly as regards machining and plain assembling operations, the time required to perform operations cannot readily be stated, but the series of illustrations here offered will give a fairly good idea of the work of women directly on aircraft construction. Special mention may perhaps be made of the use by women of the carpenters' jack plane for planing up struts, the truing up of tie-rods on planes and the finish-shaping of propellers. The illustrations are from photographs taken in factories in various districts of England and were courteously provided by the labor-supply department of the Ministry of Munitions.

Women in England now do all classes of rib work for every make of airplane. In the headpiece they are shown engaged—with a few men in this instance—working in a rib-making shop. Ribs are built in jigs. Women frequently operate machines in the woodworking machine shop for grooving the outer members of built-up ribs. They act as assistants in assembling planes, ailerons, fins and rudders, sometimes with no more than male supervision. In Fig. 2 is shown an assembling shop, the women being engaged on elevators and ailerons. They glue together the mahogany laminations for nacelles and construct all kinds of three-ply wood fittings, etc., such as ammunition racks, camera boxes and so on for the use of the pilot. They bind the main planes, Fig. 3, string-sew planes, Fig. 4, and in assembling planes and ribs, place all the metal fittings, assemble the tie-rods, etc. Here the woman's keen sense of touch is invaluable, as the work has to pass a rigid official inspection.

Such processes as the covering and varnishing of planes, Fig. 5, are of course always done by women, and any metal fittings that are added after the covering is complete are also put on by women. They paint the identification disks, as shown in the illustration, and in fact undertake all work on fabrics, as may be seen in the general view of an aircraft fabric workroom in Fig. 6. Women sew the fabrics together, operating double-needle sewing machines; they stretch canvas over the planes, tack it into position, edge-sew, string-sew through the body of the plane, etc. Further, women undertake general inspection both for the firm of manufacturers and also for the Government. Thus, Fig. 7 shows women engaged in plane inspection, and in Fig. 8 women are shown acting as "mates" (assistants) to joiners in building up floats for the sea planes.

TIME FOR VARIOUS JOBS

On the occasion of an exhibition of women's work in Leeds the time necessary with male supervision in each case for assembling only was given by the manufacturers concerned. The figures included tail plane, inner rib, 30 min.; intermediate rib, 15 min.; inner rib, center web, 20 min.; outer end rib, 50 min.; fuselage rear-body strut tie, 1 hour; main-plane inner wing, tip rib, ½ hour; wing flap, tip rib, 55 min.; inner rib, center web, 10 min.; assemble inner rib, 55 min.; elevator,



2, Women Assembling Elevators and Ailerons

3, Women binding Main Planes

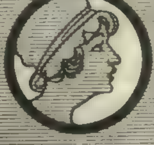
4, Women String-Sewing Planes

5, General View of Varnish Room in Aircraft Factory

6, General View of Aircraft Fabric Workroom

7, Women engaged on Aircraft Plane Inspection

8, Women acting as Mates to Joiners making Airplane Floats



9, Women boring and drilling Holes in Aircraft Propellers

10, Marking off Locking Clips for Exhaust Nuts

11, Filing Race Cage and Brackets for Control

12, Making Fittings

13, Fixing Elastic Shock Absorbers to Tail Skid.

14, Welding Metal Sockets for Airplanes

15, Oxyacetylene Welding Fittings for Aircraft

center web, 15 min.; intermediate rib, 45 min.; and inner rib, 20 min.

In Fig. 9 will be seen a woman engaged in drilling the hole in the hub of a propeller. Women operate thicknessing and planing machines, either rough-thicknessing boards for hand finishing or thicknessing and planing boards ready for block gluing for propellers. They set out from templets or drawings the pencil lines for band-sawing, and they also do the band-sawing itself. They operate the halving machines for four-bladed propellers. They bore and drill the hubs of glued-up blocks. They undertake all the doweling necessary. They operate wood-shaping machinery after it is set up by men, and they rough and finish with the spokeshave between guide grooves, sandpapering and finishing, and when necessary sharpen the spokeshaves on oilstones. All operations in French polishing and painting are undertaken under male supervision. They do such work as tipping, etc. Further, they complete all operations of fabric wrapping; they solder edge-seams after brass sleeve tips have been fitted by skilled men; they insert rivets and screws, spot-solder the heads, rasp and rub down with emery blocks and final-finish with emery cloth and polish. Transfers of the name of the maker, etc., are also added by women.

No detail reference is made here to the machining operations undertaken by women. They do much of the minor fitting and also of laying out, girls being trained for bench fitting of airplane parts both at special centers and at the factories themselves, where they pass two or three weeks before being sent into the shops. They machine fittings in turret lathes, automatic screw machines and also in engine lathes, in some instances setting up for themselves. They lay out, as shown in Fig. 10, such details as locking clips for exhaust nuts, using surface gages and all the ordinary machinists' small tools and methods. About one in six seems to be the usual proportion of women who without much training can read ordinary drawings for this purpose.

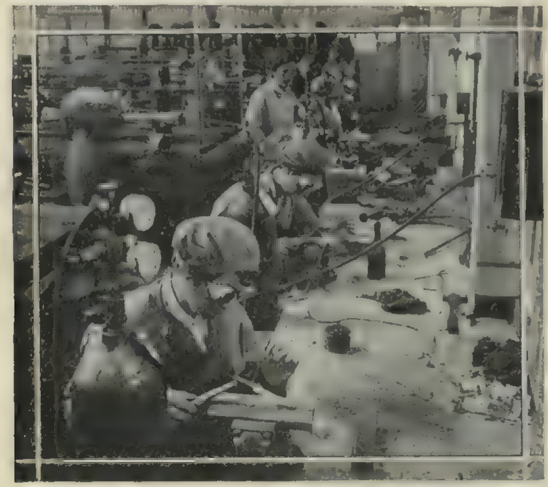


FIG. 16. WOMEN WELDING AIRCRAFT PARTS

In Fig. 11 women are shown engaged at the bench, making control brackets, etc., and in Fig. 12 they are seen adjusting packing blocks and form-filing, bending, gaging by micrometer, etc., for control cable clips. In Fig. 13 women are shown fixing elastic shock absorbers on tail skids; in fact, all partial assemblies of rear skids are completed by women. In the course of their fitting work they thread the ends of tie-rods and assemble the fork ends, putting on the thread by machine or by hand with stocks and dies. They also swage wires in rolling machines for airplane construction, operate presses, both hand and power, etc.

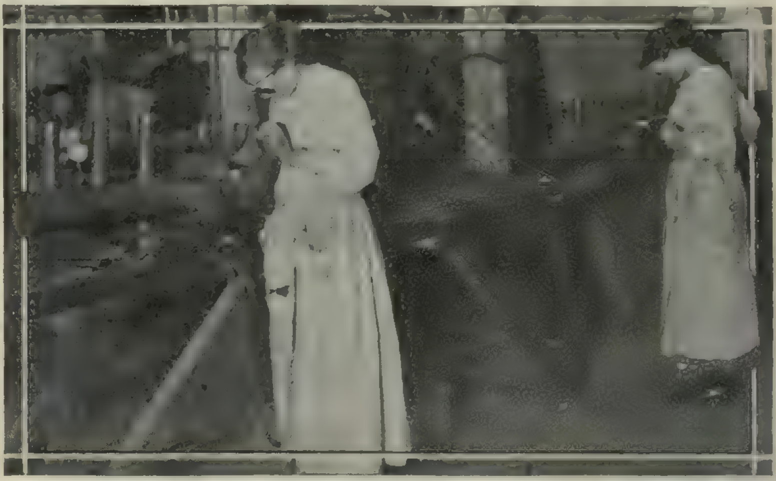


FIG. 17. WELDING EXHAUST MANIFOLDS FOR ENGINES

Much coppersmithing, tinsmithing and similar work is undertaken by them. They braze nipples and cocks into pipes. They test pressure gages and tanks; they draw copper tubing; they cut sheet metal with shears, and they do every kind of welding for aircraft, in many cases without male help, while in some instances only one man is retained for the heavier work. Oxyacetylene welding, including aluminum and electric welding, is of course undertaken, and Figs. 14 to 17 give a series of views of women engaged in this kind of work. In Fig. 14, for example, they are shown welding metal sockets; in Figs. 15 and 16 oxyacetylene welding is being done on other parts, and finally Fig. 17 shows women welding exhaust manifolds for airplane engines. About three weeks of training is needed for such work as oxyacetylene welding the pipes used on silencers.

The operations undertaken on metal parts of aircraft thus include laying out, filing, drilling, welding, brazing, tinning, blanking, bending, riveting, threading, tapping, turning, fitting bolts and nuts, assembling, sandblasting, painting and enameling.

Thin, Loose Collar Parts a Shaft

By Herbert S. Davis

We use a Root positive blast blower to supply air for our furnaces. In overhauling the blower a thin steel collar was placed on the shaft of one of the blades to take up the side play, but it was not fastened or made a tight fit on the shaft.

As the blower is somewhat noisy, it is in the cellar, where it is least heard and seen, but is oiled regularly. The ashes and dust in the cellar are naturally attracted to the blower, and the consequence was that the thin steel collar, along with the ashes and oil, gradually cut the shaft off about the same as steel blades, sand and water cut stone into slabs.

A Study of Velocity Diagrams for Shapers and Slotters—I

By A. LEWIS JENKINS
Assistant Professor of Mechanical Engineering, University of Cincinnati

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SYNOPSIS — *An analysis of particular applications and modifications of the "four-bar chain" mechanism. What is stated not only applies to shaper and slotter crank motions, but is useful also to machine designers who have occasion to use modifications of this common quick-return motion.*

QUICK-RETURN mechanisms are used on shapers and slotters to increase the speed of the ram during the return stroke and thereby decrease the time required per each cutting stroke. The speed of a ram driven by a quick-return link motion is not constant throughout either stroke, as in the case of a planer table. It is obvious that the velocity of the ram is zero at the ends of the strokes and cannot be made to attain a velocity of 20 to 60 ft. per min. within a travel of a fraction of an inch without requiring a large force to produce the necessary acceleration, but it should acquire a suitable cutting speed at a short distance from the beginning of the cutting stroke and maintain this speed until the end of the stroke is almost reached.

Many shaper and slotter mechanisms do not give even approximately constant speed throughout an appreciable portion of the stroke, whereas others satisfy the practical requirements for the velocity of the ram or cutting speed throughout the stroke about as accurately as such requirements may be specified. Some consider it desirable to have the tool running at full speed when it enters and when it leaves the cut, and others prefer the tool to enter and leave the cut at a slower speed than is attained at the middle of the stroke.

The rate of change of velocity, or acceleration, at different points in the stroke not only affects the action of the tool on the work, but produces inertia forces throughout the mechanism which may be greater than the forces caused by the pressure of the chip on the tool.

FORCES ON GEARS AND BEARINGS

The analyses of some shaper mechanisms show that pressure on the gears and bearings due to the force required to produce the necessary acceleration at the beginning of the return stroke is greater than the forces resulting from the pressure of an average chip against the tool during the cutting stroke.

The number of strokes per minute may be easily determined for a given revolutions per minute of the driving pulley for a shaper or slotter mechanism in much the same way as the spindle speeds of a lathe or other machine tool are determined; but only a velocity diagram will show the variations in velocity throughout the stroke. A velocity diagram is a curve, the ordinates of which represent the velocity of the ram or the tool. The abscissas may represent equal distance or spaces passed through by the ram, in which case the diagram is known as having an "equal displacement base"; or the equally spaced abscissas may represent equal intervals of time, in which case the diagram is said to have an "equal time base." The ovoidal curve, which will appear in Fig. 10, is the velocity diagram on a displacement base for that mechanism. The abscissas are measured along the center line or path of the point R and represent the actual positions of the ram. The velocity of the ram, or point R, may be found for any position of the ram by drawing a vertical line through R and measuring the ordinates of the curves for this point. The curve below the center line is for the return stroke. The ordinate GR represents the velocity of the point R in the position shown. Such curves may be drawn for any shaper or slotter mechanism, and it is the purpose of this discussion to explain the methods of procedure.

A velocity diagram may be used in drawing an acceleration diagram from which a force diagram may be drawn for a given speed and cut that will show the total force required to produce the acceleration and also drive the tool at any point in the cutting stroke—and also the force required to produce the necessary acceleration at any point in the return stroke. There are several methods used in laying out velocity diagrams for quick-return mechanisms. For drawing a complete velocity diagram the method based on the principle of "instantaneous centers" is probably the best to use. If it is desired to find the velocity for only a few positions, the "velocity-ratio diagram" is the most convenient to use.

SPECIAL MODIFICATIONS OF THE FOUR-BAR CHAIN FOR SHAPER MECHANISMS

Any mechanism consists of one or a combination of two or more modifications of the four-bar chain, and those used in the construction of shaper and slotter mechanisms are herewith described.

The simple mechanism consisting of four links with P_1 P_2 fixed, as shown in Fig. 1, is generally used as an example of an elementary mechanism. The link AP_1 turns about P_1; BP_2 turns about P_2, and the coupler AB may be considered as a means of merely keeping A and B the same distance apart for all positions of A or B.

It is seen in Fig. 2 that if the link P_2B were made to extend around A and provided with a circular slot having its center at B, and radius equal to BA, the points B and A would always be the same distance apart and the kinematical relations, such as the ratio of the angular velocities of AP_1 and BP_2 about P_1 and P_2, would be the same as in Fig. 1.

Fig. 3 shows that if a straight instead of a curved slot were used in Fig. 2 the effect on the motion would be equivalent to making the link AB infinite in length, as far as the ratio of the angular velocities of AP_1 and BP_2 is concerned. The slot may be in any position with respect to P_2, and in the case of the slotted bar used in shaper mechanisms the center line of the slot usually passes through P_2, as in Fig. 4. Hence, the mechanism shown in Fig. 4 is a special modification of Fig. 1, in which the slider has been substituted for a coupler of infinite length.

The mechanism shown in Fig. 5 is also a special modification of the four-bar chain shown in Fig. 1, in which a slider has been substituted for the link P_2B, Fig. 1. Since the path of the point B, Fig. 5, is a straight line, the point P_2, around which B rotates, must be at infinity. Although it is impossible to construct P_2B equal to infinity, the same motion of the links AB and P_1A with respect to the fixed link P_1P_2 is obtained by the substitution of the slider. Hence, so far as the motions of the parts are concerned, the slider-crank or crank and connecting-rod mechanism is merely a special case of the four-bar chain shown in Fig. 1, in which the length of one of the links, P_2B, is made equal to infinity.

In Fig. 6 the influence of the straight slot in which the pin A both rolls and slides is equivalent to making AB equal to infinity. The slider, being constrained to move between the straight guides, is equivalent to making P_2B equal to infinity. Hence, this mechanism is a modification of the one shown in Fig. 1, in which both P_2 and B are at infinity. Each point in the slotted bar shown in Fig. 6, has the same motions as a point that would coincide with the center of the pin A on the crank P_1A.

In Fig. 7 both P_1 and P_2 are at infinity. It is easily seen from the sketch that the cylinder or pin at B moving between the guides gives the same motion or has the same effect as a slider or crosshead like that shown at A. These devices may be interchanged on any mechanism without in any way modifying its kinematical relations.

In Fig. 8 the introduction of the slider B is equivalent to having P_2 at infinity, as in Fig. 5. The curved slot, Fig. 8, having its center at A and radius equal to AP_1 maintains a constant distance between the points A and P_1 at all times. For any position of B the point A lies on the circle described around P_1 as a center with a radius equal to P_1A. This is very similar to the mechanism shown in Fig. 5.

In Fig. 9 the slot is straight, and if produced, its center line would pass through the point B in the slider. In this case both P_2 and A are at infinity.

Shaper mechanisms consist of a combination of two or more modifications of the four-bar chain. The first of these may be the modification shown in Fig. 4, in which the crank P_1A is connected to the bull wheel and causes the slotted bar to oscillate about the center P_2, as P_1AP_2 in Fig. 10; and the second modification may

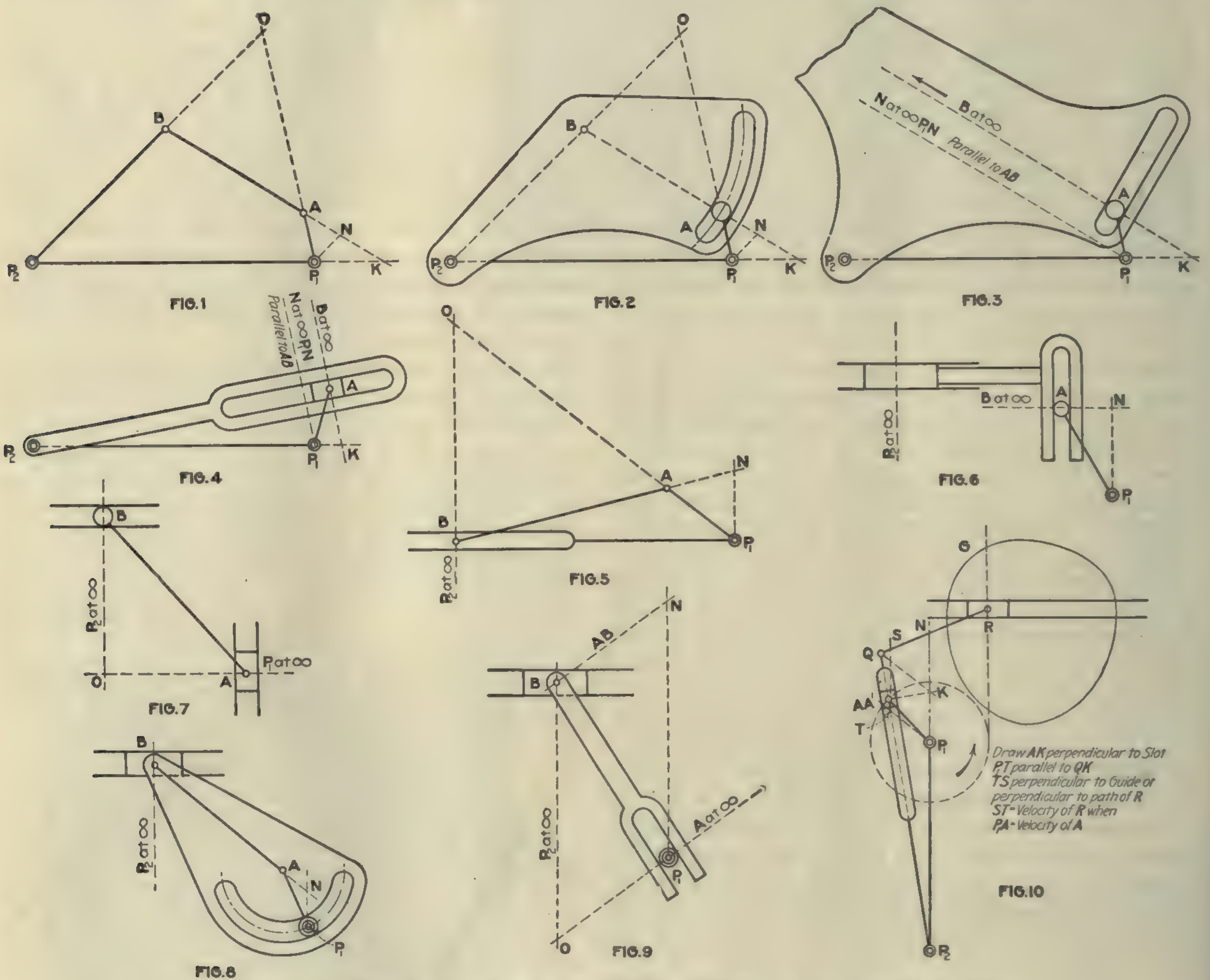


FIG.1 FIG.2 FIG.3 FIG.4 FIG.5 FIG.6 FIG.7 FIG.8 FIG.9 FIG.10

FIGS. 1 TO 10. THE FOUR-BAR CHAIN AND A NUMBER OF ITS MODIFICATIONS be the one shown in Fig. 5, in which the slotted bar P_2Q, in Fig. 10, becomes the crank P_1A; the ram of the shaper takes the place of the slider, and the connecting rod is QR, Fig. 10 instead of AB, Fig. 5.

The motion of the slotted bar may be transmitted to the ram by substituting the ram of the shaper or slotter for the slider B, and the slotted bar for P_1A in Fig. 5; P_1A in Fig. 6; AB in Fig. 7 and the slotted bar in Fig. 9. It is also seen that two sliders or two cylinders or any combination of the two may be used as in Fig. 7. Hence, the pin Q, used in Fig. 24, effects the same motion as the vertically sliding block shown in Fig. 22. In Fig. 16 a large pin fastened to the slotted bar and moving in the slot would have the same effect as the crosshead C.

Although these nine mechanisms are quite different in appearance, application and results, they are fundamentally the same; and any general geometrical relation that is applicable to Fig. 1 is also true for the other eight.

INSTANTANEOUS-CENTER METHOD

The principle of instantaneous, or virtual, centers may be used in proving the two theorems used in finding the velocity of the ram of a shaper or slotter. The proof of these theorems may be found in most any textbook on mechanism, but their special applications to crank and slotted bar and the modifications of the slider-crank mechanisms as used on shapers and slotters are not always pointed out.

In Fig. 1 the link AB rotates instantaneously about the point O, which is called the instantaneous center, and hence,

$$\frac{\textit{Linear velocity of } A}{\textit{Linear velocity of } B} = \frac{Va}{Vb} = \frac{OA}{OB} = \frac{P_1A}{P_1N}$$

where P_1N is drawn parallel to P_2BO; Va equals linear velocity of A about P_1, and Vb equals linear velocity of B about P_2. The theorem for the ratio of the linear velocities of A and B is to the effect that if P_1A represents the linear velocity of A about P_1, then P_1N drawn parallel to P_2B represents to the same scale the linear velocity of B about P_2. In Figs. 3 and 4, B is at infinity; P_1N is parallel to AB or perpendicular to the slot and equal to infinity. Hence, $\frac{Va}{Vb} = \frac{P_1A}{\infty} = 0$.

In Fig. 5, where $P_2B = \infty$, the line P_1N is drawn perpendicular to the slot, or perpendicular to the motion of B.

Although the point B in Fig. 6 is at infinity, every point in the slotted bar has the same motion as B; and if the slotted bar is the ram of a shaper and the P_1A the oscillating bar or pendulum, then $\frac{Va}{Vb} = \frac{P_1A}{P_1N}$.

In Fig. 7 the points P_1, P_2 and N are at infinity, and the ratio $\frac{P_1N}{P_1A}$ is indeterminate; but the value of $\frac{Va}{Vb} = \frac{OA}{OB}$ and may be found.

The ratio of the linear velocities of A and B in Fig. 8 is obtained in the same way as for Fig. 5. In Fig. 9, P_2 and A are at infinity and the ratio $\frac{Va}{Vb} = \frac{\infty}{P_1N} = \infty = \frac{1}{0}$.

The second theorem concerns the ratio of the angular velocities of P_1A and P_2B and may be stated as follows: "The angular velocity ratio in link work is inversely proportional to the segments into which the coupler divides the line of centers." In Fig. 1 the coupler AB is produced to cut the line of centers at K and divides the line of centers, externally, into the segments P_1K and P_2K. This theorem means that

$$\frac{Wa}{Wb} = \frac{\textit{angular velocity of } A \textit{ about } P_1}{\textit{angular velocity of } B \textit{ about } P_2} = \frac{P_2K}{P_1K}$$

In Figs. 2, 3 and 4 the line AK, or imaginary center line of the coupler is perpendicular to the slot. Hence, in Fig. 4 the point K is found by drawing a line through A perpendicular to the slot, and $\frac{Wa}{Wb} = \frac{P_2K}{P_1K}$.

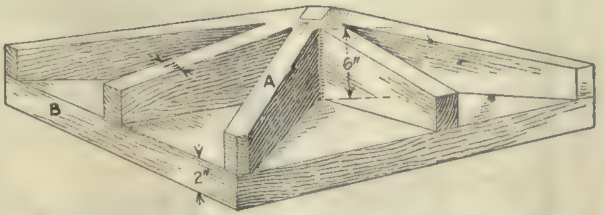
Pattern Dimensions and Lumber Sizes

By M. E. Duggan

Three castings were wanted. For the production of these castings a pattern was required.

Notice the dimensions A and B in the illustration. Rough lumber dimensions carried in stock for patternmakers' uses are 1, 1¼, 1½, 2 in. and up. Stock above 2 in. is seldom kept on hand in pattern shops. Two-inch rough stock, after surfacing two sides, measures 1⅞ in. or less.

Let us assume, for example, that the whole plate B is to be made to the dimensions called for on the drawing. For the 2-in. dimension, boards must be glued together; 2-in. board surfaced two sides cannot be produced from a 2-in. rough plank.



PATTERN DIMENSIONS AND LUMBER SIZES

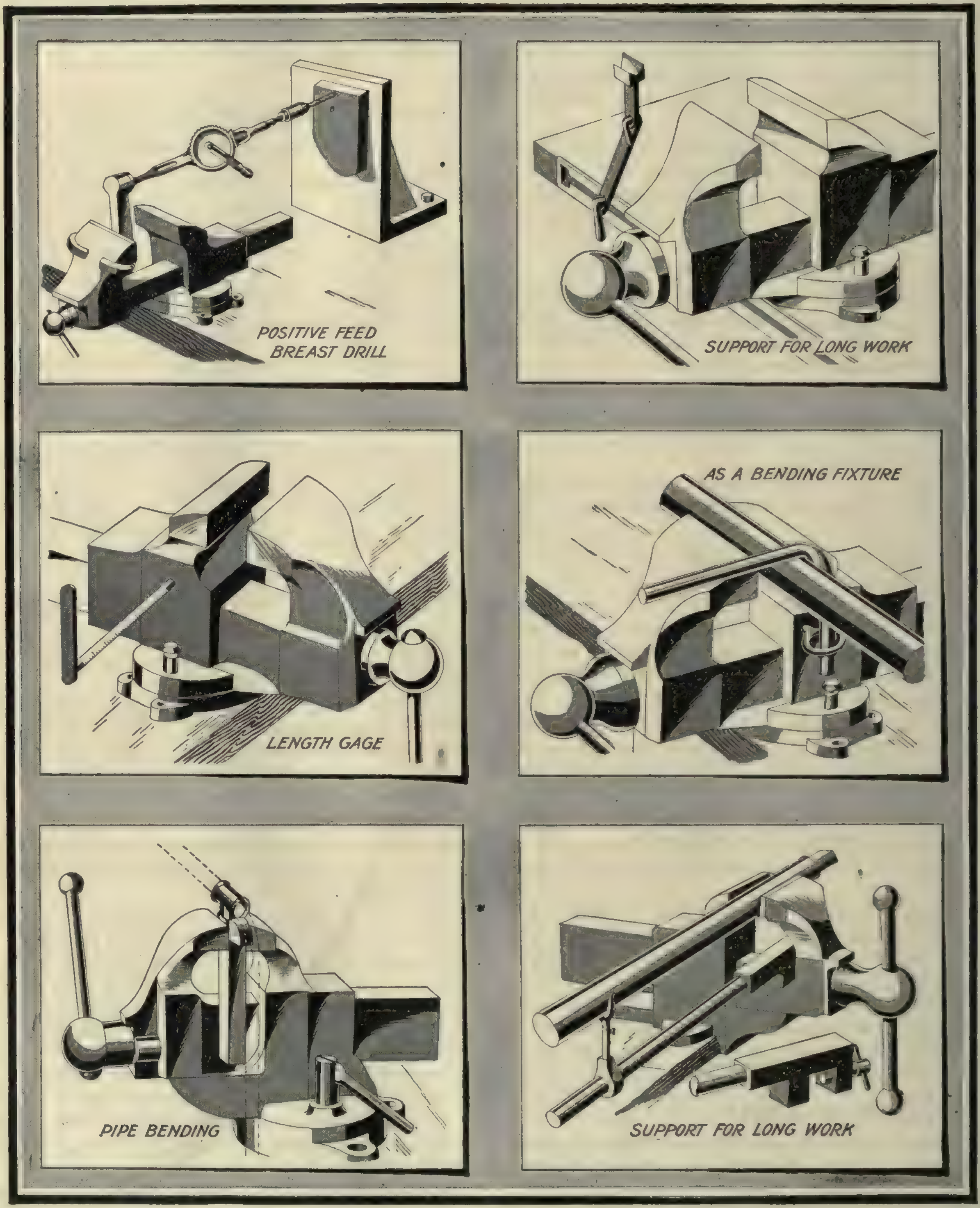
Making this plate out of two thicknesses of lumber—it makes no difference whether it is nailed or glued or slapped together—the preparation calls for extra material, labor and time that could be eliminated if the thickness dimension was slightly under 2 in. If the plate could be made out of 2-in. rough boards, the change would in no way affect the strength or the purpose of the casting and would be a big help to the patternmaker.

The use of stock lumber can be applied to the rib A, however, in a different way. No gluing of stock is necessary. The 1-in. rib can be made out of the 1¼- or 1½-in. boards, but why convert a ¼- or a ½-in. thickness of good, bone-dry and expensive pattern lumber into shavings when a ⅞-in. rib made from a 1-in. rough plank would be just as satisfactory? In fact, a ¾-in. rib, in a great many instances, would be strong enough for the purpose for which the casting is wanted.

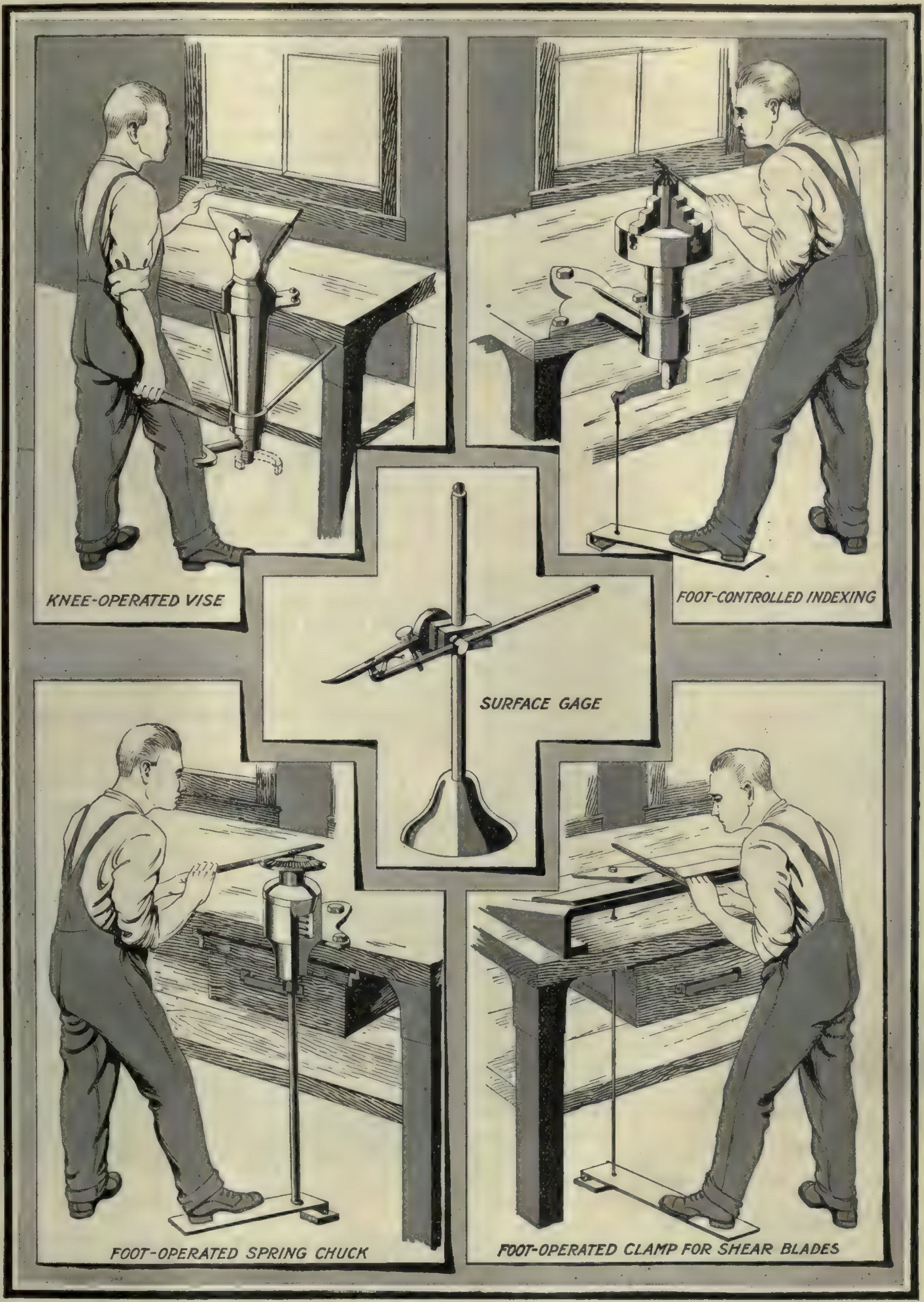
The draftsmen in a large shop where I was employed kept themselves posted on the lumber stock. The note "minus," following a dimension, appeared on a great many drawings, meaning, "dress the plank to that dimension as near as possible." In other words, for 2-in. minus, a 2-in. plank would be used. If draftsmen would put this plan into practice, they would greatly assist the patternmaker in his work.

From a Small-Shop Notebook

By J. A. LUCAS



A NUMBER OF HANDY VISE KINKS


KNEE-OPERATED VISE
FOOT-CONTROLLED INDEXING
SURFACE GAGE
FOOT-OPERATED SPRING CHUCK
FOOT-OPERATED CLAMP FOR SHEAR BLADES

HANDY WORK-BENCH DEVICES

From Jack to Bill—Breaking up a Spy Plot and Other Things

Readers may be amused to know that all the "damfoolishness" in these Jack-and-Bills is a transcript of actual occurrences. Some years ago I was running an inspection job, which included furnishing all the mathematical lore required in the shop. "Jack" ran the "sawmill," cutting up steel stock, and came to me every week to have the number of hours he had worked multiplied by 17 c., that the shop might not beat him out of any part of his "sallery."

He filled the heart of the "super" with pure and holy joy by announcing his desire to be considered in the line of promotion to my job. The superintendent set forth the necessary qualifications about as they are enumerated in the following, and was delighted by "Jack's" reply that he might be, perhaps, obliged to study up the "trig," but "the rest of it didn't jar him none."

The old hymn says "There is a land of pure delight," a description which, to my mind, applies well to the average machine shop, if one has the proper kind of eyes to behold the amusing features of life therein. The "limberga" bomb incident happened in a New England City, a few days ago, almost exactly as narrated.—The Author.

Deer Bill—Ive bin thinkin abowt beein a inspektur thay gits good salleris and dont hav no hevvy wurk. Wat wood you advize abowt me lurnin to bee one Bill, thay dont hav to taik no showr baths like wat the mecanniks does in that shop in Misshergun you no ware a man tels me thay has sqirls to pik up dropd nuts do you bleev it Bill. Showr baths and sqirls dont look good to me but 5$ dolers a day does so wat wood you doo.

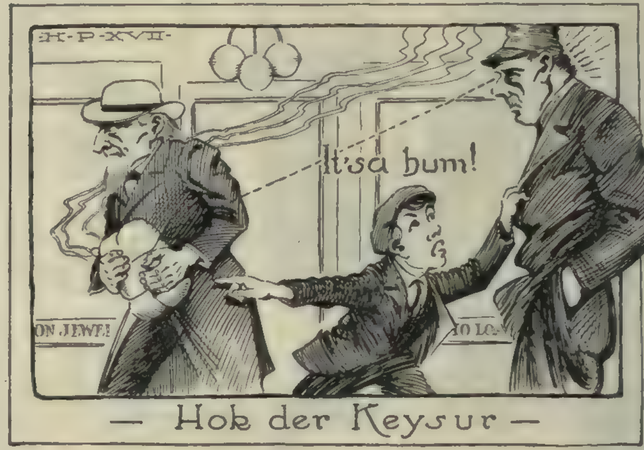
I ast the hed inspektur hear he gits sevn and a ½ a day & he tels me all I nead is yeers of experuns in the traid and Ive had that and to bee abetr wurkman than enny one els in the plaice & that dont scair me none and to no evry dimenshun and evry alouans on evry bluprnt and moar triggernometri than wat old Mr. Trig dun wen he gut it up & then the foremen are on your bak all the time for junkin so mutch wurk & the guvmunt inspekturs for nut junkin moar. Thairs anuther kine of inspektur he sez wat dont hav to no nuthin but just tri parts in gaijes all day but that kine dont git no good pay so I dont no but wat Ile go to Misshergun & run the resk of the baths.

Woodent you feal pleesd Bill to see me warein a Carrneggy heero medl not coper-lookin like that wat you win at the plumers yunions piknik for beetin in the py eetin raice but reel goald.

Ile tel you abowt it Bill wen I was cumin hoam from wurk I see boys chaisin a duch lookin guy and thay yeld that he sed hok der Keysur but thats no sents for no hokshop wood look at a Keysur no not if he was eevn a booldogg. Then thay yels hes gut a bum. Furst I thort thay sed bun for he lookd thataway but thay ment the kine of bum wat blose peepl all to bitts & I seen he had it rapd in payper. So a kid tripd him and I kikd his hed no not the kids you no Bill but the duchys and a copp caim and pinchd him and a reepoarter gink tels me Ime a heero & Carneggy shoold giv me a goald medl for savein my country from distrucshn and I toald him if he roat in his payper to say Ime a skild mecannik & he prommisd too.

So Ile send you the payper and by a lot of em for to send my uther frends. JACK.

PS—Bill I aint sendin no payper for that reepoarter gink was a feend in hueman form and the payper tels that the bum was a bundle of limberga the duchy wat was reely a Jermun was taikin hoam and pretzuls and the reepoarter geezr sez I kikd a man wat was down & clamed I ort to hav a heero medl for my currij and he cant rite inglish & I bleev hes a foren spi for he cawld me a *mechanic* witch looks to me like it was foren tawk for mecannik wat do you think Bill had nt I ort to tel the pleece abowt that reepoarter or woodent it do enny good.

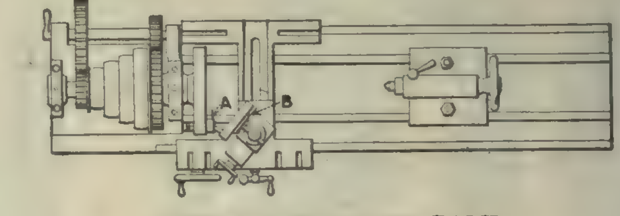


Cutting Large Radii on a Lathe

By H. L. Turner

The method described for cutting a large radius on a miller, page 577, Vol. 46, reminds me of one I used for cutting large radii on a lathe.

To machine a number of pipe flanges so that they would fit with reasonable closeness around the outside of some steel tanks about 5 ft. in diameter, a cutting tool was mounted on the faceplate, as shown at *A* in the illustration, and the flanges were held by screwing them onto the piece *B*, made for the purpose and held in the toolpost. The amount the compound rest was turned to give the correct radius was found by trial.

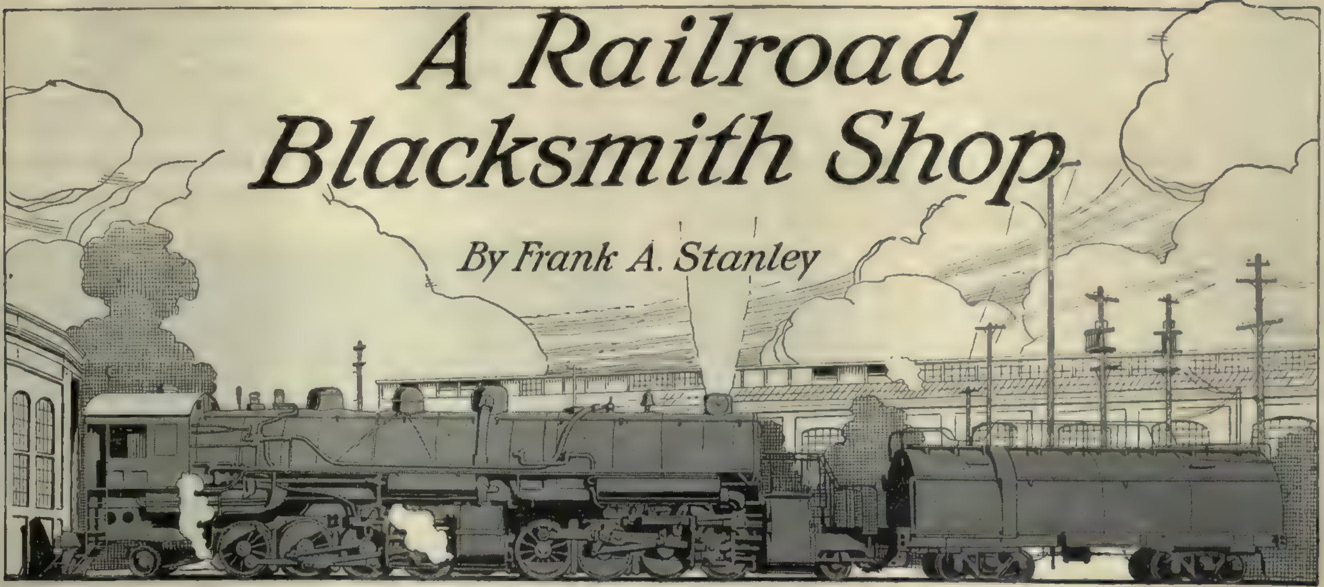


LATHE RIG FOR LARGE RADII

The axis of the work should be at the same height as the lathe centers and in a plane parallel to the travel of the cross-slide. The work was fed past the cutting tool by hand, by means of the compound rest.

A Railroad Blacksmith Shop

By Frank A. Stanley



SYNOPSIS—*Ingenious steam and water curtains to prevent the heat issuing from the mouths of oil-fired forges are described. Tool racks of admirable design and a home-made forging machine or bender are also shown.*

It IS seldom one has the privilege of visiting a better-organized or more neatly conducted forge shop than that in the Southern Pacific repair plant at Sparks, Nev. The clean, exhilarating atmosphere and the clear sunlight peculiar to this section of the West are naturally important factors in the satisfactory operation of an industrial plant. These features, coupled with the personal characteristics of executives and workmen, have made possible at Sparks the maintenance of a blacksmith department along lines that might well be followed in many larger establishments doing a manfacturing business.

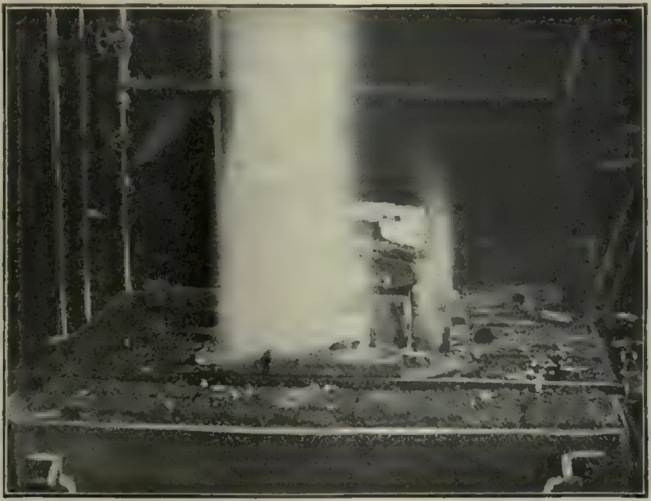


FIG. 2. STATIONARY FORGE FITTED WITH COOLING STEAM JETS

The variety of work handled in this shop and the methods of accomplishing results in forging, forming, welding, etc., are in themselves of sufficient interest to justify several articles. Descriptions of special operations will appear later in these columns. It is the purpose of the present article to deal more specifically with certain unusual features in the equipment itself.

Both oil and coal fires are used in the shop, and in connection with the oil-fired forges and furnaces, several of which are located along the shop wall, some noteworthy cooling apparatus has been developed and installed. The operation of this equipment has thereby been made most effective and satisfactory by reducing to a negligible quantity the volume of heat that would otherwise issue from the mouth of the forge to the discomfort and disadvantage of the workman.

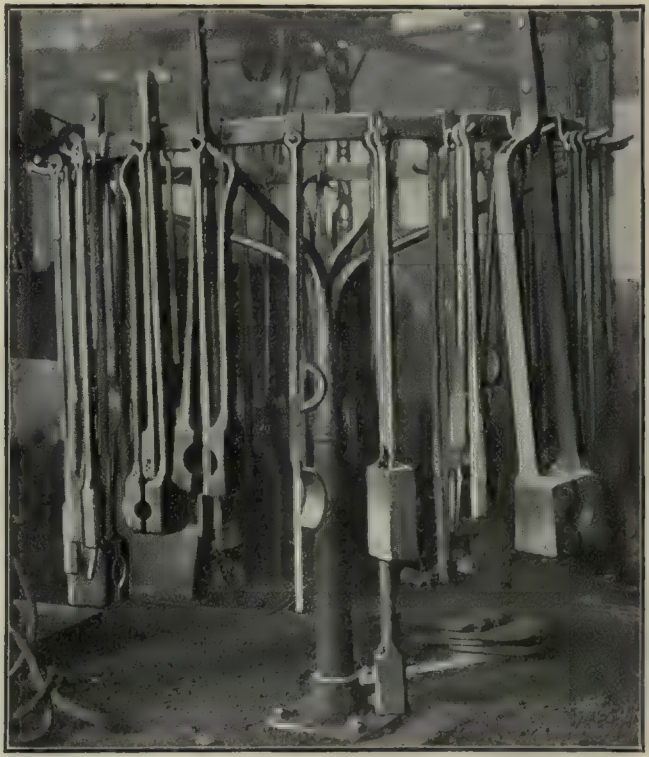


FIG. 3. CIRCULAR RACK FOR HEAVY BLACKSMITH TOOLS

Fig. 1 illustrates clearly this cooling system as applied to an oil-fired heating forge or furnace. The piping for oil fuel and for the air supply, with the controlling valves, is shown at the left side of the casing. The cooling apparatus for preventing the discharge of hot gases directly outward from the furnace mouth consists of two elements: One, a series of minute steam jets discharging vertically from a point directly in front of the flame to carry the gases upward; the other, a baffle-plate in front of the vertical heat zone thus formed. This plate is made to serve as a most effective cooling shield through the medium of a row of water jets that, flowing downward from the top of the baffle-plate, provides a continuous film over the entire outer face of the sheet metal.

The pipe from which the small steam jets play upward is shown in horizontal position immediately in front of the mouth of the furnace. The water pipe passes upward at the front; and the horizontal length extending across to the right, which is drilled with small holes to allow the water jets to discharge downward, also serves as a support for the upper end of the sheet-steel baffle-plate. The lower edge of this plate rests in a V-shaped channel that slopes slightly to the left and discharges the water into the funnel-shaped mouth of the vertical waste pipe.

The camera has registered accurately the visual effect produced by the combined action of the upshooting steam jets and the confining baffle-plate. The actual results so far as concerns the practical elimination of heat at the front of the apparatus can be appreciated only by personal observation and test. It is of interest to be able to state in this connection that the bare hand may be held on the face of the metal plate for an indefinite period without other sensation than that of a mild degree of warmth.

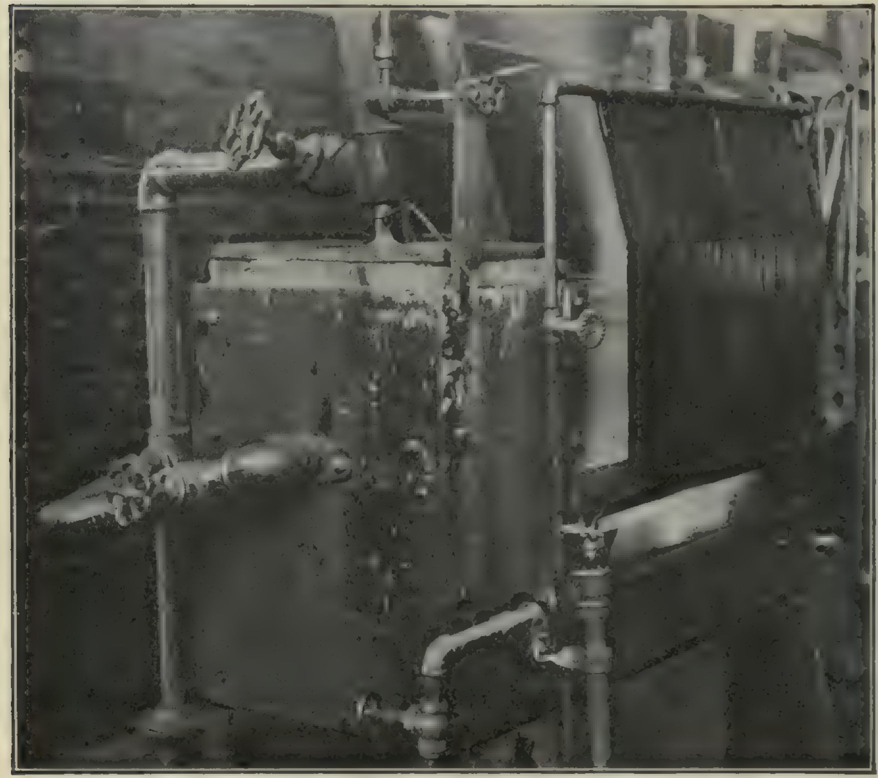


FIG. 1. OIL FURNACE WITH SPECIAL APPARATUS FOR COOLING

The forge, in Fig. 2, is an open brick-chambered blacksmith fire operated by oil fuel and provided with a steam-jet system for diverting the flame upward, thus securing the same advantages as described in connection with the apparatus illustrated in Fig. 1. The application of the water-cooled baffle-plate is impracticable in this case, and in any event is not required owing to the location of the heating chamber in respect to the working edge of the forge.

The steam pipe lies across the forge just in front of the mouth of the fuel chamber, and the action of the series of fine jets in carrying the flame and gases directly upward is illustrated with remarkable clearness in the illustration, Fig. 2.

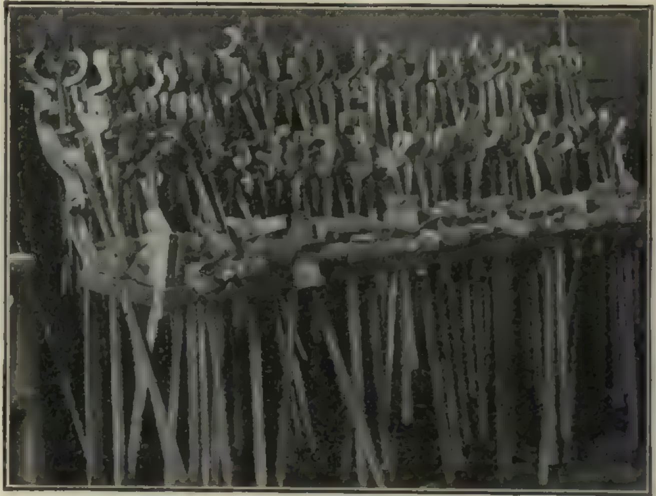


FIG. 4. RACK FOR TONGS AND SMALL TOOLS

Taking proper care of miscellaneous tools about a blacksmith shop is an undertaking with difficulties of its own, and only too frequently little attempt is made to solve the problem at all. Tongs, chisels, swages, dies and the like are apt to be thrown in a heap when out of use; like all tools improperly stored, they are difficult to locate when wanted, and when found are in anything but first-class condition. In contrast to this fairly common state of affairs, it is a pleasure to illustrate the systematic manner in which such tools are taken care of in the shop forming the subject of this article. Two views, Figs. 3 and 4, represent two types of racks that permit blacksmith tools of all kinds to be kept in good order, so as to be easily located when needed and readily removed for use and replaced when their work is completed. The first of these racks is for heavy tools and is located behind the big power hammer, as indicated. It is circular in form, consisting of a steel ring some 6 ft. in diameter supported upon a series of arms branched out from the standard, which is mounted in a square flange at the base. The supporting hooks for the tools are U-shaped and double ended. When placed over the ring that forms the top of the rack, one end projects and the other out, thus enabling tools to be hung up inside the ring as well as outside.

The rack in Fig. 4 is also of metal and is for three banks of tools, which are separated sufficiently from one bank to the next to allow any given tool to be selected easily. In form, the rack is a rectangular frame supported at the rear by standards that slope backward toward the wall and carry two additional horizontal bars for holding tongs and similar appliances.

A special device for various bending and forming operations is the home-made machine shown by Fig. 5.

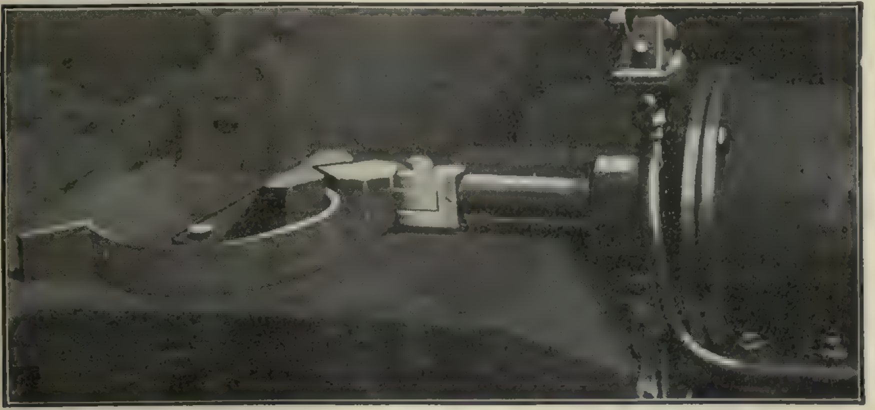


FIG. 5. HOME-MADE FORMING AND BENDING MACHINE

It is used for light and medium work. The ram is operated by an air piston the controlling valve for which is located at the front of the cylinder. The end of the ram is fitted with a slotted head that carries a former of the required shape to suit the work in hand, and the opposing die or anvil is of course made to conform to the bend or angle desired. The cylinder is part of an old air-brake equipment and has a stroke long enough to answer for a wide variety of parts requiring forming up in this manner. In worn-out axles the smith shop always has a source of supply for material for certain classes of forgings desired for one purpose or another. Fig. 6 shows the working up of an axle into a rectangular section for a bar or strap, an operation accomplished under the steam hammer with very little trouble. The long-handled gage seen on the edge on the anvil is held horizontally by a man at the right of the hammer to regulate accurately the width of the bar as forged edgewise, or in the position shown; in working the forging to thickness, the gage head is tipped flatwise to establish the correct depth of the work from end to end.

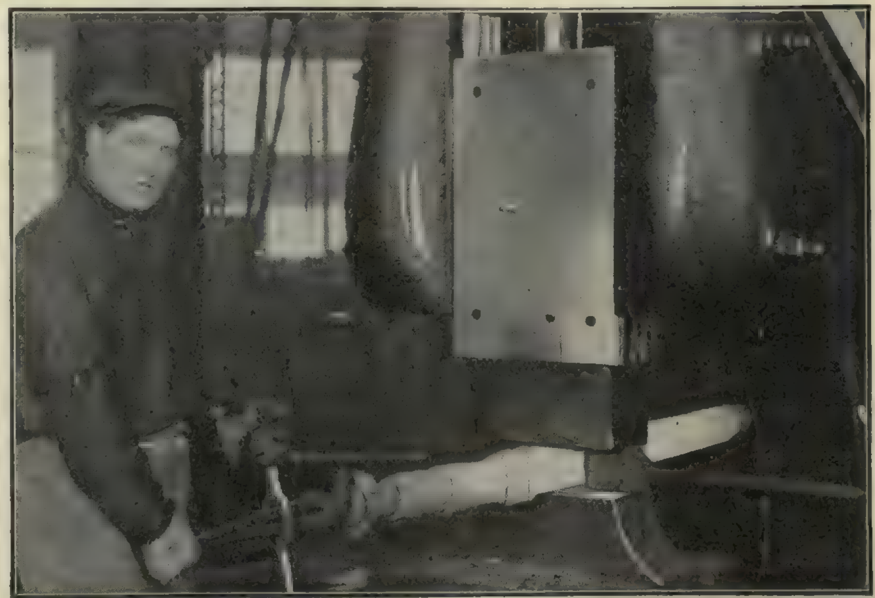


FIG. 6. MAKING A FLAT BAR OUT OF AN OLD AXLE

Machine-Tool Building in Holland

By H. J. J. Esmeyer

It was with much interest that I read the article, "Is America Going To Lose a Good Market?" page 254, Vol. 46, of the *American Machinist*, by Jan Spaander. No doubt it may interest American machine-tool builders and other readers of this journal to know something more regarding the possible development of the manufacture of machine tools in Holland. Being closely connected with the Berkels Patent Co., Rotterdam, manufacturing an 18-in. American type double back-geared quick-change engine lathe, I believe I am in a position to furnish some interesting information.

In the first place I would remark that manufacturing machine tools in Holland will probably lead to an extension of the American machine-tool sale, as no doubt the imports of American machine tools will grow larger as Holland becomes a more industrial country. I am inclined to believe that the machine-tool imports into England, Germany, Sweden, Belgium and other countries have not been reduced by the fact that these countries are manufacturing many machine tools for their own use. Many of the smaller countries, such as Belgium, Switzerland and Denmark have had machine-tool works for many years, and still these countries import large quantities of American machines. No doubt the high figures at which American machine tools are sold have been the direct cause of the manufacture of machine tools in Holland being undertaken. Having once started, I believe the pioneers will not drop their efforts, even if in the first few years no big profits can be made. Several factories in Holland have started to build their own machines. I know of one Amsterdam concern which manufactured something like 36 engine lathes. Some smaller firms at Dordrecht, Stadskanaal, Tegelen and other places make their own gap-bed lathes; others make presses, sensitive drills, etc. A firm in Arnhem makes small shapers and milling machines. But few companies, I believe, will continue machine-tool building when the war is over: The Berkels Patent Co., of Rotterdam, which is building lathes; the Eerste Nederl. Kogellager & Schroevenfabriek, Voorburg, making small turret lathes; the Holland Machine Co., the Hague, which makes gap-bed lathes; the Rotterdam Iron and Metal Foundry, making board drop hammers, drilling machines, gear hobbers, etc.

Going into the question of building machine tools in Holland, I believe two points are to be considered: First, will the Dutch manufacturer be in a position to build a machine tool that can compare favorably with those supplied by the foreign market; second, how will cost price compare? Answering these questions will be a reply to the article referred to above:

Although Holland, as Mr. Spaander says, does not boast of any natural (steel or mining) resources, our castings are cheaper than in America. Before the war, good-quality castings were supplied by Dutch foundries at $5 to $6 per ton. Pig iron is imported from England, Germany, Sweden, etc. Our rolled steel comes chiefly from Germany and Sweden, whereas bright drawn stuff is supplied from Germany and England. This rolled stock is purchased at figures far lower than those prevailing in America, and can be obtained to fulfill the desired specifications. So we can use, for example, a high-grade carbon steel or chrome-nickel steel for the spindles and other materials to suit each special purpose.

As regards the cost price of rough materials, I believe that this will certainly not be higher in this country than in America.

WHERE AMERICA HAS THE ADVANTAGE

There is, however, one great point in which we compare unfavorably with America, and that is in the machining of the various parts and making the machines with such accuracy and with such a stiffness as is found in American tools.

Therefore our company started by purchasing high-class machine tools, such as Gray planers, Pratt & Whitney grinders, Milwaukee milling machines, Eberhardt shapers, Eberhardt gear hobbers, Fellows gear shapers, Bilgram bevel-gear planers, thread-milling machines, Gisholt turret lathes, Norton and Landis grinders, and a number of special machines were built to suit various operations.

Moreover, the American system was adopted, using special gages, jigs and fixtures designed to suit all purposes, also using the Periodograph time-register system supplied by the Gisholt Machine Co., which system works to great satisfaction.

WITH AMERICAN MACHINE TOOLS AMERICAN TIMES MAY BE EQUALLED

Using the best American machine tools, we believe we will, after sufficient experience and training of our workmen, be able to reach the American producing times, although we do not expect to accomplish this within four or five years. Seeing, however, that the standard of living is so much lower in Holland than in America, the Dutch workmen would be able to work only two-thirds speed unless higher wages are paid. Besides, there is the question of freight, which, undoubtedly, even after the war, will remain an element not to be neglected.

To give some idea of the results obtained in one year, following examples are quoted: About a year ago the time required for aligning spindles with shears, tailstock with head, spindle with cross slide, etc., was 48 hours; this time has been reduced to 2 or 3 hours. The limit of error allowed in 1916 was 0.001 in. in 24 in.; this has been reduced to 0.0005 in. in 24 in. Planing an 8-ft. lathe bed used to take 190 hours; the time is now something like 34 hours, and moreover, the quality of the planing has been greatly improved by the use of a Gray planer. As the beds are very accurately planed, scraping has been considerably reduced, a true planed surface being superior to a scraped one.

It will be readily understood that in starting the manufacture of machine tools in the present abnormal times, we met with a lot of difficulties. We were obliged to make a complete set of snap gages, using the Swedish Johannson measuring blocks. A number of special reamers, milling cutters, etc., had to be made.

The 18-in. lathe now placed on the market by this company is an American machine, double back-geared, with quick change, but the company is now bringing out a new 24-in. machine, designed entirely on the American type but to suit the Dutch market, embodying special features that Dutch machinery works always found lacking in American machines. I really do not understand why American machine-tool builders never tried to suit the Dutch market in these respects.

The Berkels Patent Co. is closely connected with a modern foundry, the Rotterdam Iron and Metal Foundry; also it has its own screw works.

I am inclined to believe that a serious effort will extend machine-tool building in Holland, and I am sure this can be reached only by following the American system—specialization.

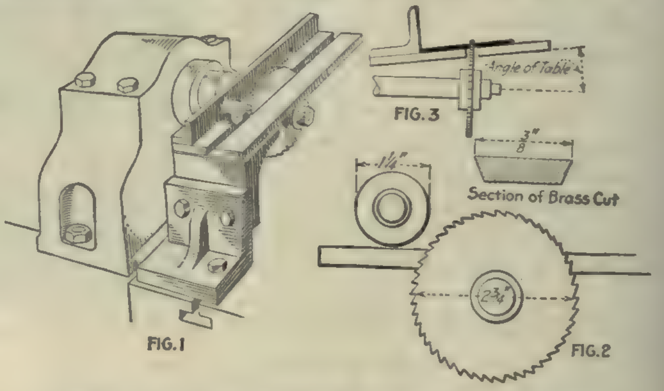
We are now turning out lathes at the rate of four per week, and we shall be able within a very short time to reach six lathes weekly without extending our works or erecting further machine tools.

The Berkels works have been building some special machines for the Dutch Arsenal Works, Hembrug, including a gun-barrel drilling machine and a rifling machine for gun tubes up to $4\frac{3}{4}$-in. bore.

Metal-Slitting Attachment

BY S. E. BARBER

A number of $\frac{1}{8}$-in. brass sheets had to be cut into narrow strips. Fig. 1 illustrates the simple lathe attachment that was made to handle the work. Fig. 2 is an end view and gives the relative positions of the slitting saw and the roller used to hold the strips down on the table. Fig. 3 shows how the table can be tilted to secure a bevel cut.



FIGS. 1 TO 3. METAL-SLITTING ATTACHMENT

The Panoramic Sight

By

W. L. Olmstead

V. Assembling Operations

SYNOPSIS—*A few of the machine and assembling operations of the body and elbow parts and the hand grinding operations on the gears are described in this article. Also, a brief outline of the inspection requirements is given.*

On THE azimuth-circle hood, Fig. 51, there are 13 operations, as follows: (1) Rough and finish bore the large inside diameters *A*. The inside thread is not cut in this operation. (2) Finish top surface. Finish hole to 2.403 in. (3) Bore, ream and face azimuth-worm holes *B*. (4) Bore, ream and tap plunger hole *C*. (5) Bore and tap for cam retaining nut *D*. (6) Mill radius *E*. (7) Straddle-mill sides of radius *E*. (8) Mill elongated hole *F* for clearance of azimuth-worm stem. (9) Mill face and cut opening for azimuth-circle window *G*. (10) Mill radius and section for glass for azimuth-circle window. (11) Cut qualified thread. (12) Drill five holes *H* for azimuth circle hood screws. (13) Drill four holes *I* for movable index cover.

To complete the azimuth worm, Fig. 53, six operations are required: (1) Center both ends. (2) Rough turn all over. (3) Mill thread. (4) Finish turn; allow 0.001 in. for fitting. (5) Mill flats on end. (6) Drill, tap and ream end for locking screw.

For the azimuth circle support, Fig. 55, the work is divided into the following operations: (1) Rough turn outside diameter and inside recess; drill 1⅛-in. hole; finish thread and face. (2) Face, bore, recess inside clearance cut, and cut inside thread for shank, using two taps for sizing. (3) Screw on thread-lathe chuck; rough outside, finish inside, and recess. (4) Screw firmly to shank, Fig. 54, after the shank has passed its seventh operation, to obtain location of dowel holes. Place identifying marks and numbers on shank and support. Take apart and drill dowel holes in support only. (5) Mill clearance cuts *F*. (6) Stamp piece, mark and file. Assemble support and shank.

Nine operations are necessary on the shank, Fig. 54: (1) Bore and ream 1-in. hole; face end. (2) Face to length plus 0.050 in. Rough down hub for support even with outside diameter of the shank. (3) Hold in miller vise with false jaws and form mill outside shape. (4) Rough mill T-lug. (5) Finish mill T-lugs and scrape to gage. (6) Bore, ream to size, chamber, cut qualified thread for elbow and face end. (7) Finish turning and threading for support and face to correct length. (8) Screw the azimuth-circle support, Fig. 55, after the support has passed the third operation, to the shank, and drill the dowel-pin holes to the shank from the support. (9) Drill screw holes for attaching to elbow.

The operations on the rotating prism holder, Fig. 56, are: Broach square hole, turn and thread on square mandrel and jig drill screw holes.

SPRING PLATE FOR AZIMUTH CIRCLE

The spring plate, Fig. 57, is made of unannealed german silver punched from flat stock. The rough dimensions of the punched disk are 2¾-in. diameter, 1¼-in. hole. The disk is then held in a spring step chuck on the lathe. The chambered side is roughed and finished and the hole bored. The side thus finished is placed on a taper shank expansion arbor that fits the lathe spindle, and the opposite side is turned. The lower bearing *A* and the upper bearing *B* must be turned true so that the thickness 0.062 in. will gage the same at every point.

The brass block, Fig. 58, when finished, is cemented into the rotating prism flush with the surface. In making the blocks, a brass ring is turned and bored and the angle turned on each side. The ring is sawed into eight segments. The flat is then milled and the pieces drilled and burred.

For the elbow, Fig. 59, there are 10 operations: (1) Broach seats *A*, Fig. 59—two roughing broaches and

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one finishing broach. (2) Lathe, bore and thread one side for elbow cover. Keep correct dimensions from center. Use sizing tap and gage. (3) Lathe, bore and thread opposite side for elbow cover. (4) Bore, thread, tap and face hubs *B* and *C* in the lathe. (5) Mill the sides of the elbow with the end mill. (6) Burr. (7) Shape outside diameter. (8) Mill window opening. (9) Trim castings. (10) Drill all holes except the four holes used for attaching to the shank.

The operations on the azimuth-circle support and shank (assembled) are: (1) Screw support and shank together, transfer and drill dowel-pin holes in shank and permanently dowel the parts together. (2) Finish all outside turning, and threading. In cutting the thread on the support, it must be started at a predetermined point so that the hood, when assembled to the support, will be seated in its correct position. This is called a qualified thread. (3) Drill and ream the double-pinion shaft hole, Fig. 54. Drill the hole to flat figures with no tolerance. The double pinion directly transfers the measuring movement from the rotating head to the rotating prism in the sleeve. No allowance is made for backlash errors in the gears; therefore, the pinion shaft holes must be accurately located in their true vertical position. (4) Mill clearance cut for pinion in the support. (5) Drill four holes in shank and tap for elbow retaining screws.

HAND GRINDING OPERATIONS

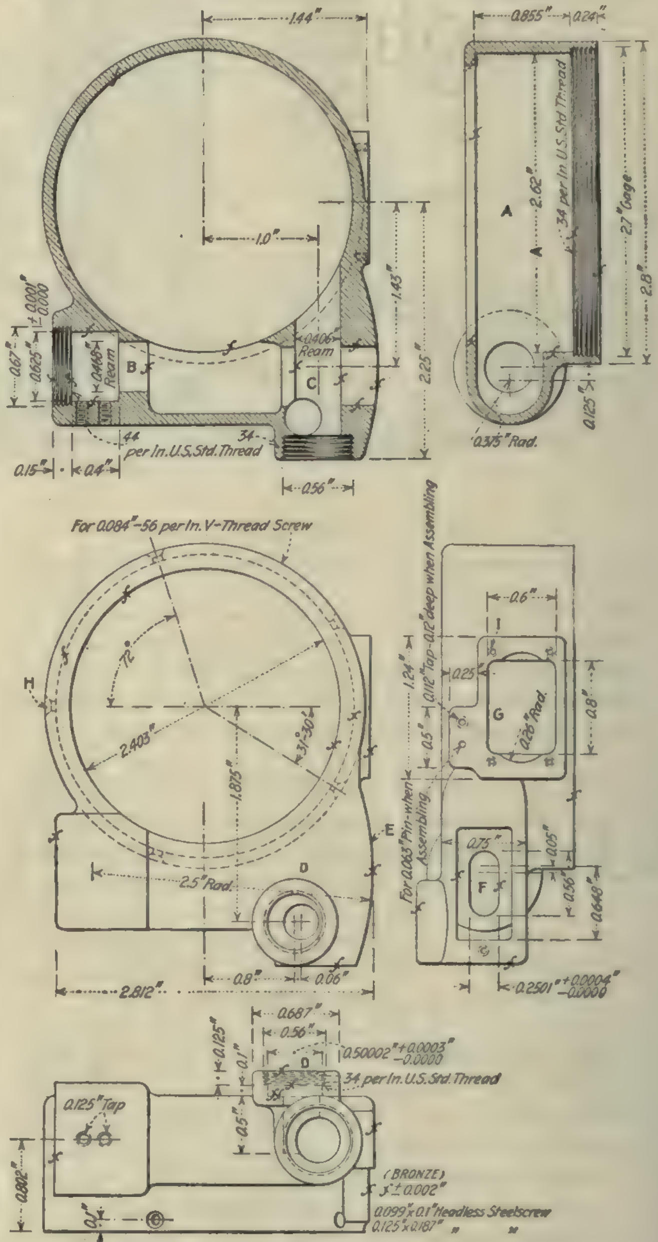
In assembling the azimuth circle, Fig. 48, to its support, Fig. 55, powdered pumice stone is used. A small quantity of moistened pumice is applied to the lower seat, and the parts are lapped or ground by hand. The worm is ground into the teeth of the azimuth-circle wormwheel with pumice and oil. A small quantity is applied with a sharpened stick, and the worm and wormwheel are revolved together until the wormwheel teeth show a smooth bearing.

The gears are also ground in with pumice. Each gear of the double pinion, Fig. 37, is ground in separately and then thoroughly washed and cleaned. If an attempt is made to grind both gears in at the same operation, it will result in backlash.

After the azimuth circle has been fitted to the support, Fig. 55, the small gear on the double pinion may be ground with the gear teeth on the lower inside hub of the azimuth circle. During this operation the geared sleeve, Fig. 50, is removed from the shank. Six temporary pinion shafts are used for holding the pinion in the support during the several grinding or lapping operations on the small pinion and azimuth-circle gear. For the first grinding operation a temporary pinion shaft 0.008 in. under size in diameter is used to hold the pinion in the support. A small quantity of pumice and oil is applied to the pinion and azimuth-circle gear teeth; and when fitted together, the high spots of the gears are ground away by revolving the azimuth circle by hand.

A shaft 0.002 in. larger in diameter is then used and the grinding operation again performed. This is repeated until within 0.002 in. of the regular shaft size; the last two shafts vary 0.001 in. During the grinding process a close inspection with a magnifier should be made to prevent bottoming or riding on the edge of the tooth. The bearing surfaces of the azimuth circle are wiped perfectly clean and oiled slightly when replaced at the end of each grinding operation.

After the small pinion has been ground to the azimuth-circle gear, the latter is removed and the large pinion is ground with the teeth in the supporting sleeve, Fig. 50. The method of grinding is the same as that used for grinding the small pinion. For revolving the sleeve by hand a threaded plug similar to that in Fig. 61 is screwed into the sleeve.



Azimuth Circle Hood

FIG. 51. THE AZIMUTH-CIRCLE HOOD

The ball bearings on the azimuth and elevation worm-shafts are ground by hand into the sockets into which they fit and are finished with rotten stone.

The eye lens and field lens are thoroughly cleaned, cemented and sealed in the eyepiece to the blueprint figures, and the locking screw is adjusted to hold the field-lens retaining ring in place. Plastilina can be used for sealing the lens in place.

Before the reticule cell is permanently assembled to the eyepiece, the cell seat for the reticule should be altered so that the reticule, Fig. 60, will rest the proper focal length from the eye lens. This result can be obtained by using a collimating telescope, or collimator *A*, Fig. 61. This instrument is a tube or telescope fitted with an achromatic objective at the focus of which crosshairs are arranged. A slot used for producing parallel rays is cut in the tube at this point.

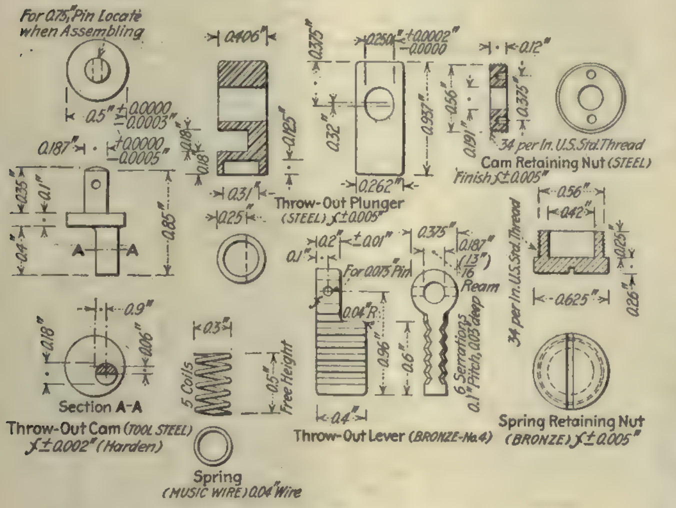

For 0.75" Pin Locate when Assembling
0.5" +0.0000 −0.0003"
0.187" +0.0000 −0.0005"
0.35
0.1"
0.4
0.85
A
A
0.406"
0.18
0.18
0.125"
0.31"
0.25"
Throw-Out Plunger (STEEL) ƒ±0.005"
0.375"
0.250" +0.0002" −0.0000
0.32"
0.937"
0.262"
0.12"
0.56"
0.191"
0.375"
34 per In. U.S. Std. Thread
Cam Retaining Nut (STEEL) Finish ƒ±0.005"
0.9"
0.18"
0.06"
Section A-A
Throw-Out Cam (TOOL STEEL) ƒ±0.002" (Harden)
0.3"
5 Coils
0.5" Free Height
Spring (MUSIC WIRE) 0.04" Wire
0.1"
0.2"
±0.01"
For 0.075" Pin
0.04" R
0.96"
0.6"
0.4"
0.375"
0.187" (13/16") Ream
6 Serrations 0.1" Pitch, 0.03" deep
Throw-Out Lever (BRONZE-No. 4)
34 per In. U.S. Std. Thread
0.56"
0.42"
0.125"
0.625"
0.26"
Spring Retaining Nut (BRONZE) ƒ±0.005"

FIG. 52. DETAILS OF THE SMALL PARTS

The seat for the reticule is carefully cleaned and the reticule seated thereon. It is held in place temporarily by small pieces of soft wax applied to the edge. The cell is screwed into the eyepiece to within a few thousandths of the shoulder. The collimator is then held against the eyepiece, and the etched lines of the reticule are observed by sighting through the instrument and eyepiece to some distant point. By screwing the reticule cell back and forth, it will be observed that the graduation lines on the reticule will become either blurred or sharply defined, according to the direction of the movement.

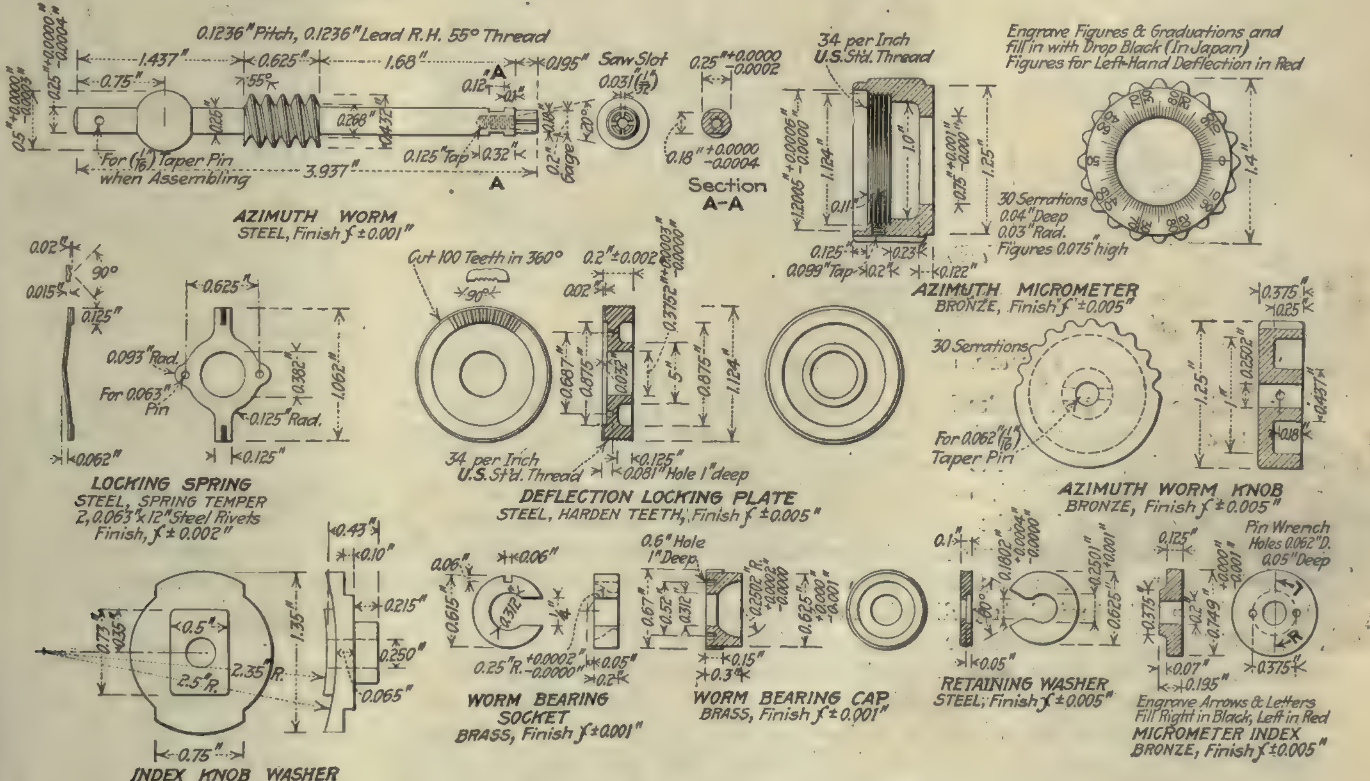


FIG. 53. DETAILS OF THE AZIMUTH WORM

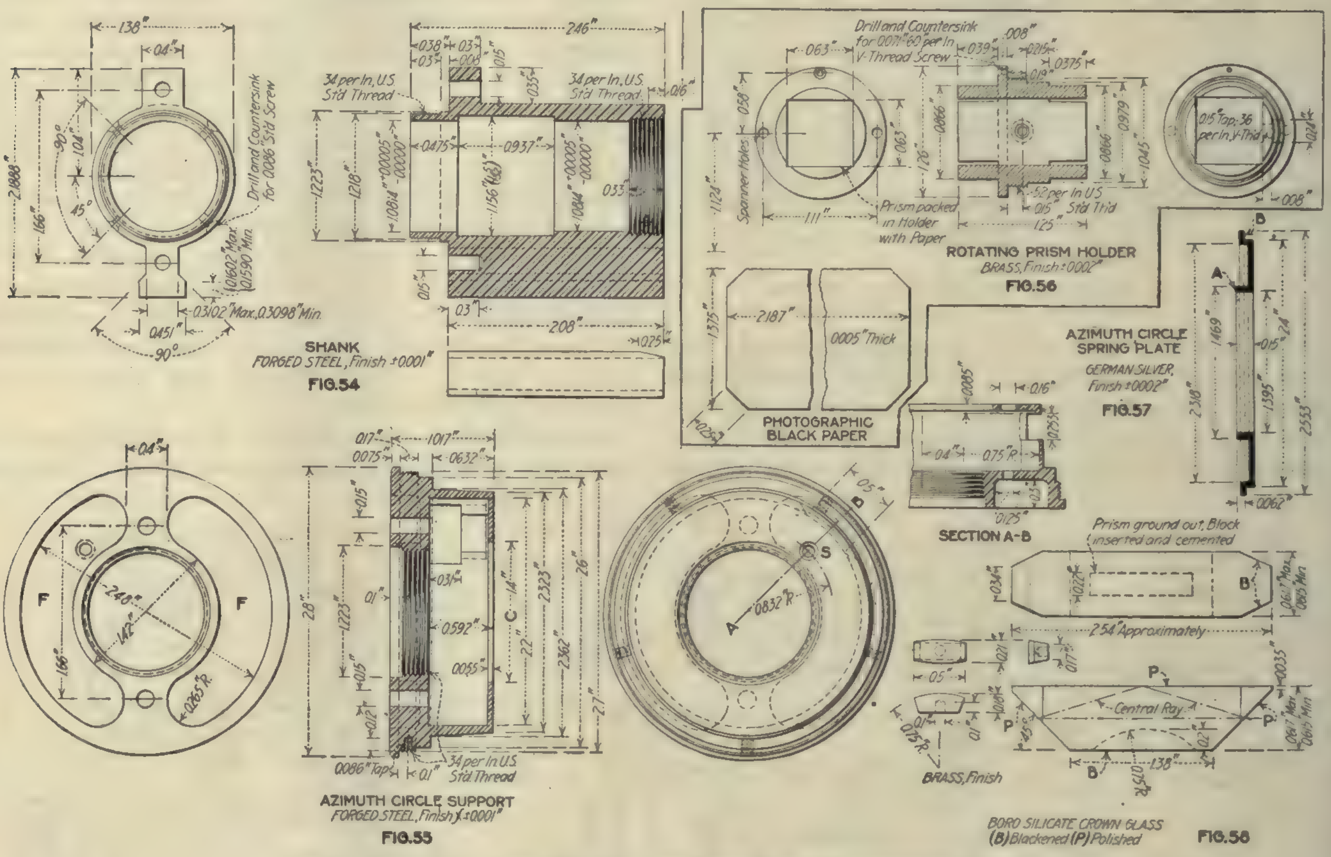
The adjustment for obtaining a sharp definition of the graduated lines is made by facing off the reticule-cell seat on a false plug in the bench lathe a few thousandths at a time until the lines, as observed through the collimating telescope, appear in proper focus. When this result has been obtained, remove the cell from the eyepiece, clean the reticule seat thoroughly, replace and burnish the reticule to its seat just tight enough so that it may be turned in its seat by pressure of the finger. Then reassemble to the eyepiece.

During the final assembly, all machined joints leading to the interior chambers of the sight which contain optical elements are sealed with litharge cement. The latter is manufactured as follows: Boil raw linseed oil in a pan until it smokes. Then set it on fire and let it burn for a few minutes. Cover the pan to extinguish the blaze and pour the warm oil into a receptacle containing red lead and litharge in the proportions of 1 oz. of each to 1 qt. of oil. Keep the mixture at a temperature of 70 deg. F. for 10 days, stirring it once a day. The cement is applied in a thin coating to the parts to be cemented and allowed to dry. Only a small quantity of cement is required. It dries very slowly. It is not affected by either water or alcohol. When required, the cement can be dissolved with turpentine.

The night-illumination shutter window glass in the elbow is inserted and staked into place. Litharge cement is applied to make the joints waterproof. Next, the left elbow cover is screwed into place in the elbow and sealed with a composition of heavy vaseline and beeswax or similar dustproof and waterproof material.

The inside chambers of the elbow are thoroughly washed with benzine, and the interior metal parts are wiped with a clean cloth free from lint. All traces of moisture are eliminated by heating over an alcohol lamp until thoroughly dry. The eyepiece is temporarily screwed into the elbow; also the objective cell. It is assumed that the objective lens has been permanently sealed in the cell. The operation consists of carefully cleaning the cell seat, inserting the objective lens, applying Plastilina or similar sealing material and burnishing.

The lower reflecting prism is then temporarily fitted, and the assembled elbow is mounted on a fixture so that the vertical axis of the elbow will be held in a horizontal position and perfectly level. Square up by the surface previously machined for one of the side covers. Sighting through the eyepiece upon an object or target at least 500 yd. distant, the objective is screwed in or out with the fingers until free from parallax. Parallax is an apparent displacement of the crosswires when the eye at the eyepiece changes position and is due to their being slightly out of the focus of the object glass. The lower reflecting prism from some definite point is measured so that, when removed, it can be returned to its correct position.



SHANK
FORGED STEEL, Finish ±0.001"
FIG.54
34 per In. U.S. Std Thread
Drill and Countersink for 0086 Std Screw
AZIMUTH CIRCLE SUPPORT
FORGED STEEL, Finish ±0.001"
FIG.55
34 per In. U.S. Std Thread
0086" Tap
ROTATING PRISM HOLDER
BRASS, Finish ±0.002"
FIG.56
Drill and Countersink for 0071" 60 per In. V-Thread Screw
Prism packed in Holder with Paper
Spanner Holes
52 per In. US Std Thd
PHOTOGRAPHIC BLACK PAPER
0005" Thick
AZIMUTH CIRCLE SPRING PLATE
GERMAN SILVER, Finish ±0.002"
FIG.57
SECTION A-B
Prism ground out, Block inserted and cemented
2.54" Approximately
Central Ray
BRASS, Finish
BORO SILICATE CROWN GLASS
(B) Blackened (P) Polished
FIG.58

FIGS. 54 TO 58. DETAILS OF A NUMBER OF DIFFERENT PARTS

Direct the eyepiece on a known vertical plumb line painted on an object 500 ft. distant. Revolve the reticule (not the cell) with the finger until the vertical line etched on the reticule is parallel with the vertical plumb line of the target. Permanently burnish the reticule in the cell and place identifying marks on the eyepiece. The objective cell is then removed, and the diaphragm, Fig. 60, is screwed in. Remove the reflecting prism and clean out the elbow chambers thoroughly. Replace the prism, screw on the side cover and seal. Sighting through the eyepiece, the diaphragm is adjusted back and forth until the largest sharp field of view is obtained. It is then staked slightly in that position, provided the elbow parts are free from dust or moisture. The objective can then be temporarily replaced in the position formerly obtained.

Oftentimes after the assembled metal and optical parts have apparently been thoroughly cleaned, a few sharp taps with a stick will dislodge particles of dust or dirt. These particles must be removed to avoid their appearance later when the sight is in use. The reticule is in the focal plane of the eyepiece, and dust specks appearing on its surface are magnified. After an optical part has been carefully cleaned with a soft cloth, the dust specks are removed with a camel's-hair brush.

Sight on an object and with the eye at the eyepiece revolve the prism holder and its sleeve by hand. If the picture viewed through the eyepiece revolves concentric to the object selected, the adjustment is correct.

SHANK ASSEMBLY

To adjust the rotating prism, cement the brass block, Fig. 58, into the prism flush with its surface, and drill and tap. Put the shank with the elbow and eyepiece temporarily assembled in the horizontal fixture, Fig. 64, with the eyepiece up. Insert the revolving prism, wrapped with paper as described below, into the holder, and the holder into the supporting sleeve, Fig. 50, and assemble them in the shank without the gearing. Direct the telescope at a plumb line. Turn the prism so that the end surfaces lie in vertical planes and a plumb line appears parallel to the vertical line of the reticule. Move the fixture, if necessary, to make the image of the plumb line coincide with the vertical line of the reticule. Turn the rotating prism 180 deg. until the plumb line again appears parallel to the vertical line of the reticule.

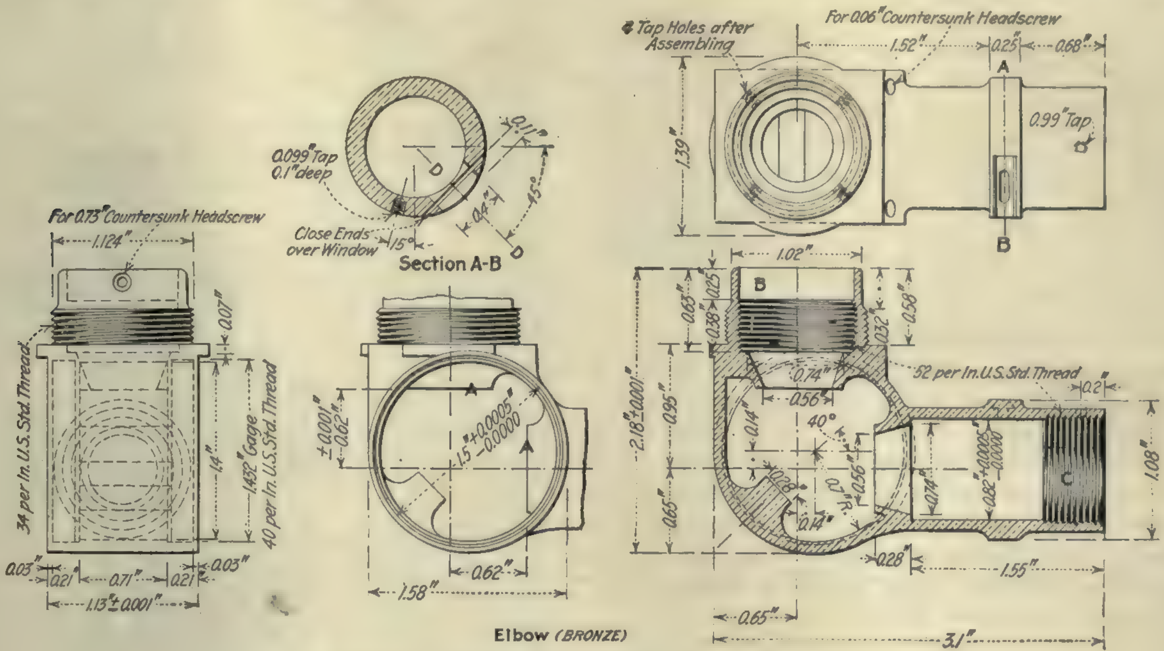


FIG. 59. VARIOUS PARTS OF THE ELBOW

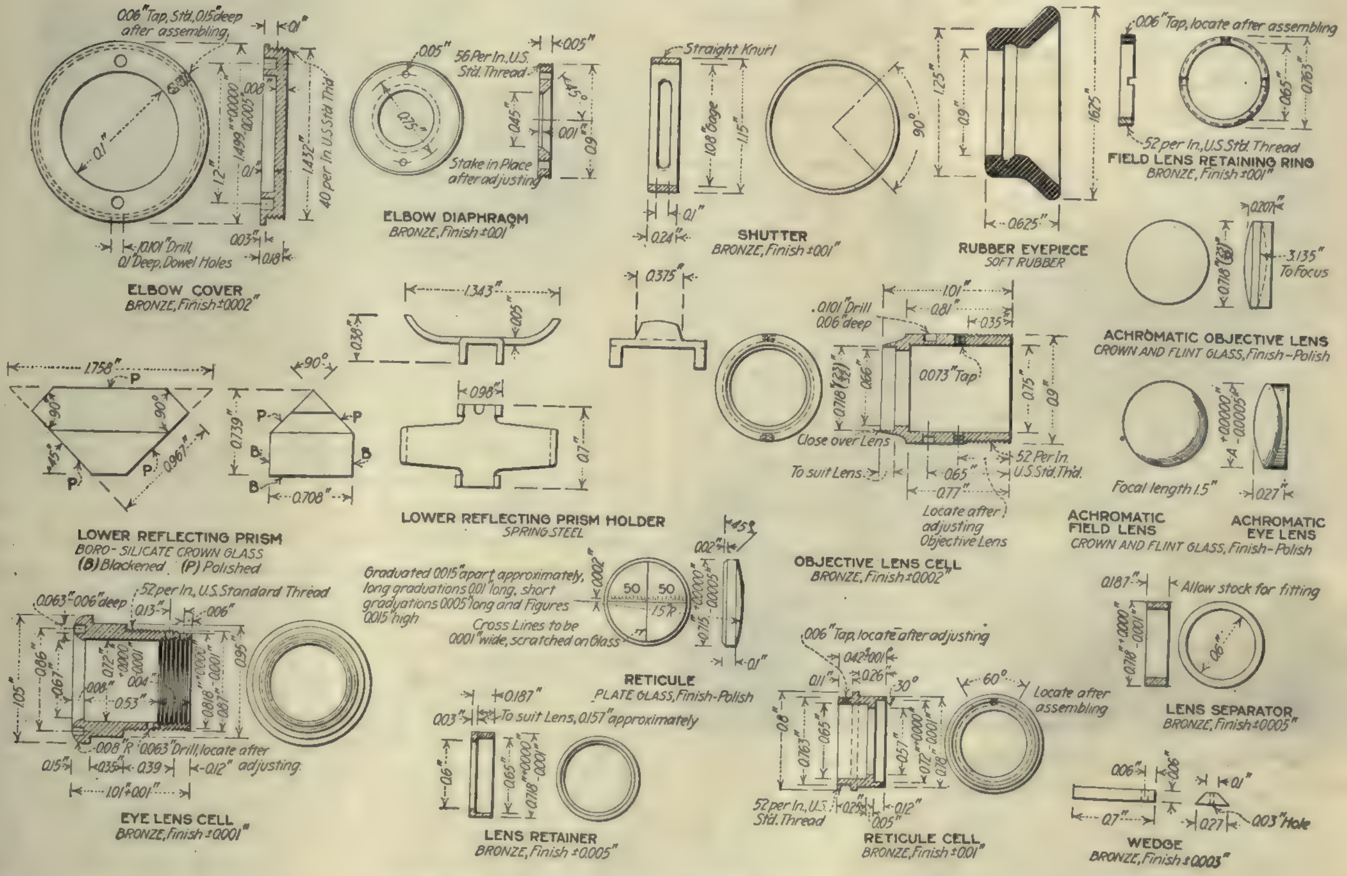


FIG. 60. DETAILS OF VARIOUS IMPORTANT PARTS

Correct half the error of deviation of the vertical line on the reticule from a plumb line by slightly filing off and slightly bending over the supporting walls of the upper and lower ends of the prism holder. Note that if the upper surface is bent toward the axis of the holder, the lower surface on the same side of the holder should be filed an equal amount, as the prism should be rotated on one of its shorter axes. The filing or bending of the holder should be only on the surface prepared for the base of the prism and the opposite surface. The other two surfaces of the prism holder should not be touched. The metal to be taken off will be only a few thousandths of an inch.

Then rotate the fixture to bring the vertical line of the reticule on the plumb line again, and repeat the test. Before assembling the prism in its holder for testing or final adjustment, partly wrap the prism with a sheet of dull-black paper 0.005 in. thick, of the length of the bearing surface of the holder. For this purpose turn back one edge of the paper $\frac{3}{32}$ in. against the polished surface of the base, then wrap the paper over the three unpolished surfaces and turn it over the other edge of the base and cut so that it extends $\frac{3}{32}$ in. beyond the edge of the base. After final adjustment of the rotating prism insert the setscrew in the prism holder. Note that the setscrew should not bottom against the prism.

FINAL INSPECTION FOR PARALLAX

Assemble the mechanical and optical parts of the rotating head complete in accordance with the drawing. The interior should be free from dirt or dust specks. Seal the window shield in place with litharge. Screw on the side covers and seal with vaseline and wax. Assemble the azimuth circle to its support and screw the hood to the shank. Then screw on the rotating head. Clamp the assembled sight to a testing fixture similar to that shown in Fig. 62.

This fixture has a beveled slot cut perpendicular to its base, into which the lug on the sight shank fits. It is held in place by the locking screw *A*. Direct the sight on an object at least 500 yd. distant and observe through the eyepiece whether the sight is free from parallax. If not, screw the objective back and forth until the desired result has been obtained. Then unscrew the elbow, spot drill through the screw hole in the elbow, drill and tap for the retaining screw.

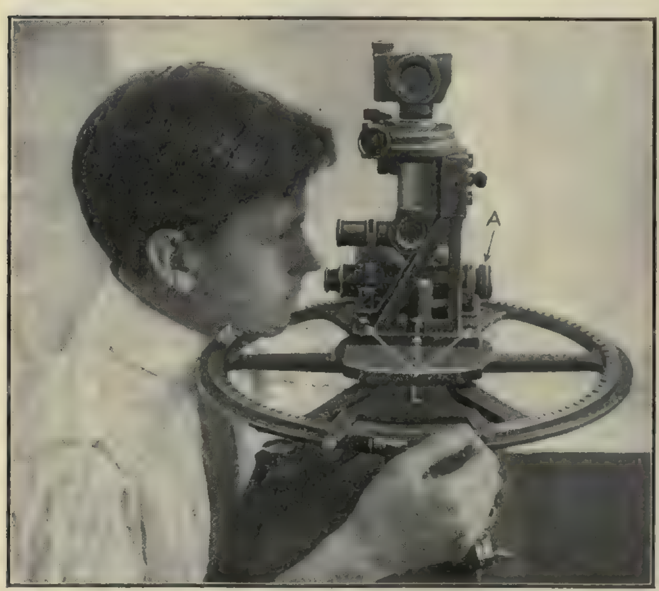


FIG. 61. MODEL 1915 PANORAMIC SIGHT MOUNTED ON TESTING FIXTURE

The objective is then removed, so that the elbow chamber can be thoroughly cleaned. In the final cleaning a soft cloth dipped in alcohol may be used on the metal parts, if necessary. Alcohol is used so that no moisture will remain on the parts. The rotating head, hood, azimuth circle and shank are also removed and the parts cleaned before making the final assembly and adjustments.

It is assumed that the lenses and mountings, the rotating prism, the pinions and pinion shaft, the azimuth circle and the rotating head are assembled. The vertical fixture, Fig. 64, is used. Carefully level and place the panoramic sight in the socket of the vertical fixture. In looking through the eyepiece, if the field of view seems to incline either to the right or left—that is, if the vertical line of the reticule is not parallel to the plumb line—then the rotating prism is not in correct relation to the rest of the instrument and it will be necessary to remove the rotating head and the azimuth circle and change the relation of the prism to the larger gears. This change is made by removing the pinion shaft and turning the pinion until those teeth are in mesh, which brings the field of view into a vertical position. This operation usually requires much care and time.

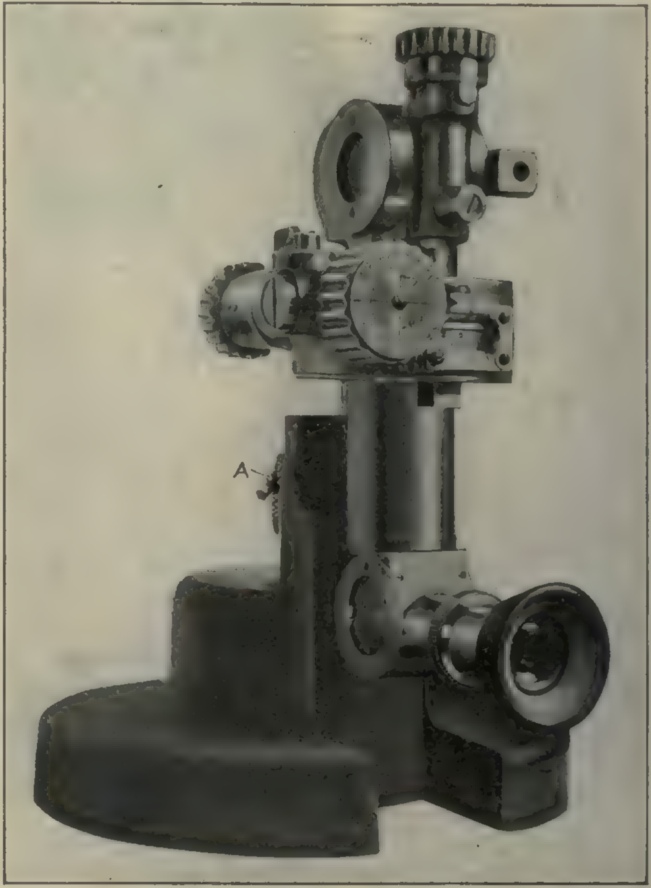


FIG. 62. MODEL 1917 PANORAMIC SIGHT AND VERTICAL HOLDING TESTING FIXTURE

If it be found that after a long trial one position of the teeth gives better results than any other position, but that the results are not yet satisfactory as to verticality of the field, it will then be necessary, having determined this best position of the teeth, to make the ultimate adjustment for verticality of the field on the revolving prism and revolving-prism holder. To do this, unscrew the revolving-prism holder screw securing the rotating-prism holder to the supporting sleeve for the revolving prism. The revolving-prism holder, with the revolving prism, may then be revolved in the supporting sleeve by hand until the field assumes the correct vertical position. Having obtained the position, clamp the revolving-prism holder and the supporting sleeve carefully together and drill and tap a new hole for the setscrew. The field adjustment should now be satisfactory.

The pinion and gear teeth which are in mesh to give verticality of field should be spot marked for future adjustment. These marks are readily recognized by any machinist or instrument maker, and no difficulty should be experienced in at once bringing the field into proper adjustment. Also note that the portion of the above description relating to the removal of the setscrew securing the rotating-prism holder and supporting sleeve together is intended to be applied only in extreme cases. In general, however, no need will be found for removing the setscrew and redrilling.

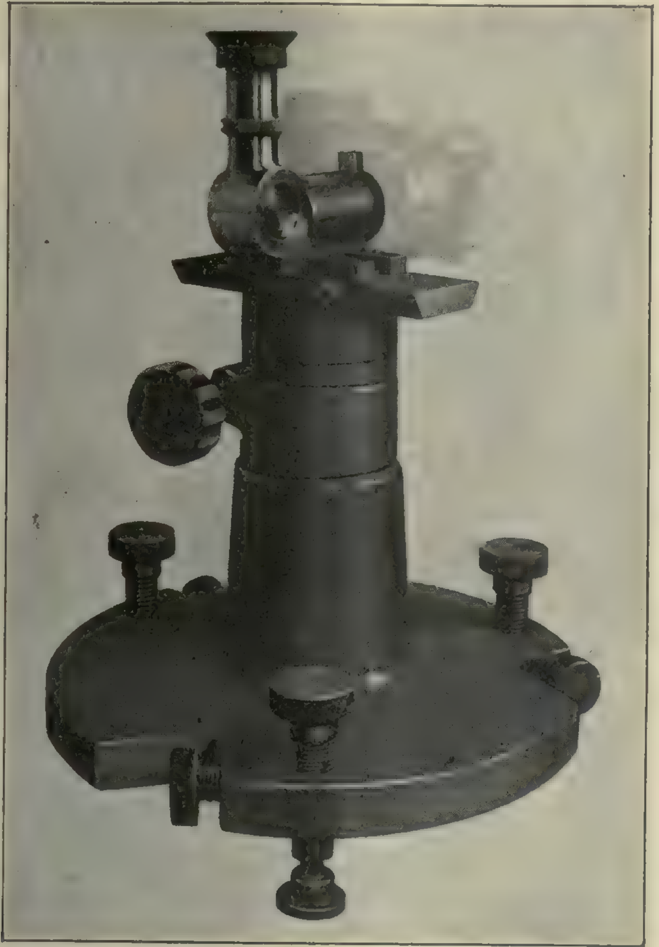


FIG. 63. HOLDING FIXTURE USED FOR ADJUSTING ROTATING PRISM

It may occasionally be necessary to loosen the setscrew slightly and then push by the merest hair the rotating-prism holder in one direction or the other, again tightening the screw. But caution is enjoined for any such operation. Replace the rotating head, azimuth circle, etc. The sight still mounted in the vertical fixture is then directed toward a target at the same height as the center of the window cell. Such a target should be laid out 500 ft. or more distant, using an accurate transit or Y-level. Now look through the eyepiece of the panoramic sight. The horizontal line of the reticule from end to end should appear at the same height as the fixed target selected. If the crosslines appear above or below the target, correction should be made on the lower reflecting prism and not on the reticule. The necessary corrections should be made by filing carefully the brass bearings of the seat for the lower reflecting prism in such a way as to make the prism lean forward or backward, as the case may be, an amount sufficient to correct for the full error.

This operation is extremely delicate, and the filing or scraping should be proceeded with most carefully. The bearing surfaces of the prism seat must be cut away to produce a change in the position of the prism from front to rear, or the reverse only, but lateral tilting produced by leaving the seat higher on one side than the other must be avoided. If the field is not vertical, either the rotating prism has been wrongly assembled or the eyepiece elbow has not been properly screwed up. If parallax cannot be removed, the objective-lens cell or the field-lens cell or the reticule cell has been incorrectly assembled.

ADJUSTING AZIMUTH CIRCLE

In adjusting the azimuth circle the plate is mounted on a horizontal fixture similar to the one in Fig. 61, and the fixture is carefully leveled. The fixture is provided with a circular angular measuring attachment graduated into 360 equal divisions. Fine measuring adjustments are obtained by using the vernier attachment. The collimating telescope *A*, Fig. 61, is mounted on the fixture and aligned on a plumb line. The fixture is then clamped into place. Without changing the setting of the fixture the azimuth worm knob on the sight is turned until the vertical line on the reticule coincides with the plumb line. The azimuth circle is then set to read 48. For adjusting the azimuth circle the movable index cover may be shifted, and the worm index on the worm may be readjusted.

The holding fixture, Fig. 61, is used when testing for error in the azimuth circle. The collimating telescope is not used in this case. The index is set at zero on the scale of the fixture. The indexes of the panoramic sight are also set at zero. The sight is mounted on the fixture, and the fixture is oriented until the vertical line of the reticule cuts the vertical line of the target. The fixture is then clamped in place. The graduated dial of the fixture carrying the panoramic sight is then moved through 45 deg., or one-eighth of a revolution, and set at that point. The azimuth-circle graduation of the sight is then tested for one-eighth of the revolution by turning the azimuth micrometer knob until the vertical line of the reticule again cuts the vertical line on the target. The scale readings of the azimuth worm knob, if correct, will show the same reading as the test fixture. At this point in the test the backlash error can be noted by turning the azimuth knob until the vertical line of the target has been passed, then reversing until the line again cuts the target. The readings can then be compared and the error, if any, noted.

The sight is tested for error in azimuth graduations at each division of 45 deg., or one-eighth of the circle. There are 16 readings taken. During the first revolution of the azimuth circle, eight tests are made. The panoramic-sight scales and those of the fixture, Fig. 61 are again set at zero and the process repeated. This is necessary, as the rotating head travels only half a revolution during one revolution of the azimuth circle.

At the various testing points the error of elevation, if any, is also noted. It sometimes happens that the seat of the azimuth circle has not been turned true, which will cause an error in elevation as the azimuth circle turns. This error is noted by the elevation or depression of the horizontal lines of the sight and the target when the rotating head is being revolved in azimuth. At one complete revolution of the revolving head, the horizontal crosswires must cut the same target within a tolerance of one-half mil.

The elevation error of the scale on the rotating head is taken on two targets of known elevation and depression, preferably 15½-deg. elevation and 15½-deg. depression. The panoramic sight is mounted on the fixture shown in Fig. 61. The elevation micrometer knob is set at zero and the elevation index scale at 3, and the sight is set so that the horizontal line on the reticule cuts the horizontal line on the target. Elevate the rotating head by the micrometer knob to the maximum elevation movement and allow a small margin for overlapping the scale graduations. Then depress the head to the other extreme, if variation is noticeable sidewise in relation to the vertical line on the target; or if full movement cannot be obtained, the rotating-head prism must be removed and the necessary metal parts filed, scraped and readjusted.

The method of testing for error in graduations is the same as is used for testing the azimuth scale. The elevation micrometer knob is turned until the reticule line cuts the various known lines measured on the target, and the error, if any, is noted on the scale of the rotating head. Inspection for backlash error is made during this inspection.

A rigid optical and mechanical inspection is required for parallax; chromatic and spherical aberration; distorted field; flat field; astigmatism; collimation; double reflection near center of field (due to error in lower reflecting prism not having been ground correctly); azimuth and elevation error in mils at first and second revolutions; backlash of worm and gears and dimensions of T-lug.

Lubrication and Painting

In assembling, put a little vaseline or tallow on the worm and gear teeth. Heavy vaseline or tallow can be used for lubricating steel parts. Wherever steel runs in brass, tallow cannot be used, as it will cause verdigris. For the running parts, such as the lower surfaces and inside circumferential of the azimuth circle and the outside surface of the supporting sleeve for the rotating prism, use a few drops of clock oil.

For field service the exposed surfaces of the sight are painted with enamel, olive drab in color. The highly finished machined parts, such as the micrometer index and graduated knobs, are dulled with a coat of lacquer. The flash of a polished metal surface sometimes is carried for a long distance and betrays the position of the piece to the enemy.

The part to be enameled is first washed thoroughly with benzine or gasoline. When the part contains an insert of german silver, the insert is sandblasted and one coat of pyramid lacquer applied. This protective coat will prevent the surface of the german silver from becoming stained by finger acids.

The parts to be enameled are given three coats of olive-drab baking enamel. One coat at a time is applied. On account of the surface irregularities of the small metal parts, the best results are obtained when the enamel is applied with a brush instead of by the spraying method. After each coat of enamel is applied, the part is placed in a baking oven heated to 120 deg. F. and baked for 3 hours. After the second baking, the part is ready for the crystal finish.

The crystal finish is obtained by the use of a special crystallizing baking varnish. This material may be obtained from a number of manufacturers by whom instructions for its use are furnished.

The finishing coat of crystal varnish is applied to the work with a brush—evenly and not too heavy a coat. It is then placed in the baking oven, and the heat regulated so as not to exceed 120 deg. F. The door of the oven is left open to obtain free air circulation. The work is removed at intervals for inspection. From 35 to 40 min. is required for crystallization. When this has been obtained, the work is baked for 4 hours at 220 deg. F.

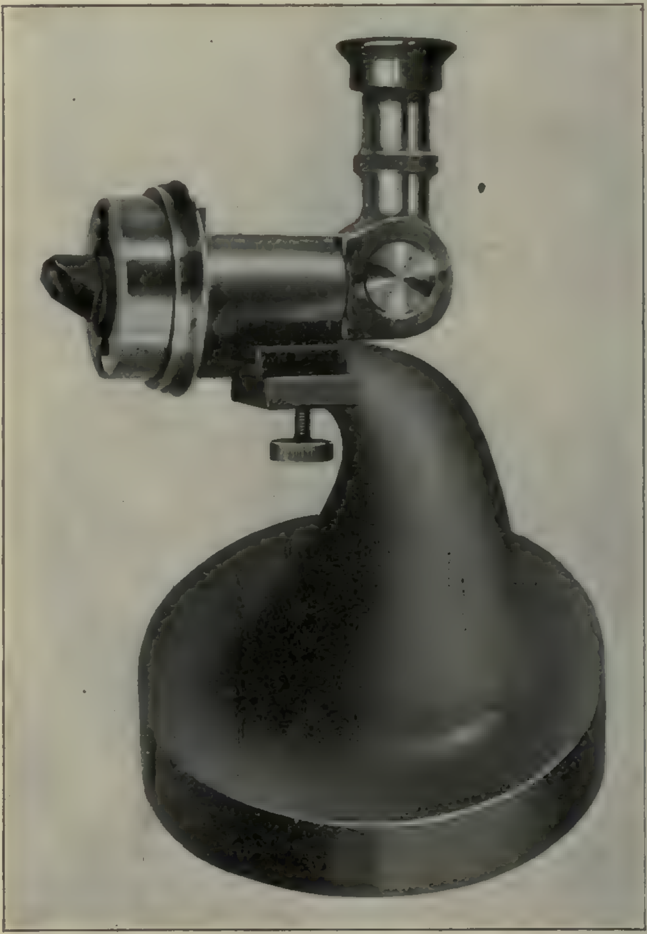


FIG. 64. ELBOW AND SHANK ON HOLDING FIXTURE

The lines of the graduated scales are filled in with drop black japan. In this process the graduated part is given one coat of cold white lacquer. After this has dried, japan is rubbed in with the fingers. The piece is permitted to stand a short time; then the surplus japan is washed off with soap and water and freely rubbed with the fingers until all the japan has been removed except that embedded in the lines of the scale. This result cannot be obtained if a brush is used for moving the surplus japan. For filling in graduations in red, the same method is used, and deep fast vermilion in oil is substituted for the japan black.

Cast-Iron Shells in Permanent Molds*

By EDGAR A. CUSTER
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SYNOPSIS—*The author introduces his subject by pointing out the superior effectiveness of the cast-iron shell in attacking earthworks. It is also clearly shown that the efficiency of a shell fired against troops is dependent almost entirely upon the character of its fragmentation, in which particular cast-iron shells have been shown to be much more satisfactory than forged-steel projectiles. Cast-iron shells, with proper foundry procedure, also can be easily made in enormous quantities. France is making over 1,000,000 rounds a day at present in dry-sand molds. A steel forging for a 4.7-in. shell costs over $7; a cast-iron shell of similar size can be made for a little over $2. With these advantages in mind, the case for the cast-iron shell seems complete, provided proper foundry practice can be secured so that the shells will be of uniform and satisfactory quality.*

THE present conflict has brought about wonderful changes in the generally accepted ideas of warfare. The terrible curtain of fire has made its appearance, earthworks and trenches have been substituted for elaborate and costly fortifications, and the airplane and submarine have profoundly influenced the strategy on land and sea. In the trenches, old-time stink pots and grenades are being thrown by the ancient catapult, bombs are shot from a contrivance that closely resembles a home-made Fourth-of-July cannon, and the form of sling-shot that David used on Goliath has been modernized to a wonderfully effective point. Now we have the spectacle of an unheard of number of rapid-fire, high-caliber guns raining upon the enemy, myriads of cast-iron shells. The continued use of these apparently grotesque contrivances and the revival of cast-iron shells rest on the fact that they have been found to be the most effective means for doing the work in hand.

CAST-IRON SHELLS NOT NEW

There is nothing new in the use of cast-iron projectiles—before the age of steel they were the sole means of battering down defenses and attacking at long range. Some of the reasons why the use of cast-iron shells was abandoned are that the metal has never had a very good reputation for uniformity and freedom from sponginess and gas holes, its tensile strength is low, and it lacks toughness. Any of the defects commonly found in cast iron will seriously affect the trajectory and direction of a shell and render it comparatively useless. It must be absolutely reliable and land at the point at which it was aimed. If one portion is spongy and hence lighter, it will wabble in flight and its main purpose will be destroyed. The weakening effect of sponginess or blow-holes may cause the shell to break under the shock of the initial explosion and destroy the gun. A forged-steel projectile meets all these objections and has the call.

The objection to steel projectiles is that they are comparatively ineffective against earthworks or trenches when the caliber is 5 in. or less. The amount of contained explosive is small, and a great proportion of the explosive effect is used in bursting the walls of the shell. In larger sizes this objection is less apparent. The explosive effect increases with the added charge in a greater ratio than the strength of the added amount of metal in the projectile. The present war has taught us that steel, concrete and brickwork offer but little resistance to modern seige guns, and they have been abandoned for earthworks manned with an ample force. The burden of attacking must and does rest with the artillery, and the army that is equipped with the most effective guns using the most effective projectiles will win the most battles. The projectile that is most efficient against earthworks and covers its zone of dispersion with the greatest number of fragments of the proper size is the projectile that will surely be used. It only remains to make that projectile so that it not only will be strong enough to resist the propelling explosion, but also will be perfectly sound and uniform in texture.

TARGET SHELLS DO THE WORK

During the Spanish-American war, when our fleet was off Santiago, it was observed that one vessel was creating great havoc in the earthworks guarding the entrance, and upon investigation it was found that this vessel was using loaded practice shells. These shells would tear great holes in the works, while the steel shells were comparatively ineffective. As the vessel had quite a number of these shells in stock it became very popular with the other ships. A few years ago, some experiments were made on the lower Chesapeake to determine the effect of cast-iron shells on the superstructure of a condemned war vessel. One shell that penetrated the structure and burst in a wardroom was particularly observed. The room was about 20 x 60 ft., and one side was lined with lockers. Every locker was torn to pieces, and the paint on the walls and ceiling in the line of the explosive force was cut off as with a sand blast. It was the unanimous opinion that the explosion would have killed every man who happened to be in the room at that time. A few tentative experiments were made after this, and a permanent mold was constructed; but the project was allowed to drop, and no effort was made to thoroughly investigate the subject.

The first intimation we had that cast-iron shells were being used in the present war was an article in the *London Engineer*, which described a number of fragments of cast iron that were undoubtedly portions of an exploded shell. It was noted that some of the pieces were slightly chilled on one side, and the *Engineer* surmised that cast-iron cores were being used. As the peculiarly destructive effect of these shells was observed not only in the open, but also against earthworks, the idea that the Germans were using cast-iron shells on account of the scarcity of steel was abandoned. As a matter of fact, as early as May, 1913, German and Italian munition makers were discussing this phase of projectile work and were seeking all the information that was available. In August, 1913, it was reported to the writer that shells had been made that were satisfactory in that they had the proper degree of fragmentation and were strong enough to resist the effect of the propelling charge. Moreover, these shells were made in iron molds with iron cores.

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*Paper read at American Foundry Association meeting, Boston, Mass., Sept. 27, 1917.

THEORY OF THE CAST-IRON SHELL

The theory of the cast-iron shell is that, when used against earthworks, the greater part of the explosive force is not expended in bursting the walls of the shell and the effect is as if that amount of explosive were detonated in the earthwork. When used in the open, the great fragmentation of cast iron will allow the shell to burst into a far greater number of pieces than a steel shell and will cover the zone of dispersion very closely. It is essential for the work that the degrees of fragmentation be calculated to a nicety. Too great fragmentation will make the shell ineffective. A steel shell weighing 13½ lb., when charged with 1 lb. of trinitrotoluol, will burst into approximately 1050 pieces if there is complete detonation. The largest pieces average 0.3 to 0.4 lb. in weight, and many of these are splinters due to the fibrous nature of the metal. The fragments recoverable have a wide variation in weight, as shown by the fact that while the average weight of the large fragments is almost ½ lb., the average weight of all the fragments is about 0.01 lb. It follows that a very large per cent. of the fragments would do no harm or at least would not disable except at very close quarters. A cast-iron shell under the same conditions would burst into nearly 1500 pieces with the fragments comparatively uniform in size and weight. It has been found that wide differences in the fragmentation of steel shells have been caused sometimes by the incomplete detonation due to the primer failing to function properly. This is not so serious with the weaker cast iron, but serves to emphasize the fact that a large proportion of the explosive force is expended in bursting the steel walls.

Target shells have been made of cast iron for many years, and almost any foundry can make them. It is only essential that the casting be solid and capable of being machined to the proper sizes. The weight of the bursting charge is made up by thickening the walls. If it is not up to weight, a little sand is poured into the cavity. When it comes to making a projectile of cast iron that is to be used against an enemy, a number of difficulties are set up. It must be very strong, it must be easily machined, it must be absolutely solid and free from spongy spots and blow-holes, and above all, every shell must have exactly the same degree of toughness. To meet these requirements, the foundry must be run on a strictly scientific basis. There can be no guesswork or slipshod methods. When shells are cast in sand, the elements of carbon, silicon and manganese must be held to very definite limits, and these limits vary with the thickness of the shell walls. Moreover, these limits can only be determined by trial. The point aimed at is the correct degree of fragmentation, and all foundry methods must be carried out with this point in view. Dry-sand molds—open and porous—perfect cores and trap or swirling gates must be used. The foundry requirements for this work have been ably set forth in an article by Edgar A. Custer, Jr., in the April, 1917, issue of *The Foundry*, and the methods of melting and care of iron and fuel described must be carried out whether the shells are made in sand or in a permanent mold.

Ordinary foundry iron, when properly cast in a permanent mold and when removed at the proper time, has in the resultant casting the same degree of hardness irrespective of any variation in the chemical constituents, so long as the same size, weight and shape of casting are made. The time the casting remains in the mold is the determining factor of the degree of hardness. A casting weighing about 60 lb. remains in the mold 4 or 5 sec., while a casting of the same general contour weighing 500 lb. will require from 25 to 60 sec. before it is safe to lift it out. To illustrate this point, data on a casting weighing 1100 lb. are presented. Fig. 1 shows the general outline of a mold that was used to make a shell bushing. It will be seen that a trap gate was used and that the casting had a very heavy base and comparatively thin upper walls. In fact, about 65 per cent. of the total weight was concentrated in the lower third of the casting. This large mass of metal increased the time interval in that it was necessary to set the walls deeper than in a casting of smaller bulk. There were no risers, and the only means provided for the escape of air from the matrix were a few shallow channels cut into the mold at the top of the casting. A large cast-iron core operated by a hydraulic cylinder formed the interior cavity. The mold was opened and closed by a similar cylinder. Into this mold, irons of the following analyses, all of which were melted in an ordinary cupola, were poured:

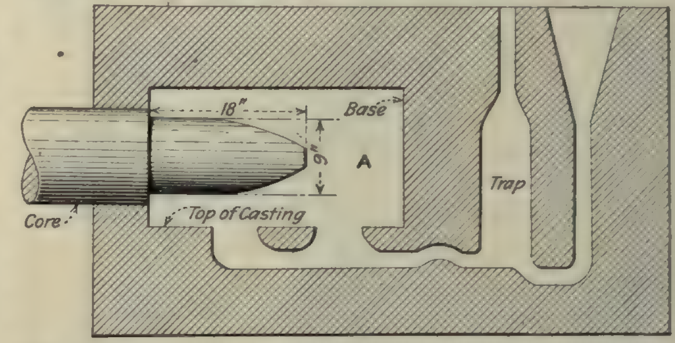
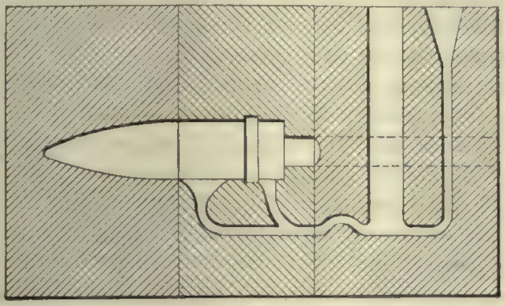


FIG. 1. TWO-PART CAST-IRON MOLD WITH 15 INCHES OF METAL AROUND GATES, RUNNERS AND CASTING

	Mixture No. 1	Mixture No. 2	Mixture No. 3	Mixture No. 4
	Per Cent.			
Manganese	1.50	0.50	0.80	1.50
Sulphur	0.03	0.05	0.06	0.03
Silicon	1.05	1.75	2.25	1.05
Phosphorus	0.05	0.06	0.06	0.05
Steel Scrap	....	....	....	16.00

From 10 to 12 castings were poured from each of these irons; and when the castings were broken, not one showed the least sign of sponginess or gas holes. The mold was poured full, and the first part to freeze was the entrance gate, so that there was no possibility of feeding. Only enough iron was poured to fill the cavity.

The time of setting was measured by the time the core remained in the casting before it was safe to draw it. Number 1 iron required 1 min. and 20 sec. before the core was drawn. When the core was allowed to remain in the casting 1 min. and 30 sec., it was gripped by the iron and had to be cooled to room temperature before removal was possible. Number 2 iron required 1 min., and Number 3, 30 sec. In Number 4 a new condition was set up when 16 per cent. of scrap steel was melted with the charge in the cupola. In this case it was 2 min. and 20 sec. before the core could be withdrawn. The results show that in a casting of this size the low-silicon iron cools much more slowly than one of higher silicon content. The effect of the long time in the mold was to make the casting very hard, and heat-treatment was given to bring it to machinability. The temperature of the core had no effect on the time of setting; the tenth casting was given the same time as the first, although the core was heated to a temperature of over 400 deg. F.



Section D-E-F

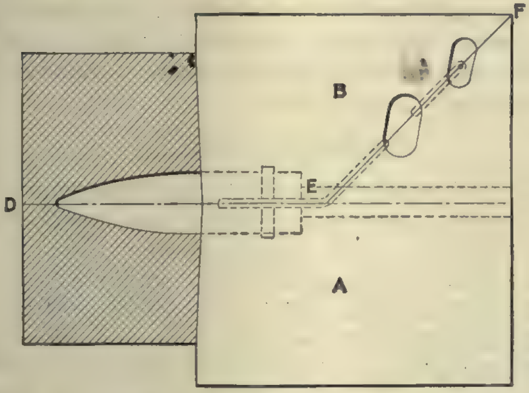


FIG. 2. THREE-PART PERMANENT MOLD FOR A 60-POUND SHELL

Mold for a 60-Pound Shell

A mold was made for a shell that, when finished, weighed 60 lb. The mold was made in three parts, as shown in Fig. 2, and was equipped with a cast-iron core. It will be seen that the portion of the shell forward of the bourrelet band is cast in the solid part of the mold, and no provision is made for venting. The parting of the movable portions of the mold runs in a straight line through the center of the shell and extends 3 in. beyond the base. It then turns at an angle of 45 deg. and runs straight the remaining distance to the outside of the mold. The pouring cup is placed about 5 in. from the outer end of the parting, and the main sprue runs down to an easy curve to the bottom of the trap. The entrance to the trap is ¾ in. in diameter, while the main sprue is 1½ in. in diameter. The trap gate is 5 x 4 in. with heavy filleted corners and open at the top. The sides are given ⅛-in. draft, so that the moving parts of the mold will open readily. The bottom of the trap is set low enough to allow a slight hump to be placed in the runner between the trap and the matrix. This hump serves to catch any air or dirt that may be carried with the first rush of the metal. The center line of the runner is 3 in. below the bottom of the matrix, and two gates are cut—one between the revolving band and the base and the other between the band and the bourrelet. The gates are $\frac{1}{16}$ in. wide and have a small fillet where they enter the matrix. The mechanism for drawing the core is attached to the part *A* and moves with it. Channels are cut in *A* and *B* in the proper position to receive the copper band. The operation of casting is as follows: The copper band is placed in the channels, the mold closed and then poured as fast as the runner will take the metal, keeping the pouring cup full until the end. In 4 sec. the core is withdrawn, the mold opened and the casting removed. The copper band will be firmly cast into place.

Toughness and Hardness

It was found that a mixture corresponding to No. 4 in the experiment previously mentioned, with the exception that the manganese was under 0.08 per cent., gave the casting the toughness necessary for the proper degree of fragmentation, but the long exposure in the mold made the casting too hard. A scleroscope reading of 65 to 70 was the invariable result irrespective of any difference in the mixtures. It was evident that some form of heat-treatment was necessary to bring the casting to a workable condition. It had been determined that a mark of 45 would give the proper degree of fragmentation. Quite a number of trials were made before it was found that a "flash" heat of 865 deg. C. would restore the casting to a good workable condition and bring the scleroscope to just about the correct figure. It was further found that the castings should be allowed to cool before being subjected to the treatment, so that a number of shells could be treated at the same time, starting at the same basis of temperature. If the heating furnace has sufficient heat capacity, it requires about 20 min. to bring the castings to the right temperature; and they are then allowed to cool free from drafts.

In a permanent mold, it is impossible to get a casting free from gas or air holes without the use of trap gates. There is no trouble in filling the mold when semi-steel is used. The metal does not need to be poured especially fast. Nevertheless, unless a substantial trap gate is provided, small holes will collect against the bottom of the core and the top of the casting. The most careful pouring will not change this condition. There is a point when semi-steel can be poured in a permanent mold without these holes forming and without trap gates; and that point is when the metal has cooled until it is almost viscid. The difficulty of successfully hitting this point is so great as to make this method beyond the range of commercial success.

The difficulties that lie in the way of making a cast-iron projectile in sand have been set forth. Some of these troubles may be avoided by the use of a permanent mold. The selection of different irons for different sizes of shells is not necessary. To explain this, one must take into account the fact that the influence of silicon and manganese is exerted only when the molten metal is cooling in the mold, and the total effect of this influence is measured by the time the molten metal takes to become solid.

In a sand-cast projectile weighing 65 lb., the time is 5 min.; in a permanent-mold casting the time is 5 sec. The softening effect of silicon is due to its property of forming graphitic carbon—in itself silicon is a hardener. A casting with no carbon and high in silicon would be hard as glass. It requires a certain amount of time to form the graphite flakes; and if this time is reduced to a minimum, the formation of these flakes will be prevented. Graphitic carbon will be present, but it will be in such a finely divided state as to be practically amorphous. It resembles the temper carbon of a malleable casting, but is uniformly distributed throughout the structure. Now if the time of setting is so short as to prevent the formation of graphitic flakes, it must follow that under these conditions silicon has no softening effect. The same statement may be said as to the effect of manganese. A moderate amount of manganese will add strength to a sand casting and is a valuable constituent for a great variety of work. In a permanent-mold casting the effect is to make the casting hard and brittle.

When cast-iron shells are used in the open, the fragmentation must be exact, but when used against earthworks, only the explosive force counts. Since it is impossible to set aside shells for each duty, it is obvious that the degree of fragmentation must govern the process. This is easier to accomplish with a permanent mold than by any other known process. As has been said, the question of hardness does not depend upon the variations of the pig iron so long as ordinary foundry iron is used. The same statement is true of the so-called semi-steel so long as the same percentage of steel scrap is melted with the iron. The term "ordinary foundry iron" is used to denote pig iron ranging from 1.75 to 2.75 per cent. silicon, below 0.80 per cent. manganese and with sulphur below 0.08 per cent. Phosphorus has no appreciable effect up to 1 per cent. A casting that would analyze 3 per cent. total carbon, 1 to 1.20 per cent. silicon, 0.06 per cent. manganese, 0.05 per cent. sulphur and 16 per cent. steel scrap would be an ideal composition for a 60-lb. shell. All shells, whether cast-iron or steel, must be subjected to a definite heat-treatment and, in the case of cast iron, the degree of heat and time of exposure to get the proper scleroscope test can be determined only by experiment.

THE DESIGN OF THE MOLD

Now a word about the design of the mold. The main point to be considered is that plenty of metal should surround not only the matrix, but also the sprues and runners. In a casting such as a 5-in. shell, there should be at least 10 in. of metal outside of every portion of the mold that comes in contact with the molten metal. The purpose of this is twofold—to provide a sufficient heat-storage capacity so that the molten metal will be robbed of its heat in the shortest possible time and to make the mold strong enough to resist the tremendous expansive power of the cooling metal. The matrix and the core should be made to the exact size of the casting before finishing. Make no allowance for shrinkage. Why there is no apparent shrinkage when these castings are made in a permanent mold is a moot subject. It may be that since the interior of the casting is molten when it is taken from the mold and the outside contraction has not started at the time of removal, the expansive force of the cooling interior metal will neutralize the contracting force of the cooling exterior. It is a very interesting point, but it is true that when the casting is so thick that the interior is molten at the time of removal, shrinkage may be safely ignored.

As a further item of design, the mold should be so equipped as to be easily and quickly opened and closed. The movable portions should run on grooved wheels fitting V-shaped tracks. The purpose of this is to prevent small particles of iron interfering with the adjustment of the moving parts. Casting is apt to be a sloppy proceeding and there are always small particles of iron splashing around. Mount the molds so that there is plenty of space underneath to collect any molten metal that may carelessly escape. Before closing the mold, run a flat scraper over the face to remove any smaller particles that may adhere. If these general rules are followed out, two 60-lb. shells can be cast every minute, and all will be of the same weight, size and texture.

POSITION OF COPPER BAND

There is one very important point in the manufacture of cast-iron shells that must be considered, and that is the position of the copper revolving band. In some steel shells this band is placed within a very short distance of the base, but in a cast-iron shell plenty of metal must back up the band. Even with the strength that steel gives, portions of the base are sometimes torn off by the tremendous force set up when the band enters the rifling at a very high velocity. The effect of this rupture is to disturb the trajectory and direction to such an extent as to render the shell not only useless, but dangerous. When the guns are behind the line, pieces of the band, base and even the projectiles may fall into friendly ranks with disastrous results. In a 5-in. shell, the distance between the band and the base must be at least 2½ in., and the band must be sunk into the body of the shell only sufficiently deep to hold it in position. If this point is not observed, the cast-iron shell will be a failure.

When the large projectiles are cast, there is a tendency to form wrinkles on the exterior and interior of the casting, due to the surge of the metal while pouring. This is an annoying feature, but the remedy is to make the main runner, where it enters the trap, the controlling factor. If the diameter at that point be kept so small that the main runner can be kept full of molten metal during the entire pouring, these wrinkles will not be in evidence.

The question arises as to the use of steel in permanent molds for the purpose of making shells. The added strength of this metal and the ease with which it can be brought to specifications in the open hearth are certainly attractive. There is no doubt as to the suitability of steel for this work, and it will readily pour in a permanent mold. Moreover, it is not hardened or weakened by the action of the mold. The grain is very fine, and it yields exceptionally well to heat-treatment. The main difficulty is that the process of casting in a permanent mold is a continuous performance, while the melting of steel in an open hearth is more or less intermittent. The steel, when it comes from the open hearth, must be poured without delay; and after the metal in the ladle is poured, there must elapse an interval of hours before the next heat is ready. Furthermore, the economical melting of steel demands that it be made in furnaces of large tonnage, and to pour this tonnage within the time limit within which the steel remains sufficiently molten to work would require an immense number of molds and an elaborate and costly equipment to handle the ladles, operate the molds and take care of the castings. If the melting of steel can be economically accomplished, so that a continuous supply of molten metal is available, then the manifest advantage of steel over cast iron can be utilized.

When steel is cast in a permanent mold, an allowance must be made for shrinkage, as there is not the same initial expansion as is the case with cast iron. A greater bulk of mold must be provided to take care of the higher temperature, and the gates, trap and runners must be given a coating of heavy clay wash after each pouring. This is necessary to prevent cutting the mold. A very slight undercut will put the mold out of business until repairs can be made. Once the "sting" of the molten metal is taken away by the runners, gates and trap, steel will do no harm to the matrix.

FRENCH SPECIFICATIONS

The French government has issued specifications for shells cast in sand, which are here given in part. They call for the analysis of shells of 122- to 155-mm. caliber. The chemical analysis is as follows:

	Per Cent.
Graphitic carbon	0.70
Combined carbon	2.40
Silicon	1.35
Manganese	0.70

The amount of total carbon and silicon must not exceed 4.7 per cent. If this limit is exceeded, the iron will lack toughness. At least 2 per cent. of the total carbon must be combined to produce proper fragmentation. The percentage of dust increases as the combined carbon decreases.

PERCENTAGE OF CARBON AND SILICON FOR BEST RESULTS

Although the sum of total carbon plus silicon is set at 4.7 per cent., it is preferable to keep these limits to 4.4 per cent. with a minimum percentage of silicon. The percentage of silicon varies according to the type of molding. In the 122-caliber the best results were obtained by using a minimum of 1.20 per cent. silicon for dry sand and 1.35 per cent. for green sand. The percentage of silicon varies in inverse ratio to the thickness of the walls and the caliber, the thicker the wall and higher the caliber the lower the silicon. Manganese decreases with the thickness of the walls and caliber and increases with the sulphur.

The sulphur should never exceed 0.08 per cent. and should be lower whenever possible. The percentage of phosphorus is set at 0.15 per cent. or under. The charge should be as follows:

	Per Cent.
Pig iron	40
Scrap	40
Steel	20

The term scrap is used to denote scrap melted. pigged and charged according to analysis.

These specifications correspond closely to the iron previously mentioned as being ideal for use in permanent molds. The striking point in the specifications is that the silicon decreases when a dry-sand mold is used, and this point is emphasized by the use of a still lower silicon in a permanent mold. The percentage of combined carbon will always be high when a permanent mold is used. Once the proper mixture has been determined, that mixture is used irrespective of the thickness of walls or caliber of shell.

All the foundries of France engaged in this work have been mobilized on a common basis and are using precisely the same methods of selection, analysis and general foundry procedure. This has not been done without enormous losses and vexatious delays; there have been many cases where the loss of the total heat has been reported, and a loss of 40 per cent. was not uncommon in the first stages. Teamwork, scientific methods and keeping everlastingly at it have brought results. Today the output has reached staggering proportions—over 1,000,000 rounds per day are being made.

DISADVANTAGES OF FORGINGS

Starting from the pig, the manufacture of a steel forging involves many operations and a huge outlay for equipment. The steel is made, poured into ingots, rolled into rounds, cut into blanks, heated to the forging temperature, pressed into the rough shape, pierced and run through a draw bench before the forging is ready for machining. A shell cast in a permanent mold and starting from the pig has but two operations—melting and molding. The heat-treatment of the steel shell before machining is completed is balanced by the heat-treatment of the cast-iron shell before machining.

A steel forging for a 4.7-in. shell costs over $7 at the present writing, while a casting for the same shell can be made for a little over $2. Furthermore, a liberal saving in labor and machine-tool consumption can be effected. When larger projectiles are made, a larger proportionate saving will follow. When more than 1,000,000 rounds per day are made, and this is a low figure to expect, the difference in cost seems incredible. If $6,000,000 or $7,000,000 are spent each working day for shells alone, the incentive for saving a substantial portion of this tremendous outlay becomes a vital necessity, especially when the cheaper shells will give as good if not better service than the more costly ones. There is no comparison between the shells when the question of output is considered. Taking dollar for dollar invested in equipment, the output of cast-iron shells is 10 times greater than the output of steel forgings.

The low cost, great output per day and the effectiveness of cast-iron shells have been so completely recognized that two of the warring nations are using them to an enormous extent. France is casting them in sand,

and Germany, from the best information available, is casting them in permanent molds.

It is very hard to come before a body of intelligent and experienced men—men whose achievements have set the pace for the world—and say that, at this writing, it is doubtful if there is a foundry in the United States that could qualify at once for this work without material changes in procedure. Primarily, it is not a commercial proposition; and if this Government decides to use cast-iron shells, the work must be undertaken with the foreknowledge that trouble is ahead. The necessity will be paramount of not only putting forth prodigious efforts, but also of sinking individuality for the common good. A full and free interchange of ideas and data is indispensable. There is no doubt of the ultimate outcome; but if the experience of those who have been through the mill is utilized, a deal of time, trouble and treasure will be saved.

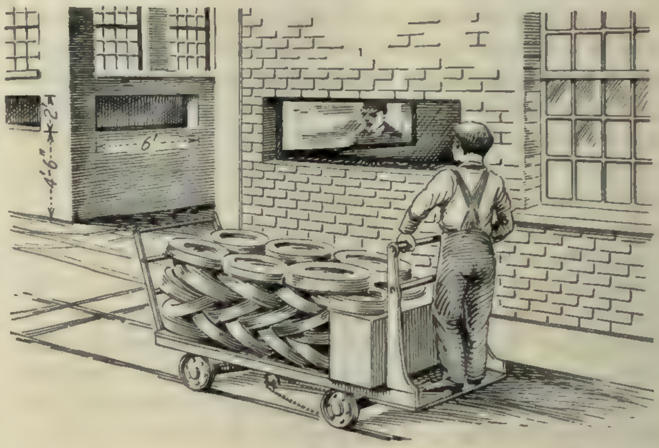
Preventing Truck Collisions

By W. A. Lailer

In connection with the hauling of various machine parts from one section of our plant to another—that is, from building to building—we make use of a number of electric trucks. Though the drivers were frequently cautioned as to care in driving, accidents happened.

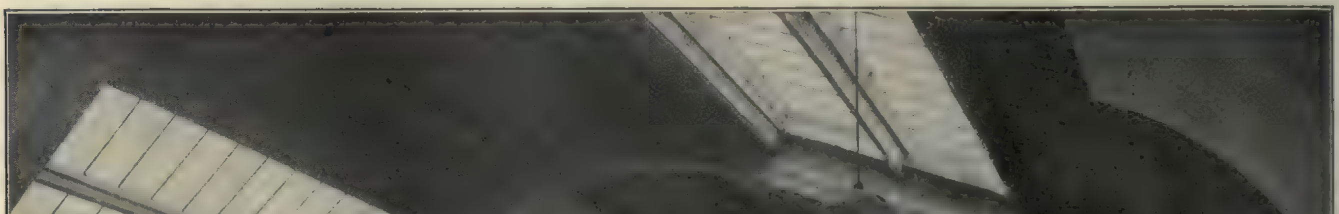
It was found that the great majority of these occurred at the corners of the various buildings, the trucks either colliding with another truck turning the corner from the opposite direction or colliding with employees on foot rounding the corner.

In order to eliminate this source of trouble, we cut windows in the wall of each building near the corner, as shown, each about 2 ft. high by 6 ft. long, and placed about 4 ft. 6 in. above the ground. By means of these windows the truck drivers or pedestrians approaching the corner can observe whether a truck or person is coming the other way, and hence can act accordingly. This scheme has proved very efficacious.



SAFETY WINDOWS

Unusual Roof Construction



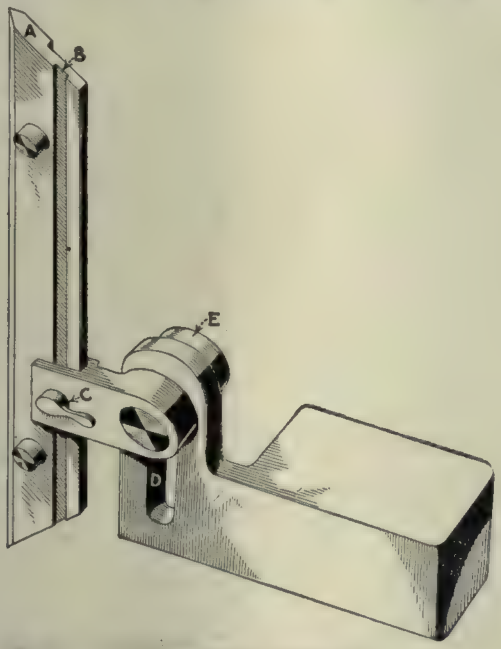
THIS PICTURE, WHICH IS SHOWN THROUGH THE COURTESY OF "AERIAL AGE," SHOWS AN INTERIOR VIEW OF THE POMILIO AËROPLANE FACTORY, TURIN, ITALY. IT IS OF ESPECIAL INTEREST ON ACCOUNT OF BEING AN UNUSUAL TYPE OF FACTORY CONSTRUCTION, OBVIATING THE USE OF OBSTRUCTIVE PILLARS

Knife-Edge Sine Bar

By Helmer T. Book

The accompanying illustration shows a tool that is very handy for accurately setting up angles. The blade *A* is made with a knife-edge, and two buttons are set parallel to its edge, as on a sine bar. The blade is adjustable, sliding in the groove *B*, and can be securely clamped to the eccentric *C*. The slot *D* in the base permits adjusting for different heights.

The blade is set in the same way as a sine bar. What I have found to be the quickest way is to use adjustable size blocks and let the buttons come down on them, the base and blocks resting on a surface plate, then tightening the nut *E*. For example, if the required angle calls for a difference in height of buttons of 1.350 in., I would make one block 1 in. and set that under one button; and another block 2.350 in., and set that under the other button.



KNIFE-EDGE SINE BAR

Perpetual Stock-Inventory Board

By G. G. Porter

Vice President, Porter-Cable Machine Co.

In keeping the perpetual-inventory card system of parts in the finished-stock room, we found that much time was lost in continually looking over the cards to see that orders for parts that had dropped below the minimum quantity were being taken care of in the factory in time to meet requirements.

It became evident that some kind of visible record that would show at a glance which parts needed to be given preferred attention would be very desirable, so the writer designed the perpetual visible inventory board, as shown by the accompanying illustrations. Since this device has been put into use, we have not been caught short when getting out a schedule of parts for final assemblies, as was quite often the case when we depended entirely on the card records.

Fig. 1 gives a general idea of the device, which was made alike both front and back, to economize room. Fig. 2 is a somewhat enlarged view of the business portion of one side. Fig. 3 is an enlarged partial view of Fig. 2, showing the device in greater detail.

The uprights of the frame are made hollow and carry counterweights. This allows the board, which is 36 in. wide by 42 in. high, to be raised or lowered for the convenience of the person in charge of it. The center of the board is made of soft wood and is covered on each side with hard felt about 1¼ in. thick. The felt is covered with cross-section paper 10 to 1 in., on which the records are made as shown.

It is to be regretted that the original lines on the section paper are so faded that they are nearly indistinguishable. We are making another board and have gone over the lines with a permanent ink and are also mounting the section paper on tough drafting paper before mounting to the felt, which seems to work out much better and give a smoother job. Every other horizontal line was inked in a little heavier than the original lines, as an aid in positioning the pins. The vertical lines should have been inked over, every tenth line being heavy and the intermediate lines light. Glass doors fitted with lock and keys cover the board and protect the pins from being moved accidentally or by anyone other than the one in charge of it.

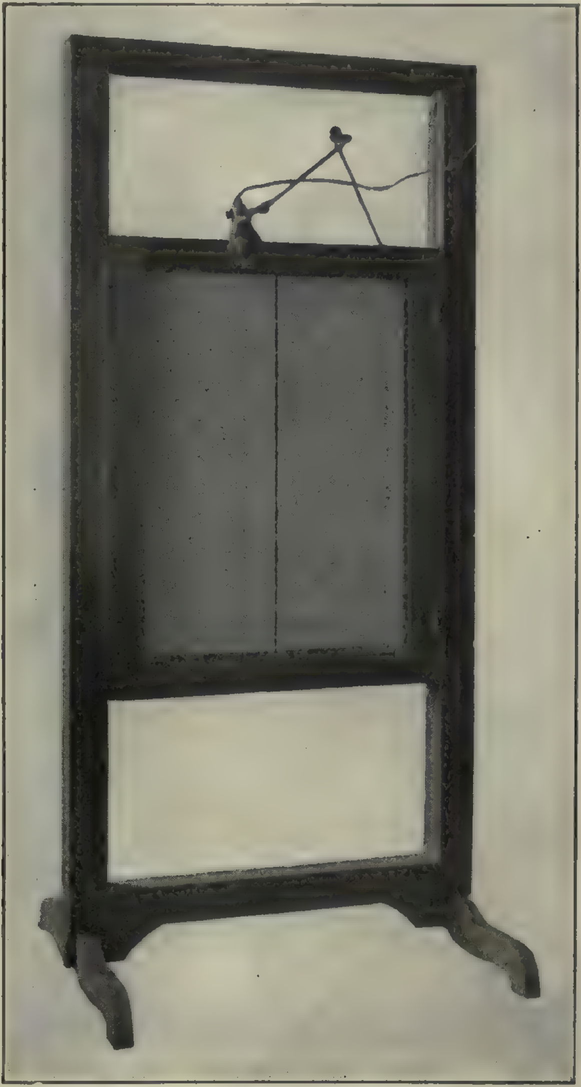


FIG. 1. GENERAL VIEW OF BOARD

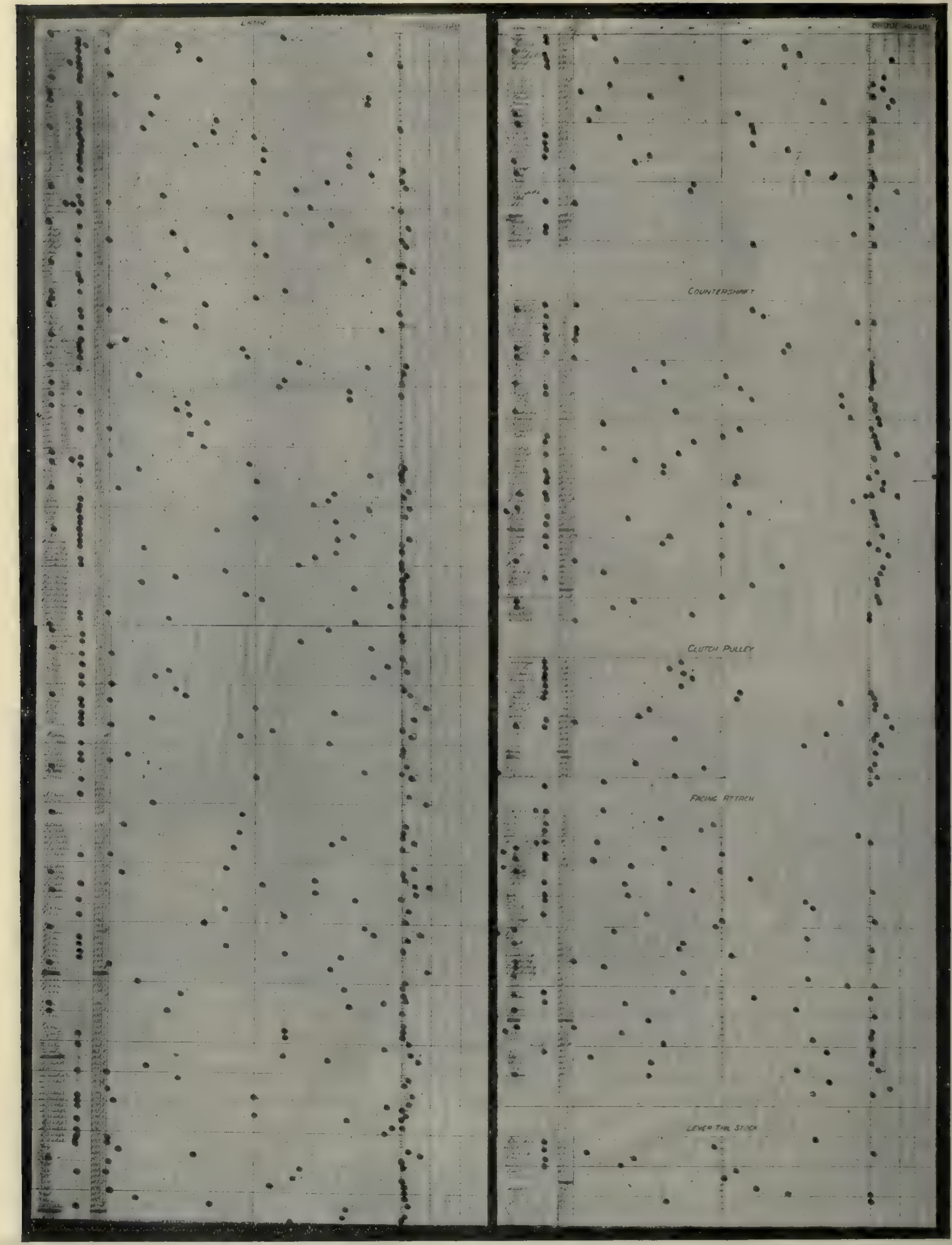


FIG. 2. ENLARGED VIEW OF STOCK SHEET

The operation of the device is as follows: All parts that go into the manufacture of our products, whether made in our shop or purchased elsewhere, are numbered and listed on the board under the proper headings, which also correspond to the perpetual-inventory cards. Black and red pins are used to indicate the number of parts on hand the position of a pin opposite a part indicating the number of those parts in finished

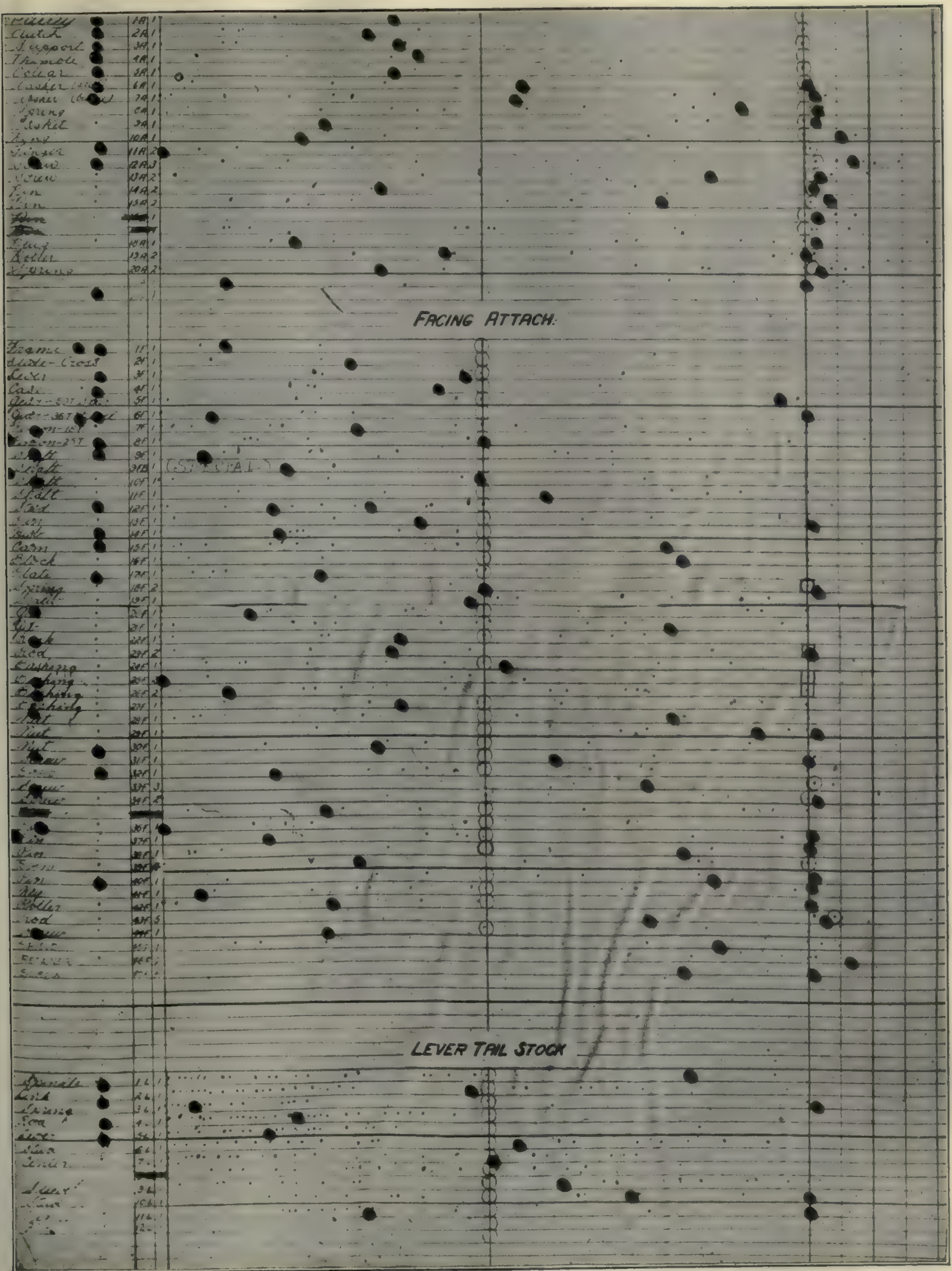


FIG. 3. DETAILS OF STOCK SHEET

stock, each vertical line from the left next to the part representing a single piece up to 100 lines. To the right, each vertical line represents 100 finished parts in stock.

The vertical lines representing 50, 100, 500, 1000, etc., are made heavier than the others, as shown. Referring to Fig. 3, the pin opposite "Lever 3-F" shows that there are 48 pieces in stock. The minimum quantity of these pieces is 50, which is indicated by a red circle drawn around the 50 position. As the number of these parts in stock is below the minimum, a red pin is used. Black pins are used to indicate parts that have not reached the minimum as yet. Therefore, a glance at the board instantly shows which parts are getting low and should be rushed through the factory.

When the parts drop below minimum, the stock keeper starts through a requisition for another order and inserts a green pin over, or to the left of, the part name. When the stock is out and the job started through the shop, the green pin is moved to the right between the part name and number, where it remains until the job is completed. Referring again to "3-F," the pin between the name and part number is green and indicates that an order for these parts is going through the shop.

In Fig. 3, there are two black pins opposite "Plug 18-A." The pin to the right stands on the 200 line and the one to the left on the 21 line; this indicates that there are 221 of these parts in stock.

A list is kept each day of finished parts received into or delivered from the finished-stock room, and from this list the next morning the finished-stock clerk posts the perpetual-inventory cards and changes the location of the pins on the inventory board.

Universal Angle Plate for the Use of Toolmakers

By R. Bernhardson

In Figs. 1 and 2 are shown opposite views of a new and helpful little fixture that has been of considerable aid to its designer in solving plain and difficult jobs. The fixture is adapted for the use of mechanics engaged in the production of work requiring precision. It is especially valuable to those who have to do with dies, master plates, gages, jigs and experimental work. Ordinarily, work of this character requires frequent changing, and set-ups are sometimes rather costly; but with this fixture, jobs are very often laid out, set up and finished in one setting.

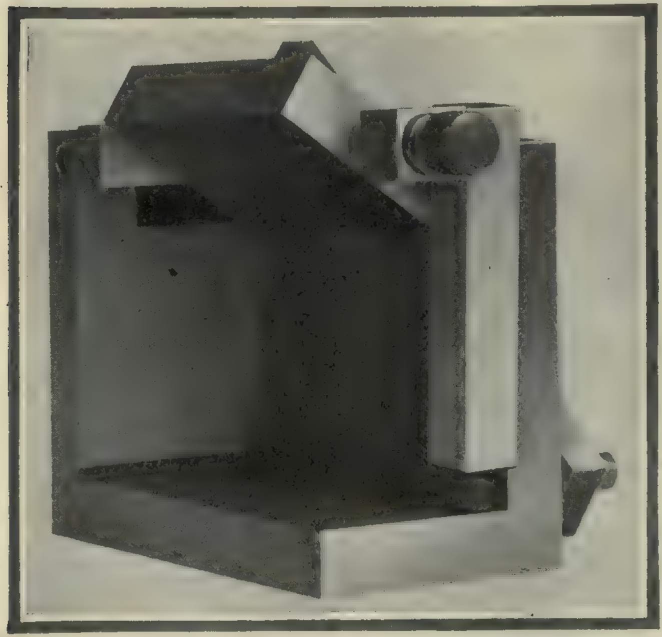


FIG. 1. FRONT VIEW OF UNIVERSAL ANGLE PLATE

The angle plate consists of 11 parts—the body, tilting table, hinge plate, two locking screws, two adjusting bars, hinge bar, sine bar and two locating pins. All of its sides are square. The tilting table can be set to two different angles at once and locked securely with the aid of a clamp over the adjusting bar. The adjusting bars are so made that the tilting table can be set to any angle within its range and in four different positions on the horizontal line. The sine bar can also be set to any angle or fraction thereof and can be held accurately with any suitable instrument over the locating pins. It is understood that, when accuracy is mentioned, degrees or fractions thereof will have to be converted into thousandths of an inch before measurements can be taken.

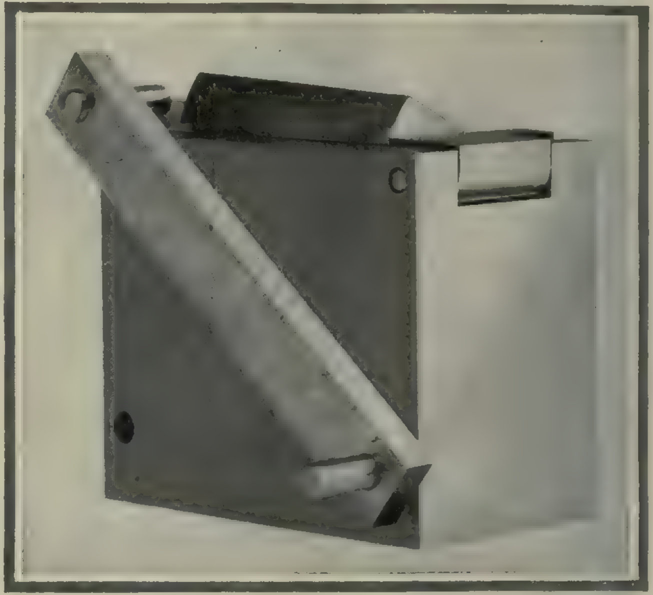


FIG. 2. BACK OF PLATE, SHOWING SINE BAR

The angle plate can be used to advantage on the bench and on almost any machine in the toolroom—for instance, the lathe and milling, planing, shaping, surface grinding and drilling machines.

Cost of Welded High-Speed Tools

By A. D. Hallett

The accompanying figures, from costs taken on a lot of 300 welded tools recently made, readily indicate the advantages of tools with cheap steel shanks and welded high-speed steel cutting tips taken from the scrap box. At a total first cost of less than 24c., a tool was made that replaced the customary $4 one in use in most shops.

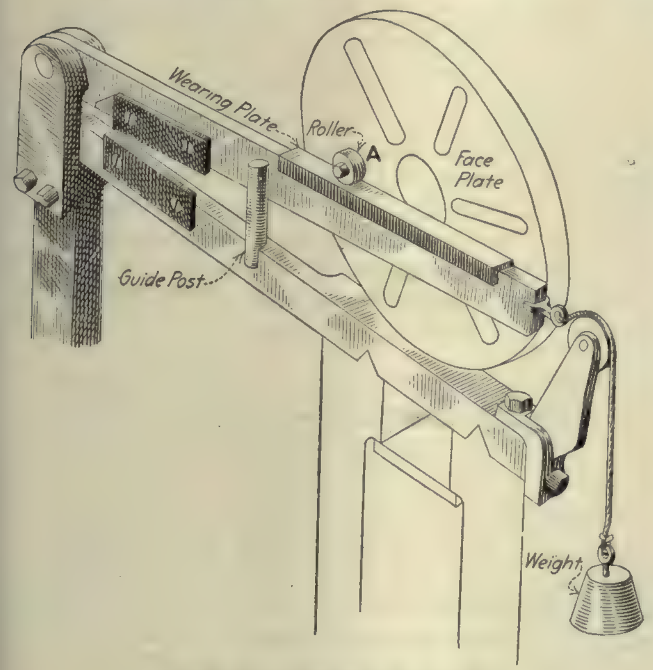
COST OF 300 WELDED TOOLS

Labor:	
Saw	$2.00
Shape	3.00
Blacksmith	3.00
Pack harden	1.60
Oxyacetylene weld	22.00
Rough grind	8.90
Gas harden	6.22
	$46.72
Material, 320 lb., new cold-rolled stock	22.40
Total	$69.12

Home-Made Power Shear

By C. H. Willey

The illustration shows how we made a power shear from material found around the machine shop. The method of attaching the shear to a lathe is also shown. A stud and roller *A* on the faceplate drive it. The back gears are used, and the lathe is run on slow speed.



HOME-MADE POWER SHEAR

Electric Pointers for the Shop Man

By Donald A. Hampson

Shops with electric drive often have no electrician in their employ. In such cases, if someone in the shop with a liking for electrical work is given a little elementary instruction, annoying delays and their loss may be avoided.

Alternating current, 220 volts, three phase, is commonly found outside of the larger cities. A typical fuse box for this is illustrated by Fig. 1, and the testing apparatus in Fig. 2—that is, two 110-volt lamps connected together in series, as shown, with a free wire, or lead, about 6 in. long extending from each lamp. The ends of the leads are scraped bare so as to make better contact when applied to a terminal.

Current enters by the three wires on the right, Fig. 1, and passing through the fuses, leaves at the left through the wires running to the motor. The fuses are the breaking members—the automatic "safeties" to guard against an overload on the motor or any excess current passing through the wires—and will "blow" in 95 per cent. of all cases before any other part of the electrical system is injured. With the three-wire system, an excessive current will blow out any one or two fuses; and it is from the fact that the ordinary cartridge fuse looks the same "before and after," in most cases, that there is a doubt as to which fuses are blown.

The test is simple and is made by applying the bared ends of the lamp leads to opposite ends of the fuses or the fuse clips or the wire connections. Referring to Fig. 1, it will be seen that the ends of the fuses are lettered; also, that the lamps are connected across from *A* to *E*. Now if the fuse *BE* is good, the lamps will light; otherwise, they will not. If the lamps light when tested across *A* to *F*, the fuse *CF* is good. This merely shows that the fuse *CF* is bringing the current to the end *F*. If it were not, there would be no current at *F* to pass through the lamps and light them when contact is made at *A*.

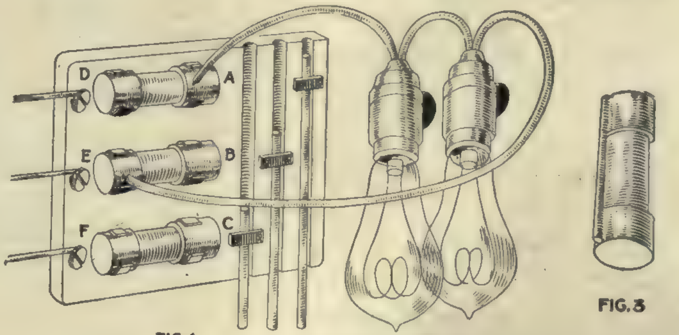


FIG. 1 FIG. 2 FIG. 3

FIGS. 1 TO 3. FUSE BOX, TEST AND REPAIR

Testing both ends of the same fuse will not light the lamps either with good or with blown fuses. The tests should be from *A* to *E* and to *F*, from *B* to *D* and to *F*, from *C* to *D* and to *E*. As explained in the preceding paragraph, the bad fuses can be detected and eliminated in this way. If there is a doubt as to any fuses on hand, they can be slipped into the clips after quitting time and tried out.

When it happens that there are no spare fuses and they cannot be had without delay, resort may be made to the simple expedient of bridging from end to end of a blown fuse on the outside. In Fig. 3 is shown a wire thus soldered on. A piece of copper wire or a strip about the size of the wires of the circuit is best to use. It should be understood that with a good cartridge fuse the ends are so joined, but the connection is inside the case and of a soft metal of proper resistance. The wire soldered outside performs the same function, but is not safe for many reasons, and such a doctored fuse should be replaced at the first shutdown.

Loosened connections are the only other common electrical troubles that do not call for expert repairs. There is always more or less jar about machines and buildings in which they are installed, and the screws at terminals sometimes work loose; then the contact is poor, and the resistance of the joint increases so that the parts heat up, often burning off altogether. This latter trouble is the first indication of the loosened screw, unless someone regularly goes over the terminals to try them.

Fuses have to be tested with the switch closed. All other work on the line, even changing fuses, should be done with the switch *out*—open.

Explanation of the Failure of Material

By William W. Gaylord

Chief Draftsman, Coe Brass Branch, American Brass Co.

I was very much interested in your article on the "Explanation of the Failures of Material" on page 813, Vol. 46, and the comparison of the various theories, but found one statement which I think must be a mistake. The statement is made that in determining the thickness of a hydraulic cylinder the maximum-stress theory and the maximum-shear theory will both lead to the same thickness of metal needed to withstand a given pressure with a given factor of safety, while the maximum-strain theory will suggest a smaller thickness of metal.

Now the formulas for the thickness of a hydraulic cylinder by the three theories are as follows:

Maximum stress $t = r\left(\sqrt{\dfrac{f+p}{f-p}} - 1\right)$ (Lamè) (1)

Maximum strain $t = r\left(\sqrt{\dfrac{4f+3p}{4f-5p}} - 1\right)$ (Lanza) (2)

Maximum shear $t = -r \pm \sqrt{\dfrac{2pr^2}{f-2p} + r^2}$ (3)

in which

r = Inside radius of cylinder;
f = Safe stress in tension;
p = Internal pressure;
t = Thickness of cylinder.

Now, taking a concrete example, assume a cylinder 2 in. inside diameter made of steel having a safe working stress of 16,000 lb. per sq.in. in tension and made to stand 6000 lb. per sq.in. internal pressure.

By formula (1)

$$t = 1\left(\sqrt{\frac{16{,}000 + 6000}{16{,}000 - 6000}} - 1\right) = 1\left(\sqrt{\frac{22{,}000}{10{,}000}} - 1\right)$$
$$= 1(1.48 - 1) = 0.48 \textit{ in.}$$

By formula (2)

$$t = 1\left(\sqrt{\frac{64{,}000 + 18{,}000}{64{,}000 - 30{,}000}} - 1\right) = 1\left(\sqrt{\frac{82{,}000}{34{,}000}} - 1\right)$$
$$= 1(1.55 - 1) = 0.55 \textit{ in.}$$

By formula (3)

$$t = -1 \pm \sqrt{\frac{12{,}000}{16{,}000 - 12{,}000} + 1} = -1 \pm \sqrt{3 + 1}$$
$$= -1 \pm 2 = 1 \textit{ in. (using positive root only)}$$

This shows that the maximum-stress theory would suggest the thinnest cylinder wall, while the maximum-shear theory would require the thickest, with the maximum-strain theory between the two.

The experiments of Cook and Robertson reported in London *Engineering*, Dec. 15, 1911, seem to show that if formula (3) be modified to

$$t = -r \pm \sqrt{\frac{2pr^2}{1.2f - 2p} + 1}$$

it will more nearly represent the experimental results.

The writer has used this formula on steel cylinders and fittings, both forged and cast, for several years with satisfactory results. Applied in the example above,

$$t = -1 \pm \sqrt{\frac{12{,}000}{19{,}200 - 12{,}000} + 1} = -1 \pm \sqrt{2.67}$$
$$= -1 \pm 1.63 = 0.63 \textit{ in.}$$

In this formula f may be taken as two-thirds of the elastic limit of the material for cylinders not subject to hammer or shock, but where there is water-hammer the stress f should not exceed one-half the elastic limit and in very severe cases one-third should be used.

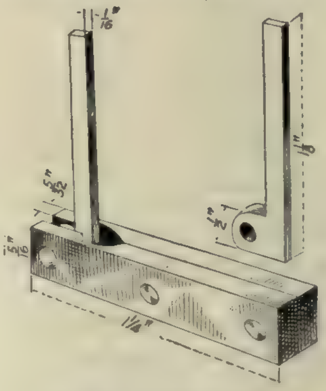
For cast iron, formula (1) should always be used, as this material fails in tension at a lower stress than in shear.

Handy Diemakers' Square for Small Work

By H. A. Schauer

Only a few dimensions are given on the accompanying sketch of a very handy diemakers' square, just enough to give an idea of its general proportions. This one is for fairly small work, but anyone desiring such a tool would have to make it to meet his special requirements.

Its special feature is the hole beneath the blade, enabling one to see what sort of contact is made between the blade and the work inside a hole or slot in a die. As the amount of clearance used in different shops varies, the blade is adjustable. The base is made in two parts, so that the sides of the slot holding the blade can be ground parallel. In this way, a fit can be made that will be tight enough to hold the blade in place. While this blade is put in with a rivet, anyone having the time can use a tapered screw or some other means that will fasten the blade securely and still be easily loosened when it needs adjusting.



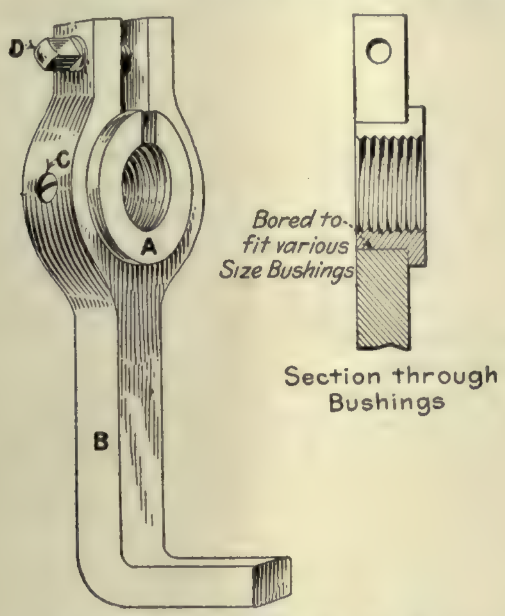
HANDY DIEMAKERS' SQUARE

Driver for Threaded Work

By William Forray

The accompanying illustration shows a tool that I am using with excellent results on threaded work. The device eliminates the "hunting up" of the two halves of nuts and a suitable lathe dog. As the dog does not make himself noticed by barking, I designed one that bites.

The device consists of a set of split bushings of the kind shown at *A* for various sizes of threads. The bushing is fastened to the driver *B* by a headless set-screw *C*. By tightening the bolt *D* the driver will be clamped firmly to the work, without injuring it.



DRIVER FOR THREADED WORK

Safety Device for Semi-Automatics

By Charles H. McCarter

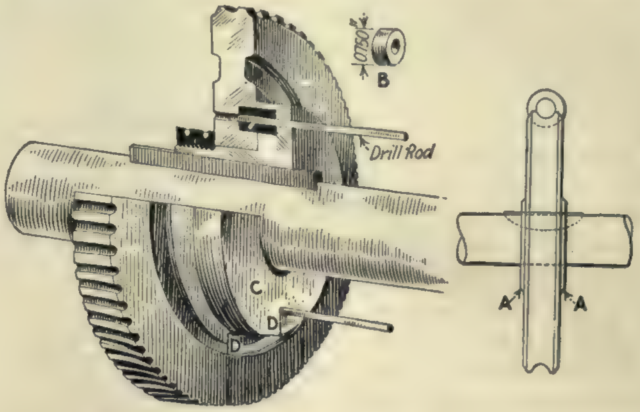
The worm and wormwheel shown in Fig. 1 were used on a semi-automatic turret machine to drive the drum on which the cams were placed for controlling the movements of the turret tools. It frequently happened that the tools jammed and sometimes broke, or the wormwheel cracked at the hub where it was keyed to the shaft.

This in time became quite an expensive proposition, as the wheel, which was 18 in. in diameter, had to be replaced, and in addition there was the loss in production. It was decided to put in a safety arrangement, so that, if the tools jammed, a pin would shear off and the turret remain idle until backed out by hand.

The hubs *A* were turned down flush with the sides as shown. Then a flanged bushing *C* was made of cast iron and faced and turned true to fit the enlarged bore of the wormwheel. One end was threaded with a 20-pitch thread and contained two circular locking nuts to keep it in place. This casting *C* was slotted and keyed directly to the shaft of the cam drum.

On the faces of the wormwheel and bushing *C* two holes were bored to receive the hardened and ground disks *B*. These disks were made of Firth Sterling Special tool steel and the holes were lapped to fit 0.125-in. drill rod. The disks were made a drive fit in the wormwheel and in the flanged bushing. The whole thing was assembled. Then the 0.125-in. rod was driven in place in each set of disks and the machine started.

When the strain on the machine became too great, the hardened disks simply sheared the drill rod; the machine was stopped, brought back to position by hand, the drill rod driven in a trifle farther, and the machine was ready to proceed as before. The relative position of the bushings was easily found by marking a line and figure on the two castings.



SAFETY DEVICE FOR SEMI-AUTOMATIC

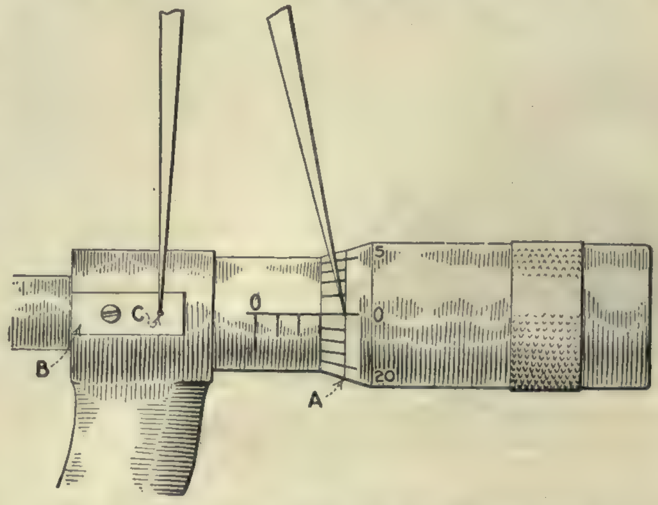
This arrangement proved satisfactory, and it was only necessary to take the disks out at intervals.

Using a Micrometer to Set Dividers

By George F. Kuhne

The illustration herewith shows how a micrometer can be used for setting dividers. Upon the sleeve of a micrometer a line is cut 0.050 in. from the end, as shown at *A*, and on the frame a slot is milled and the piece inserted at *B*. A prick-punch mark *C* is made in the insert *B*, for one leg of the dividers in setting.

Assuming that, when the sleeve is at zero on the thimble, the distance from *C* to the line *A* at zero is 0.100 in. and that we wish to scribe a radius of a circle 0.350 in., the adjustment is made to correspond to the reading, as in the drawing, which shows 0.075 on the reading and plus 0.100 = 0.175, the required distance.



MICROMETER ARRANGED TO SET DIVIDERS

Editorials

Some Problems of the Machine-Tool Builder

NEVER before has the importance of machine tools been such a vital factor and never before have the machine tool builders been confronted by so many problems. The greatest of these problems are raw materials, labor and prices, and these are sufficiently important to demand the most careful consideration.

* * *

The fixing of prices on pig iron and copper has given a basis for future prices but does not affect the present, as the material which will be used during the next few months at least, had already been bought at the higher prices. For every prudent business man always endeavors to safeguard his supply of raw material by contracting for it far enough in advance to insure a constant and adequate supply; otherwise he cannot do his share toward the much needed output of machine tools. With this in mind it is clear that no reduction in the cost of production can be looked for from this source until pig iron and copper begins to be bought at the new price.

* * *

The question of labor is a very serious one, with the actual wages even less important than the supply of workers. This is all the more perplexing and exasperating owing to the inflexible and uncompromising attitude of the war department regarding exemptions. Thousands of skilled draftsmen, machinists and workers of various kinds are refused exemption, even where they are working directly on machines for government use, or on other equally important work, making the term "selective" a misnomer as applied to the industries.

Machine tool builders are being urged to increase their output and at the same time they are compelled to train new men, and to substitute women, for skilled workers who could unquestionably be of more service in the shop than in the army.

The time seems to be ripe for a vigorous protest from all the industries against the failure to recognize the necessity for skilled men being kept where they can be of the greatest service to the country. Even if they be not exempted they should be assigned to duty in the plants where their skill can be utilized to the utmost, not for themselves or for the industry, but for the benefit of the whole country in helping to win the war.

* * *

The introduction of women into the machine shop is another problem, and one which is more complicated than might appear on the surface, especially in the older shops. There is no question as to the work women can do in the shop, but it takes time to train them, the same as with inexperienced men, and time is one of the very important elements at the present. Then too, it is not to be expected that many women will be either adapted for or inclined toward the positions which require a fundamental or all-round knowledge of machinery.

* * *

The problem of price is also pertinent and troublesome, for while prices have necessarily advanced, in some few cases to a high figure, it is important and interesting to note that machine tools have advanced less than almost any other product, during the past three years. With pig iron jumping from $10 to $55 a ton in some cases, copper from 11 or 12 cents to 35 cents, and high speed steel from 60 cents to $3 a pound—the advances that have been made in machine tool prices seem insignificant.

The inference is surely justified that either the other products have been advanced much more than necessary or that machine tools are still under priced.

The following table shows the advances in a number of products in similar lines, all of which affect the machine tool industry:

	Aug., 1914	Aug., 1917	Increase in $	Increase in %
Pig iron—No. 2 Southern at Birmingham	$10.00	$47.00	$37.00	370%
Castings	2.31½	4.51	2.18½	94%
Machine steel	1.15 (Base)	4.25 (Base)	3.10	270%
Cold rolled steel	1.50 (Base)	4.50 (Base)	3.00	200%
High speed steel	.60	2.50	1.90	316⅔%
Alloy steel and spindles	3.20	8.50	5.30	165⅝%

* * *

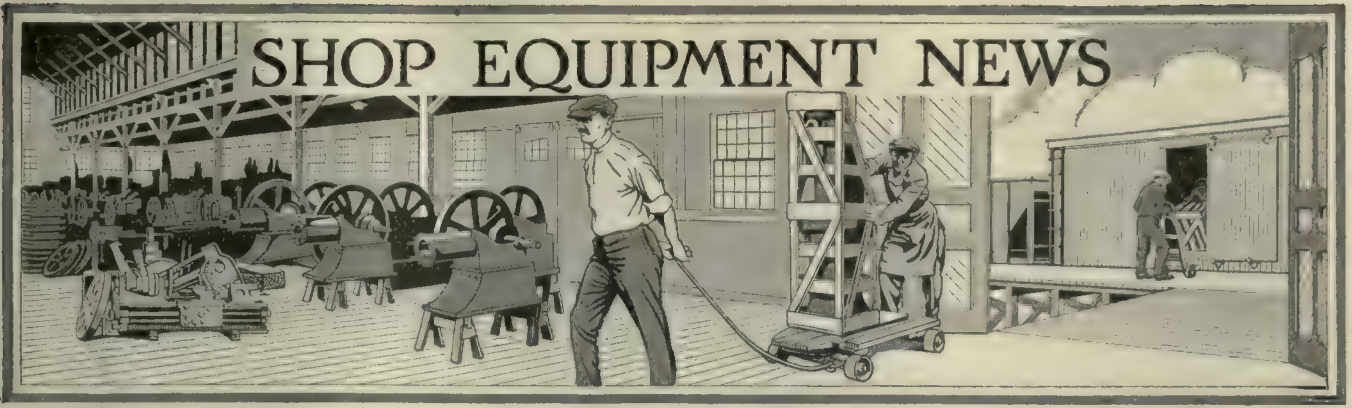
After studying these figures and noting the huge increase and prices since 1914, machine tool builders can certainly claim moderation when they realize that the average advance in machine tool prices has been 60 and 70 per cent. Some, to be sure, have advanced 100 per cent. or more, but these are offset by those that have advanced only from 20 to 30 per cent. in some cases. With such a showing as this, the machine tool builder may well object being classed with those who have used the war as an excuse to secure the greatest profits possible.

The Editor Becomes a Major

IT IS with genuine regret that we announce the retirement of John H. Van Deventer as Editor-in-Chief of the *American Machinist* for the duration of the war, for it is Major Van Deventer now, and though we know that his absence is but temporary we await his return with pleasant anticipation.

Mr. Van Deventer has been serving the country in various ways, mostly through the columns of the *American Machinist* since the war began, but we are glad that his abilities have been so well recognized by others, and that he now has this opportunity for direct service to the Government in its hour of need. He is now connected with the Gun Division of the Ordnance Bureau.

He carries with him in his new work the best of wishes from his staff and from all his business and personal associates.



This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Cone Automatic Four-Spindle Screw Machine

The accompanying illustrations show the Cone automatic four-spindle screw machine, made by the Cone Automatic Machine Co., Windsor, Vt.

Fig. 1 shows a partial end view of the machine, with the hinged gear guard thrown back to illustrate how easy it is to get at the mechansim. Fig. 2 is a similar view from the same end but opposite side. Fig. 3 is a side view with all guards removed, showing how unusually accessible all parts of the machine are to the operator with no disturbance to the adjoining mechanism.

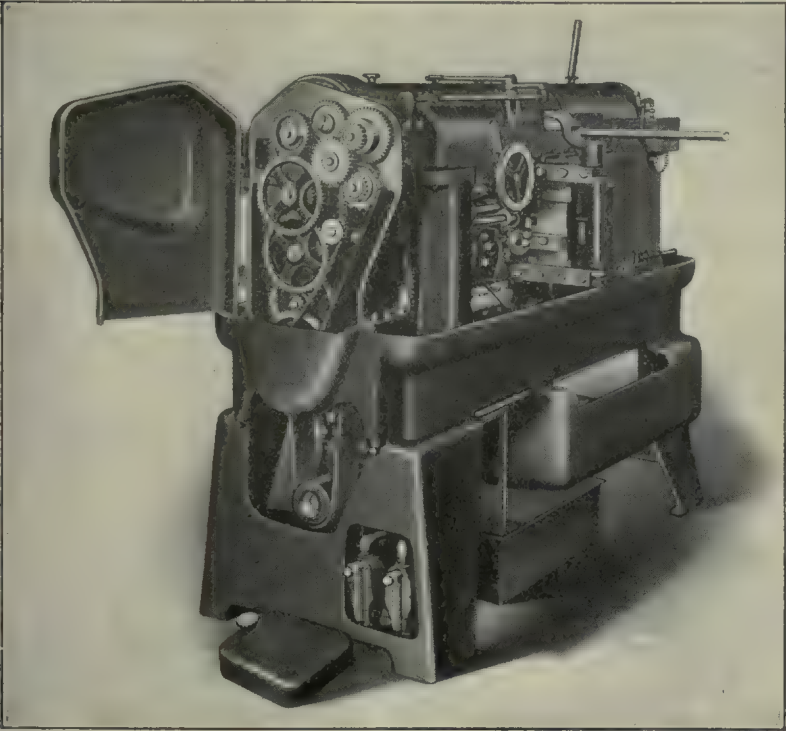


FIG. 1. MACHINE WITH GEAR GUARD OPEN

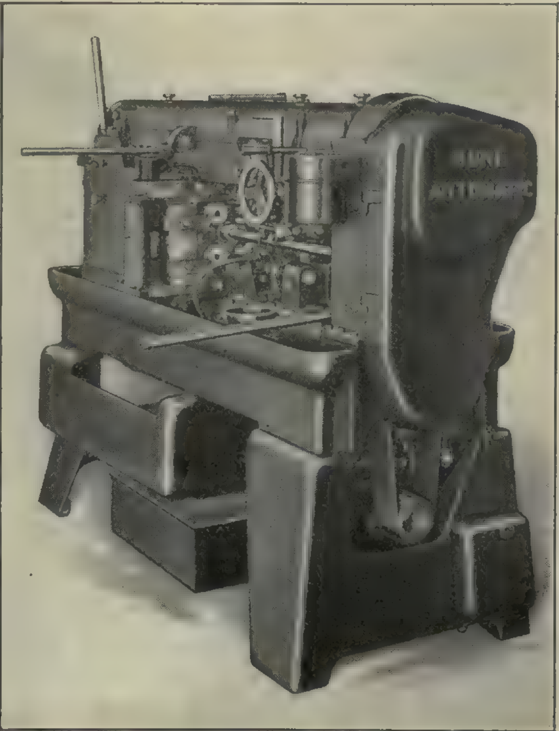


FIG. 2. OPPOSITE VIEW WITH GUARD CLOSED

This machine is built in three sizes with a capacity of 1 in., 1¼ in. and 1⅝ in. diameter by 6 in. long.

The machine is of double bed construction, one bed being over the other and separated by spacers. The upper bed carries the feed works, camshaft, main drive pulley, stock feed mechanism and indexing mechanism, all of which are very readily accessible. The entire camshaft assembly can be quickly removed by merely taking the bearing caps off. As previously stated, the upper bed is supported on and bolted to spacers which in turn are bolted to the lower bed. The right-hand spacer is in the form of a hollow column. In the motor driven machine the belt passes down through it to the motor below. When countershaft drive is provided the belt passes upward from the drive pulley to the countershaft above. No change is necessary in the machine to adapt it for either type of drive. At the end of the machine the spacer is provided with a door which covers all the change gears for the spindle drive and feed works. These are carried in the upper bed.

The center spacer carries the forward end of the spindle carrier, both cross slides and the index locking pin. The cross slides carry three forming tools, if necessary, and one cutting off tool. The cross slides have flat bearing surfaces. A taper wedge gib at the top provides adjustment for wear, and flat gibs with cap screws hold the slides sidewise.

The rear spacer carries the rear end of the spindle carrier, and means is provided for taking up any wear in the latter.

The spindles are of hardened steel ground all over, and run in adjustable bearings of phosphor bronze. The locking pin blocks are located beyond the full diameter and at the spindle nose end of the spindle carrier. They can readily be removed without disturbing any other part of the mechanism. Cutting off, the final operation, is done on the upper front spindle. This arrangement brings the last and first operations to the front of the machine, enabling the operator to see whether his work is coming correct at the finish, and if it is starting right. There is another advantage of having the forming operations on the first two slides which are close to, and supported by, the lower bed. The work coming from the final spindle is practically free of chips, and as there are only the cutoff chips to contend with the separation of work and chips is a simple matter. All turning, heavy drilling and forming is done on the two lower spindles. If necessary the rear upper spindle can be provided with a high-speed drilling attachment. The feeds of the upper spindles are independent of each other, and of those of the lower spindles. The lower spindle feeds are not independent of each other, but can of course, be arranged fast or slow as the work demands. The stock stop is controlled by the cutoff slide, the stock being fed while the tool slides are returning. The chip pan is provided with a strainer bottom, underneath which is the sump from which the pump sucks. At the end of the machine there is a wide opening into the chip pan so that the chips can be easily removed without interfering with the operation of the machine in any way.

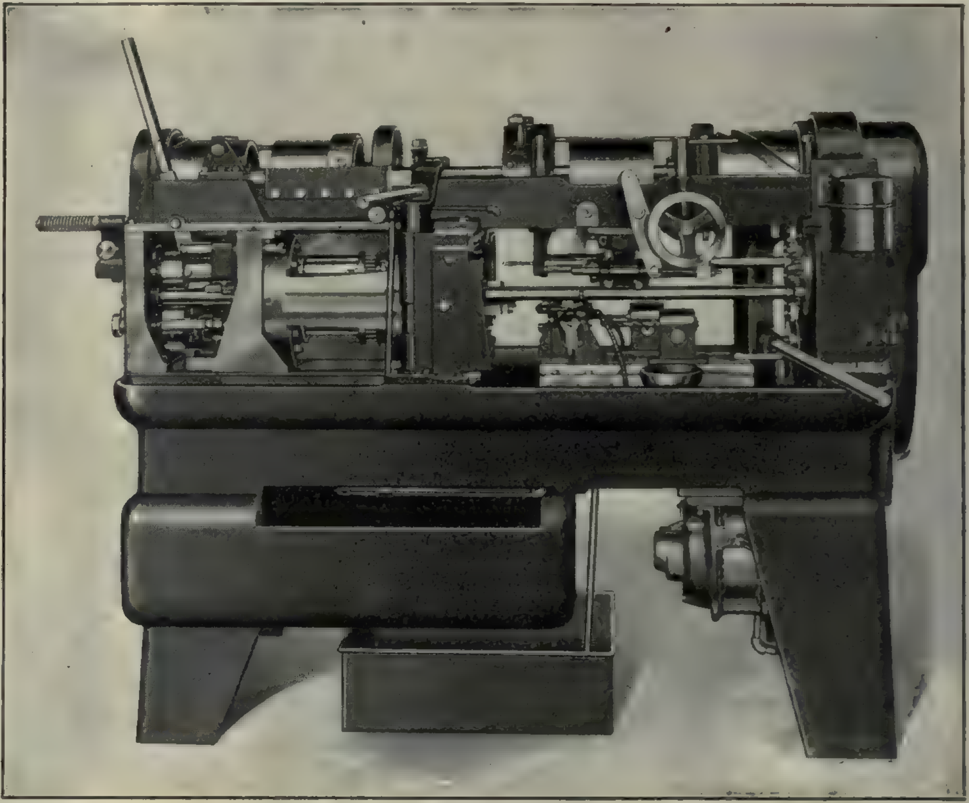


FIG. 3. MACHINE WITH ALL GUARDS REMOVED

Made in three sizes accommodating work 6 in. long and 1, 1¼ and 1⅝ in. in diameter respectively; size of spindle bearings, 1 in. machine, 2¼ x 6⅛ in., 1¼ in. machine, 2½ x 6⅛ in., 1⅝ in. machine, 2¾ x 6⅛ in.; spindle bearings adjustable; feed changes, 10; spindle speeds, 150 to 900 r.p.m.; motor used, 5 hp., with any voltage or speed desired; speed of driving pulley, 600 r.p.m.; height, 5 ft.; floor space, 30 x 78 in.; weight, 4800 lb.

"Impervite" Pyrometer Tubes

Charles Engelhard, 30 Church St., New York City, is now marketing a line of pyrometer protecting tubes under the trade name of "Impervite." It is claimed that the body of these tubes is practically identical with that of the Marquardt, as are also the coefficient of expansion, the mechanical strength and the porosity. They are claimed to have absolutely no effect on platinum wire at high temperatures, and that the melting point is above 3500 deg. F. The glaze is claimed to be harder than that of the Marquardt tube after it has matured, and thoroughly impervious when uniformly applied and strongly resistant to fluxing action. It does not become sticky at high temperatures.

Abrasive Surface Grinding Machine

To meet modern shop requirements more satisfactorily, the Abrasive Machine Tool Co., of Providence, R. I., have produced a surface grinding machine, which has features different from conventional design.

The machine is massive and of great capacity. The entire frame is a one-piece casting, being rigidly braced internally to resist distortion in use and transportation, and is supported upon three points, so located as to insure the equilibrium of the machine.

The unit system of construction has been strictly adhered to throughout, and either one of the units can be removed from the machine without materially disturbing any other part.

Fig. 1 shows this machine equipped for belt drive but provision has been made for equipping it with motor drive, the motor being mounted inside the base, as shown in Fig. 2, no extra parts being required other than a large idler pulley equipped with anti-friction bearings mounted on top of column.

The wheel head is provided with a hand wheel for fine adjustment, the dial being graduated to 0.00025 in., and also with a hand wheel with a 3 to 1 acceleration for rapid adjustment. The adjustment of the head is by means of worm and worm wheel which run in a bath of oil, and are adjustable for wear. The head is very massive, and is supported on a ball thrust bearing. It is also carried in square ways provided with a liberal taper gib for taking up wear in case this becomes necessary.

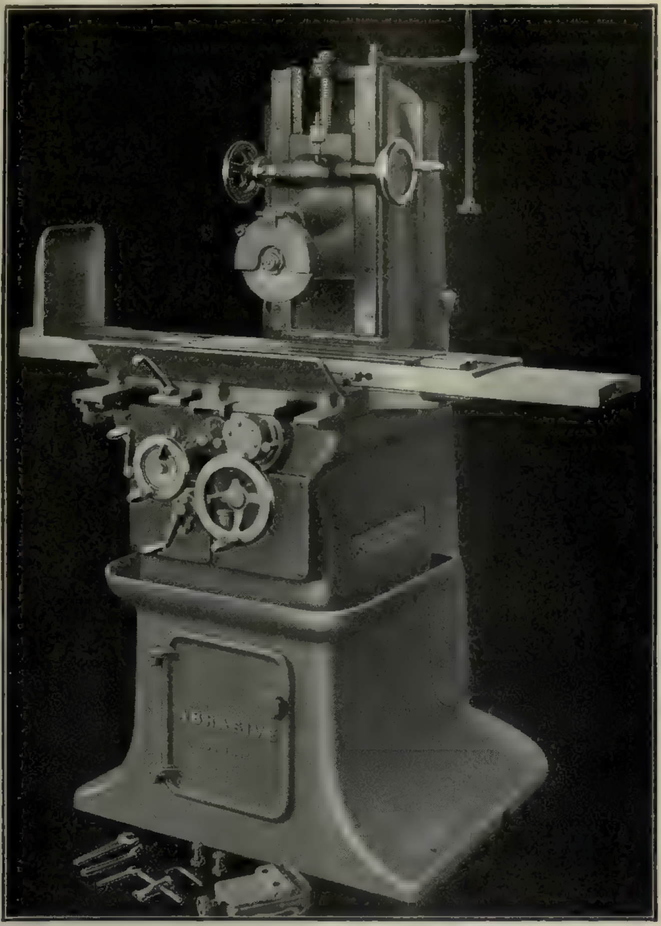


FIG. 1. THE ABRASIVE SURFACE GRINDING MACHINE

Feed capacity, 22 in. longitudinal, and 8 in. cross-feed, both automatic; vertical adjustment, 12 in.; takes grinding wheels up to 7 in. diameter by ⅜ in. face; weight of belt drive machine, 1000 lb.

A large passage way through the wheel head provides for connecting with a water pump for wet grinding, as in Fig. 3, or with an exhauster, Fig. 4, when it is desired to do dry grinding, no unsightly exterior appliances being necessary in either case, as the connections are made entirely inside of the machine.

The wheel spindle is hardened tool steel, and runs in liberally proportioned phosphor bronze boxes, adjustable for wear. The table feed and reversing gear mechanism are carried in a separate gear case, all gears being of the spur type and run in a bath of oil maintained at a constant level. This mechanism is entirely self-lubricating.

Every possible precaution has been taken to exclude emery dust and water from the operative parts of the machine, also much attention has been given to safety features, there being no moving exterior parts whereby the operator can possibly be injured. The cross-feed mechanism is mounted inside of the frame, the adjustable reversing dogs only being exposed. The driving belt is also inclosed up to the top of the machine, a feature that not only protects it from dirt and injury, but keep the workmen at a safe distance.

Much thought has been given to the convenience of the purchaser when forced to make repairs or provide for renewals; such as the flat carriage ways, adjustable gibs for taking up wear of table carriage and wheel head, eccentric adjustment of elevating worm wheel, bronze bushed cross feed and elevating nuts, and the perfect accessibility of all working parts.

All high-speed shafts, except the wheel spindle, are provided with anti-friction bearings, this also includes the loose pulley of countershaft.

A lever is provided at front of carriage for reversing the table by hand when this feature is at all desirable.

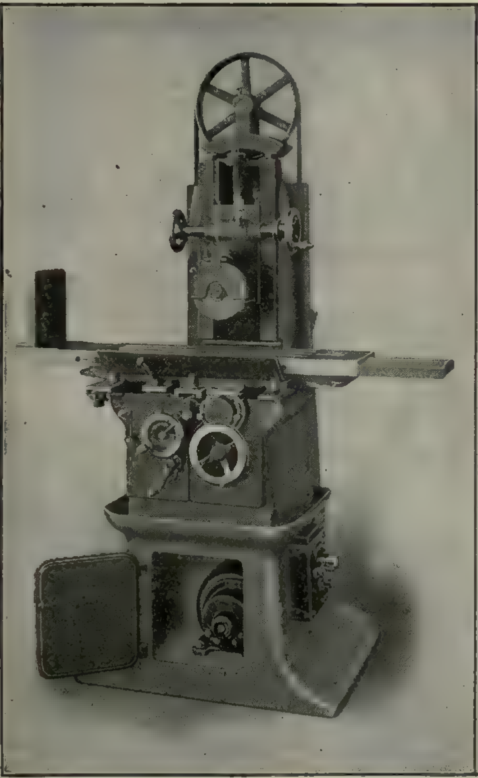


FIG. 2. METHOD OF FACING MOTOR DRIVE

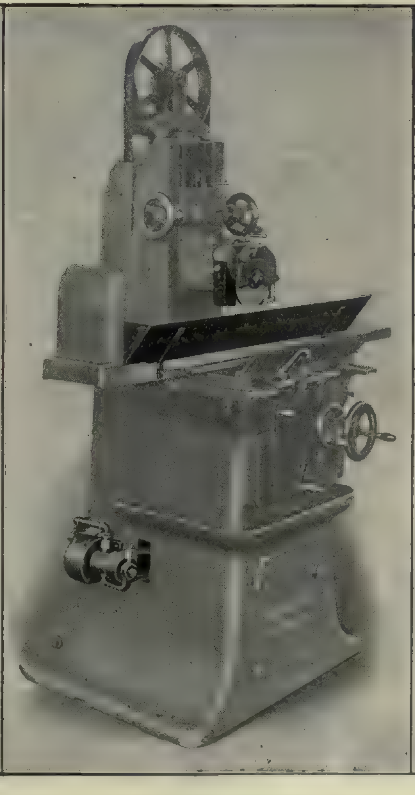


FIG. 3. MACHINE FITTED WITH PUMP AND WATER GUARDS

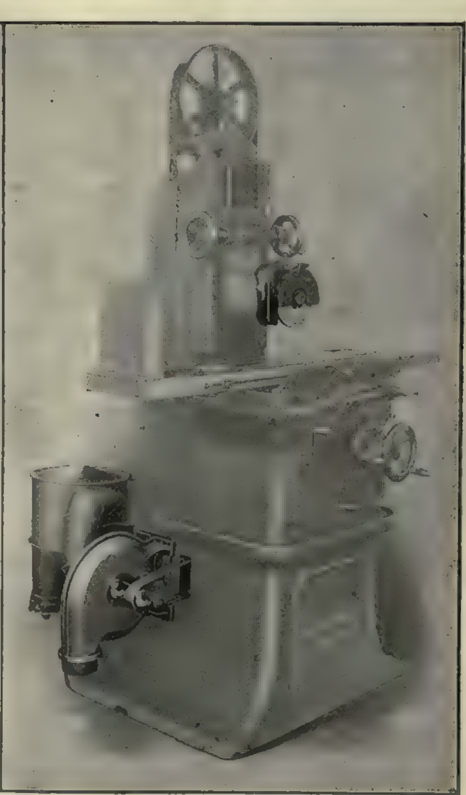
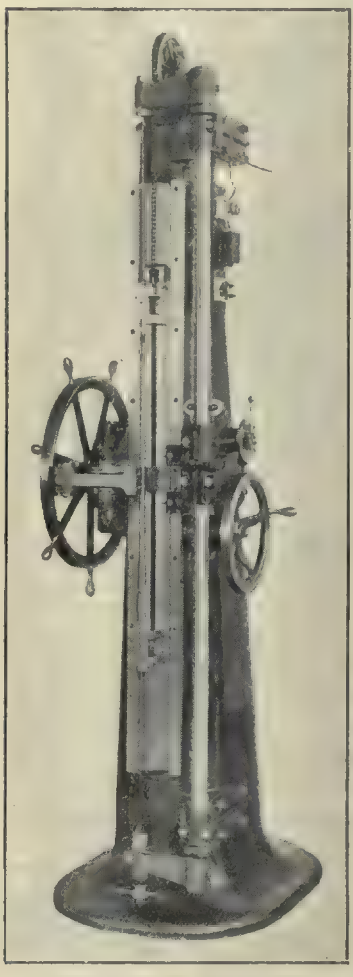


FIG. 4. DUST EXHAUST IN PLACE OF PUMP

"Sponsel" Gun Barrel Calibrating and Straightening Machine

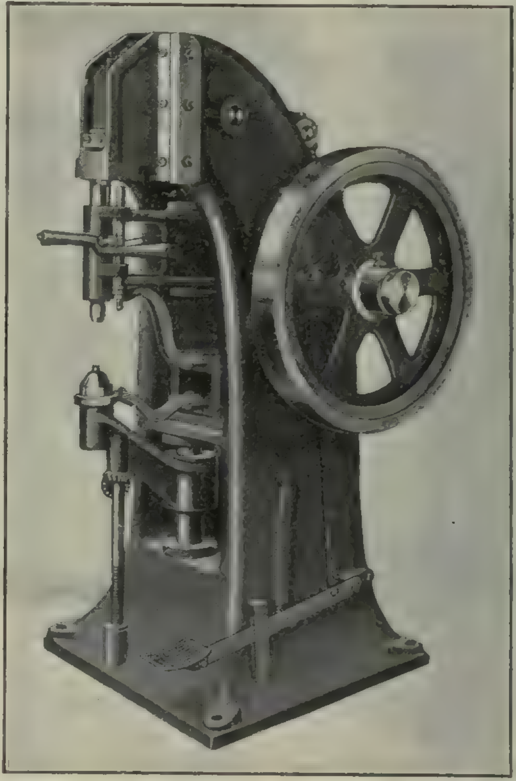
The Sponsel Co., Inc., 647 Main St., Hartford, Conn., is now marketing the machine illustrated which is used for measuring and straightening the bore of gun barrels, for the determination of reamer pockets, for the determination of eccentricity of the outside of the barrel in regard to the bore, for the location of sighting marks, and for the measurement and straightening of the bore after rifling. It is claimed that this machine enables inexperienced help to straighten barrels within very close limits. The machine straightens the work by producing a permanent set in the metal and the mechanism, which is under the control of the operator, may be adjusted to produce pressure required for any particular cross section. Deviation from straightness is detected by electric apparatus and the amount of error is determined by a graduated disk reading to thousandths of an inch. After being placed in the machine the barrel does not have to be removed until all straightening operations are completed and the danger of marks from hammer blows is overcome. Two of the advantages claimed for the machine are that it can be operated as well at night as in daylight and that it requires only about one-sixth the floor space required by the eye and hammer method.


GUN-BARREL MACHINE

"Kobert" Electric Riveting and Forging Machine

The New England Machinery Co., New Haven, Conn., is now marketing the electric riveting and forging machine illustrated. It is of the two-unit single-cycle power type and heats and drives rivets at one operation. The two units employed are the copper heating electrode, and the steel forging set, both of these being mounted on a swinging frame, which enables the operator to bring either set directly over the rivet or bar to be forged. Single-phase alternating current is used at a pressure of from four to six volts, the electrodes being of electrolytic copper, water cooled to prevent overheating. The lower die is of steel, water cooled, and so arranged that it may be easily changed where various types of work are handled. The machine is built in four sizes suitable for driving rivets of from ½ to 2 in. in diameter.

For forging work the machines, instead of making a single stroke, are provided with a multi-blow feature, which is operated by a special plunger and electrode carrier and a cam drum actuated through change gears from the crankshaft. The heating is either by a hand operated contact or by automatic rolls, in the latter case it being possible to forge material from the bar or coil, the material being heated automatically as fed.


ELECTRIC RIVETING AND FORGING MACHINE

When being used for riveting the machines are fitted with a safety device making it impossible for the machine to make two or more strokes. The safety device also prevents a stroke being made unless the heading set is in correct position.

Condensed Index—How I File the Clippings

By D. J. Nevill

Referring to your condensed index of equipment, which by the way is an excellent scheme, I have never found it necessary to paste the sheets on cards. With a 3 x 5 card there is no difficulty in getting it to stand up in the case. The thin sheets occupy much less space and are more easily handled than the cards. There is usually plenty of room in the margins for any notes that are desired. The pasting takes time and takes one away from his desk and paper to get the paste pot. It also complicates the operation of tearing and filing.

I have an index many years old in which the cuts are filed without any backing. In many cases they are doubled where too large for the case. I have never had any trouble in getting the cards to stand up.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Oct. 20, 1917—When one notices the daily increase in the number of officers' uniforms on the streets of Washington, it causes wonderment as to why so many should be so far away from the fields of military training of various kinds. But when one begins to meet old engineering friends with captain's or major's insignia on their shoulders, we realize that they are not real bonafide military men at all, but what might be called civilian officers. This is shown by the U. S. R. on the collar, meaning United States Reserve. The woods are full of them and it is a very hopeful sign.

While many of us do not approve of putting a military uniform on a man who has no just claim to military honors or distinction, there is at present no other way to give a perfectly competent engineer either authority or financial recognition. The uniform would seem to belong to those whose training had fitted them for military duty, and to no one else. It would seem as though military men would resent their insignia of rank, which has been earned by hard work at West Point and in the field, being worn by those who had not so earned it. College men who have worked hard for a degree, resent the same degree being conferred on some one who has never earned it, and who in many cases most certainly do not deserve such distinction. In both cases it cheapens the degree or rank, for those who actually earn it and deserve it, and it is to be hoped that a more rational method may soon be devised for securing the services of engineers and others needed at a time like this.

We can congratulate ourselves, however, and this means the whole country, on the fact that so many real engineers and managers of industrial establishments are now on the job. According to an official of the Ordnance Board, there are now over ten civilians to every regular army officer on that board. To be a little more exact, and yet to preserve a proper amount of camouflage, I am permitted to state that there are over 500 civilians on the board in Washington alone, with more than that number scattered about the country as inspectors and advisors in various shops.

Many of these men are sacrificing thousands of dollars a year to be of service in this crisis, are working harder and longer hours than they could be hired to work for any salary which might be offered, and the country may well be proud of them. The regular army men are proud of them too, and it is safe to say that never again will there be the same feeling of aloofness which formerly characterized too many of the West Pointers. Nor must the fact be overlooked that some of these regular officers in the Ordnance Bureau have done marvelous work in spite of all obstacles. Nights, Sundays and holidays they have labored with insufficient organization and almost no office assistance, and not always backed up as they should have been. These men will be long remembered by those who know what they have done, and they are not included in any criticisms which have been made, or which it may seem necessary to make in the future.

TOOLS AND GAGES

There is every indication that a large quantity of tools, fixtures and gages will be needed in a very short time, either by the Government or by the manufacturers who will be asked to make the munitions which must be ordered. While the plan has not been definitely announced, it is quite probable that the master or reference gages will be ordered by the Government, while the working gages will be bought by the manufacturers who secure the contracts. The headquarters for the inspection of gages, however, is likely to be returned to the Bureau of Standards as was originally intended.

Still other indications point to a great demand for machine tools and machinery of other kinds. Regular lines of supply are already taxed to their limit, in many lines, and new sources of manufacture are being sought, especially for good sized lathes and planing machines. The source of these inquiries is not for publication, but anyone who can handle work of this kind can be put in touch with the proper parties through our New York office.

JAMMING THE JAM SUPPLY

The way in which bureaucratic control of things gets itself tangled up in red tape is indicated by incidents which comes to light from time to time. One is the case of jam for the army which has more humor than seriousness. The army had always used a certain variety of jam; blackberry, as the story has it. So, when the great increase in supplies became necessary, the officer in charge simply multiplied his order for blackberry jam by the necessary factor and sent it to the manufacturers.

The order was too large to be filled and the dealers suggested that some other kind be substituted for part of the order, but this was not according to precedent and the suggestion did not meet with favor. The blackberry jam was not forthcoming, however, and the order was finally split to include raspberry. By this time, however, the supply had been so reduced that another division was necessary and the order, as finally placed, was a much greater mixture than would have been necessary otherwise.

OUTFITTING A SPECIAL UNIT

Another instance was in the outfitting of a special unit to go to France not long ago. It was a special unit, enlisted for a particular piece of work, and had been gathered in a hurry and was to sail the next day. A blanket requisition was sent the quartermaster at New York, who promptly refused to honor it because the usual procedure was to have a separate requisition for each man, giving the size of his shoes, socks, shirts, etc. The fact that they were ordered to sail the next day had no bearing on the case until, after frantic appeals from various quarters, some one was found who could perform the necessary magic, and the outfits were secured.

There is one case in particular, however, which shows great efficiency on the part of an officer in the Q. M. C. and I regret not being able to use his name. Owing to the nature of his work he was given wide discretion which was amply justified by the manner in which he handled the work in question.

THE SYSTEM TO BLAME

We must not, however, blame the officers in question too much, but rather the system, which makes them but a cog in the wheel, where the exercise of discretion subjects them to reprimand or court-martial. Army and Navy inspectors may be the best intentioned men in the world, but if they pass a shaft which is a thousandth of an inch below the size specified, they may be subjected to an inquiry, quite regardless of whether a shaft of half the size would be plenty big enough or not. The same thing is true in a way with the larger corporations, but not to the same extent in most cases. The only remedy seems to be to put only competent men in places where individual judgment can be exercised to advantage, and to forget or waive the seniority rule just as we do in private business where we desire the best results. No rules can ever be made which, followed blindly, will produce the best results. That is the great weakness of most of those who try to teach management, scientific or otherwise. They forget that learning a set of rules by heart does not make a manager. In the same way no officer who is obliged to follow the book on all occasions, can be as efficient, or meet emergencies as well as though he could use discretion when unusual conditions arose.

WHAT SOME OFFICERS HAVE DONE

It must not be imagined that I do not appreciate the great handicaps under which many of these officers worked. The marvel is that in many cases they were able to accomplish as much as they did. And no more loyal, hard working or conscientious men inhabit this planet of ours than some of these same officers. Some of them have been asked to perform tasks for which they are not fitted by their training and for which they are by no means to blame. As one retired officer who has been called back into the service put it, he had nothing to gain and everything to lose, but he had to come back. Some have died under the strain and others are likely to follow suit—just as much a sacrifice to their country as the soldier on the battlefield. And just as needless a sacrifice as the soldier who dies at his post when he should never have been asked to stay.

The fault lies with the system which did not select engineers and production managers for work in their field so that plans could have been ready, useless refinements eliminated, parts designed with a view to rapid manufacture as well as proper functioning. Instead these duties were left in the hands of men who, though highly skilled in their own lines, were not trained in rapid or economical production of munitions.

Personals

J. J. R. Lawrence, formerly with the Savage Arms Corp., is now connected with the Motch & Merryweather Machinery Co., Cleveland, Ohio.

Charles H. Colvin, who has been conconnected with the Sperry Gyroscope Co., Brooklyn, N. Y., has been made manager of the aëroplane department.

H. F. Bardwell has been appointed New York district manager for the Vanadium Alloys Steel Co., Pittsburgh and Latrobe Penn. The New York offices are located at 50 Church St.

Howard E. Branch, of the publicity department of the General Fire Extinguisher Co., Providence, R. I., has been appointed as an efficiency expert in the Ordnance Bureau, Washington, D. C.

Frank H. Brooks has resigned as president and director of E. & T. Fairbanks & Co., St. Johnsbury, Vt. P. C. Brooks, vice president and manager of the Canadian Fairbanks Co., Ltd., Toronto, Can., is the new manager.

H. W. Gaham, mechanical engineer for the Herman Pneumatic Tool Co., Zelienople, Penn., has resigned to accept a position as chief engineer of the Ocala Iron Works, Ocala, Fla.

H. F. Brandes, who for the past four years has been works manager of the Putnam Machine Co., Fitchburg, Mass., has resigned his position. He has returned to Bridgeport, and will devote his attention to interests in the Springfield Manufacturing Co.

Obituary

Eugene Franz Roeber, Ph.D., editor of "Metallurgical and Chemical Engineering," one of the McGraw-Hill Publishing Co.'s papers, died Oct. 17. He was born Oct. 7, 1867, in Torgau, Germany, and received his education in the universities of Jena, Halle and Berlin. He came to the United States in 1894 to engage in electrical engineering work, later becoming editor of "Electrochemical Industry" and its successor, "Metallurgical and Chemical Engineering." The latter paper developed with astonishing rapidity under Dr. Roeber's able direction. It was first issued as a monthly, but its growth in influence soon justified the change to a semi-monthly publication. Dr. Roeber was an indefatigable worker and to him is due the position of leadership in its field which "Metallurgical and Chemical Engineering" now occupies.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

The National Machine Tool Builders Association will hold its sixteenth annual convention at the Hotel Astor, New York City, on Tuesday and Wednesday, Oct. 30 and 31.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Crane, Portable

Canton Foundry and Machine Co., Canton, Ohio

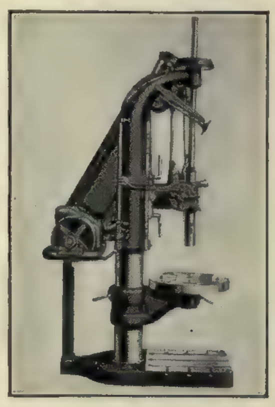
"American Machinist," Oct. 4, 1917

The base casting is of steel, while the uprights are of semi-steel reinforced with a wrought-iron band. The chain is hand forged and tested. Roller bearings are used in the wheel, and the axle, fork and yoke are machined from drop forgings. The over-all dimensions of the crane are such that it may be readily moved into any box-car. Total height, 6 ft. 6 in.; distance from floor to hook, 5 ft. 4 in.; overhang, 2 ft. 6 in.; outside width of bed, 2 ft. 8 in.; inside width of bed, 2 ft. 1 in.; length of bed, 3 ft. 2 in.; height of bed, 6¾ in.; weight, 740 lb.; capacity, 4000 lb.

Drilling and Tapping Machine

Barnes Drill Co., 814-830 Chestnut St., Rockford, Ill.

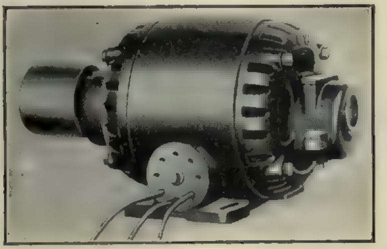
"American Machinist," Oct. 11, 1917



Height, 92½ in.; distance from face of column to center of table, 12 in.; diameter of column, 8¼ in.; diameter of table, 23 in.; diameter of spindle nose, 3 3/32 in.; taper hole in spindle, Morse No. 4 or 5; vertical travel of table, 20 in.; travel of spindle, 14 in.; travel of sliding head, 20 in.; distance from spindle to base, 18½ to 54 in.; maximum distance, spindle to table, 40 in.; diameter of crown gear, 10 7/16 in.; diameter of double pinion, 5 in.; back-gear ratio, 4 to 1; spindle speeds, eight, 23 to 230 r.p.m.; feeds, eight, 0.005 to 0.075 in. per spindle revolution; weight, 1850 lb.

Motors, Induction

Crocker-Wheeler Co., Ampere, N. J.



"American Machinist," Oct. 11, 1917

A type of squirrel-cage induction motor known as the C-W Form P, ranging in size from ½ to 3 hp., and designed for constant-speed operation on 60-cycle, polyphase circuits. Among the features claimed for the machines are good starting torque, high power factor and good ventilation

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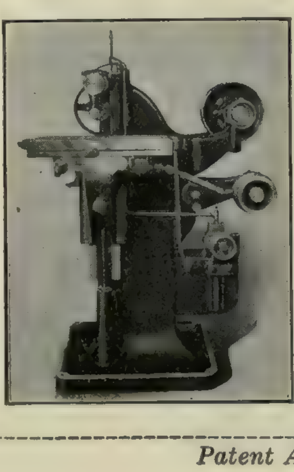
Milling Machine

Standard Engineering Works, Pawtucket, R. I.

"American Machinist," Oct. 11, 1917

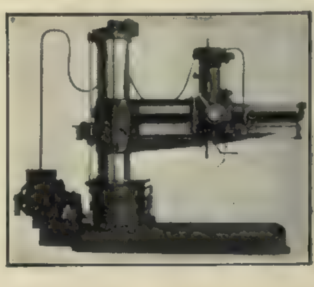


For either hand or power feed. Vertical movement of headstock, 4½ in.; working surface of table, 4 x 21 in.; table dimensions outside oil pockets, 7¼ x 26¾ in.; table travel by hand lever, 6 in.; table travel by power feed, 8½ in.; table travel by crank, 14 in.; cross-adjustment of table, 6 in.; maximum distance from center of spindle to table, 15 in.; T-slot, ⅝ in.; feeds, four, 0.006 to 0.079 in. per spindle revolution; taper in spindle, B. & S. No. 9; floor space, 27 x 36 in.; weight with countershaft, 1025 lb.

Drilling Machine, Radial

Cincinnati Bickford Tool Co., Oakley, Cincinnati, Ohio

"American Machinist," Oct. 11, 1917



A plain radial drilling machine made in 4-, 5- and 6-ft. sizes fitted with a Reliance adjustable-speed motor. The speed of this motor is controlled by shifting the armature, which is accomplished by a small motor of the reversing type mounted at the rear. Control of the small motor is by means of a two-point push-button switch located on the drill head. The machines are fitted with a plain table, cutting-lubricant outfit and an air-column binder

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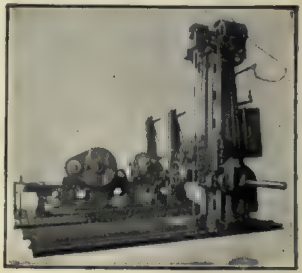
Drilling and Boring Machine

Pawling & Harnischfeger Co., Milwaukee, Wis.

"American Machinist," Oct. 11, 1917



Is somewhat similar to the company's No. 12 machine, except that the present model is provided with floor equipment and outboard supports for the boring bars. Motor, 7½ hp., variable speed, 500 to 1500 r.p.m.; horizontal spindle travel, 3 ft.; vertical carriage travel, 6 ft. 5 in.; column travel, 11 ft. 6 in.; diameter of spindle, 3 11/16 in.; Morse taper in spindle, No. 6; spindle speeds, 10 to 450 r.p.m.; feeds, four, 0.008 to 0.07 in. per spindle revolution; rate of vertical carriage travel, 3 to 9 ft. per min.; rate of column travel, 4 to 12 ft. per min.

Lubricator, Machine Tool

Madison Kipp Lubricator Co., Madison, Wis.

"American Machinist," October 11, 1917

Built for use on machine tools or other forms of machinery. Is automatic in action, stopping and starting with the machine, thus delivering oil only when the machine is in motion A hand crank is provided for delivering oil at the start or in case the machine has been idle for a considerable length of time. Each oil feed has an individual adjustment

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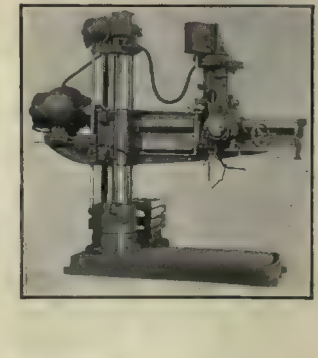
Drilling Machine, Radial

Cincinnati Bickford Tool Co., Oakley, Cincinnati, Ohio

"American Machinist," Oct. 11, 1917



A drilling machine made in 4-, 5- and 6-ft. sizes and driven by a 3 to 1 variable-speed motor mounted on the arm and geared directly to the arm shaft. The motor controller is located on the drill head. Fitted with a plain table, air-column binder and cutting-lubricant outfit. A compound-wound motor of the constant-speed reversing type is mounted on the top of the column and serves to elevate or lower the arm. Control is by means of a reversing switch and a dynamic brake. The switch is operated by a square shaft controlled by a patented interlocking device to prevent the power from being turned on while the arm is clamped

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices, which went into effect Sept. 24, will have little effect on the general market for some time. Present warehouse stocks—bought at the old mill price—will probably be sold out before the present warehouse prices to ordinary consumers are reduced. The Government prices are: Pig iron, $33 per gross ton; steel bars (Pittsburgh-Chicago), $2.90 per 100 lb.; shapes, $3; plates, $3.25. New Government prices expected within two weeks.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Oct. 19, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$47.00	$16.00
No. 2 Northern Foundry, Chicago	33.00	53.00	22.00
*Bessemer, Pittsburgh	36.30	52.95	24.95
*Basic, Pittsburgh	33.00	48.95	20.90
No. 2X, Philadelphia	33.75	53.00	21.00
*No. 2, Valley	33.00	53.00	21.00
No. 2, Southern Cincinnati	35.90	49.90	18.90
Basic, Eastern Pennsylvania	45.00	50.00	21.50

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Oct. 19, 1917	One Month Ago	One Year Ago	Oct. 19, 1917	One Year Ago	Oct. 19, 1917	One Year Ago
Structural shapes	$5.25	$5.25	$3.35	$5.00	$3.40	$5.00	$3.25
Soft steel bars	5.00	5.00	3.40	4.50	3.40	4.50	3.25
Soft steel bar shapes	5.00	5.00	3.35	4.50	3.40	4.50	3.25
Plates, ¼ to 1 in. thick	10.00	9.00	....	7.00	....	7.00	....

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Oct. 19, 1917	One Year Ago
Pittsburgh, mill	$4.75	$2.50
Warehouse, New York	4.75	3.35
Warehouse, Cleveland	4.45	3.35
Warehouse, Chicago	4.50	3.25

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Oct. 19, 1917	One Month Ago	One Year Ago	Oct. 19, 1917	One Year Ago	Oct. 19, 1917	One Year Ago
*No. 28 black	7.25	9.50	10.50	3.65	8.50	3.70	9.25	3.90
*No. 26 black	7.20	9.40	10.40	3.55	8.40	3.65	9.15	3.80
*No. 22 and 24 black	7.10	9.35	10.35	3.50	8.35	3.60	9.10	3.75
No. 18 and 20 black	7.05	9.30	10.30	4.45	8.70	3.55	9.05	3.70
No. 16 blue annealed	7.95	10.20	10.20	4.45	8.70	3.90	9.70	3.70
No. 14 blue annealed	7.85	10.10	10.10	4.35	8.60	3.80	9.60	3.60
No. 12 blue annealed	7.80	10.05	10.05	4.30	8.55	3.75	9.55	3.55
No. 10 blue annealed	7.75	10.00	10.00	4.25	8.50	3.70	9.50	3.50
*No. 28 galvanized	9.00	11.00	12.00	5.00	10.00	5.00	10.50	5.25
*No. 26 galvanized	8.70	10.70	11.70	4.70	9.70	4.70	10.20	4.95
No. 24 galvanized	8.55	10.55	11.55	4.55	9.40	4.55	10.05	4.80

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Oct. 19, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Oct. 19, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	15.30	6.30
Chicago	13.50	5.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

* Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

***Special Welding Wire**

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Oct. 19, 1917	Cleveland Oct. 19, 1917	Chicago Oct. 19, 1917
Tire	5.00	5.00	4.50
Toe calk	5.70	5.50	4.75
Openhearth spring steel	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜	42%	15½%	¾ to 1½	33%	17%
½	46%	31½%			
LAP WELD					
2	42%	29½%	2	26%	12%
2½ to 6	45%	32½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	38%	20½%	¾ to 1½	33%	18%
½	43%	30½%			
¾ to 1½	47%	34½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4	43%	31½%	2¼ to 4	29%	17%
4½ to 6	42%	30½%	4½ to 6	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	37.9%	23.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	41.9%	26.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Oct. 19, 1917	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	27.00	29.00
Tin, in 5-ton lots	62.00	61.00	42.00
Lead	8.50	8.00	7.00
Spelter	8.50	8.50	11.00

*Nominal; no market until Government intentions are known.

ST. LOUIS

	Oct. 19, 1917	One Month Ago	One Year Ago
Lead	8.00	7.75	7.00
Spelter	8.25	8.25	11.00

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Oct. 19, 1917	One Month Ago	One Year Ago	Oct. 19, 1917	One Year Ago	Oct. 19, 1917	One Year Ago
Copper sheets, base	35.00–37.00	35.00	37.50	33.00	38.50	34.00	38.00
Copper wire (carload lots)	38.50	38.50	32.00	33.00	33.00	33.50	33.25
Brass pipe, base	43.00–45.00	43.00	46.50	41.00	46.00	42.00	46.00
Brass sheets	40.00	40.00	44.50	33.25	43.00	35.00	39.00
Solder ½ and ½ (case lots)	39.25	39.25	26.62½	37.00	27.00	39.00	25.75

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Oct. 19, 1917	One Year Ago
Mill	$29.00	$42.00
New York	35.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

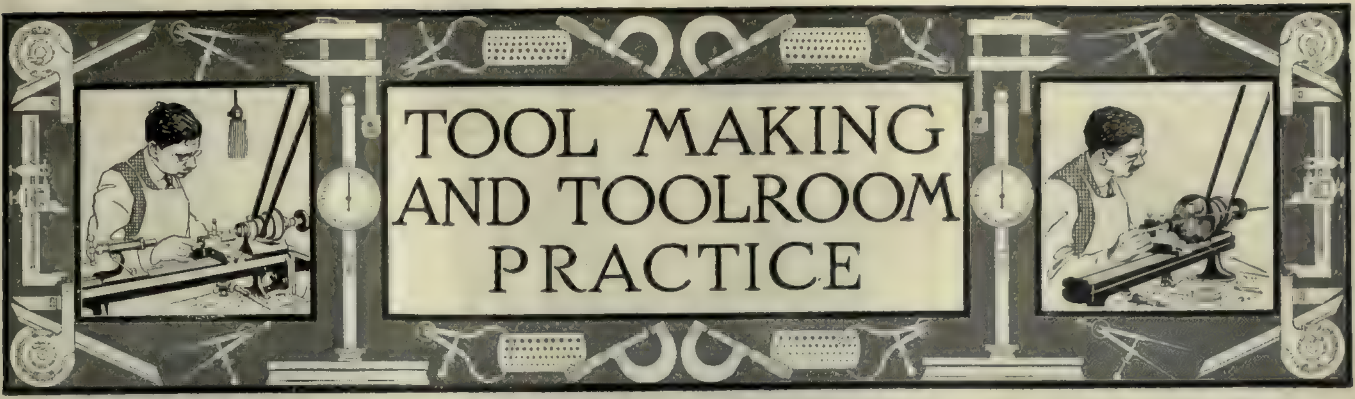
ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Oct. 19, 1917	One Year Ago	Oct. 19, 1917	One Year Ago
New York	20.00	18.00	20.50	19.00
Cleveland	21.00	16.75	21.25	17.50
Chicago	21.00	17.00	21.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Oct. 19, 1917	One Year Ago
New York	15.00	13.50
Cleveland	16.25	13.00
Chicago	16.00	13.50



TOOL MAKING AND TOOLROOM PRACTICE

Uses of the Sine Bar*

By E. J. BRYANT
Superintendent, Small-Tools Division, Taft-Peirce Manufacturing Co., Woonsocket, R. I.

SYNOPSIS—*Many of the sine-bar devices in use are of a more or less amateur character. This article shows how the sine bar is used in one of the largest tool, gage and fixture shops in the country.*

THE article "Checking Angles with Swedish Blocks," in the *American Machinist*, page 353, brings forcibly to our attention the fact that the sine bar is a tool that is being put into use because of the ever-increasing demand for more accurate workmanship. The sine bar as a tool has struggled along and, as shown in the article above mentioned, is still in the makeshift class even in most of our best-equipped toolrooms. One of the things we try to do is to standardize tools of this character to meet the demand and make real tools out of them. We will show in the few illustrations that are presented herewith how simple and easy it is to handle angular work on tools that are designed for the purpose. Fig. 1 shows a sine-bar fixture that is designed with the idea of having a self-contained tool that does not have to be clamped to something else and measurement taken from still some other object.

In order that the sine bar may be easily set, it is pivoted on the stud *A* so that in setting the stud *B* to the correct height the location of *A* is not disturbed. The stud *A*, together with the sine bar, can be adjusted vertically and clamped by a hand nut at the back to accommodate the work in hand. The bar and the whole clamping arrangement can be attached to the opposite side of the upright and the whole surface plate used as a working surface, as shown by Figs. 8 to 14. Directly under the bar is a straight-edge *C*, Fig. 1. Its top surface is parallel with the finished surface of the base. From this base all measurements can be made for setting the bar. The under surface of the sine bar and the top of the straight-edge *C* provide convenient means for checking angles.

In Fig. 2 the bar is set for an angle of 2 deg. 23 min. By reference to a table of sines of angles, we find that the sine of 2 deg. 23 min. is 0.04159. As we are using a 5-in. sine bar, we multiply this amount by 5, which gives us 0.20795; so we set the stud *B*, Fig. 1, 0.20795 in. higher than the stud *A*, and we have an angle of 2 deg. 23 min. between the lower side of the bar and the top of the straight-edge, which is the required angle for testing the collet.

Fig. 3 shows a short angular portion of a gage being checked with the right-angle projection of the sine bar. As the angle formed by the base is nearly 90 deg. and the sine of a larger angle is not as accurate as of a small angle, the base is set on its end, as in Fig. 4, which is finished at right angles with the straight-edge. The bar is set to 8 deg. 45 min., the sine of which is 0.15212; this multiplied by 5 gives 0.76060. The outer stud *B* is set 0.76060 in. below the stud *A*, giving the bar an angle of 8 deg. 45 min. with the plate. This makes the short arm of the sine bar have this same angle with the straight-edge, because the sides of each of the angles formed are perpendicular each to each.

CHECKING UP A GAGE ANGLE

Fig. 5 shows a gage mounted on the sine bar. It is first squared up so that the plug in the construction hole *B*, which extends through the piece, is level. Then the sine bar is set to an angle of 35 deg., and the hole in which the plug *A* is inserted is checked for being level. If level, it will be at an angle of 35 deg. with the base, which is what is required in the case. It can also be checked for location, which should be 0.645 in. above the center of the hole *B*. The bar can now be set horizontal, and in this position the distance of the hole in which the plug *C* is inserted is measured from the construction hole *B*.

Fig. 6 shows a small gage set up on the sine bar to determine the angle of one of its short faces to the side that is resting on the sine bar and the distance from the short face to the center of the hole through the gage. A plug has been inserted in this hole for measuring purposes. The bar is shown set to the required angle, and a parallel has been placed on the base to enable the inspector to get "close up" to the piece. The short face to which the blocks are now set should be parallel with the bar, after which the distance from this face to the plug in the hole can be easily measured without changing the setting of the piece. The angle of the two faces *A* at the end of

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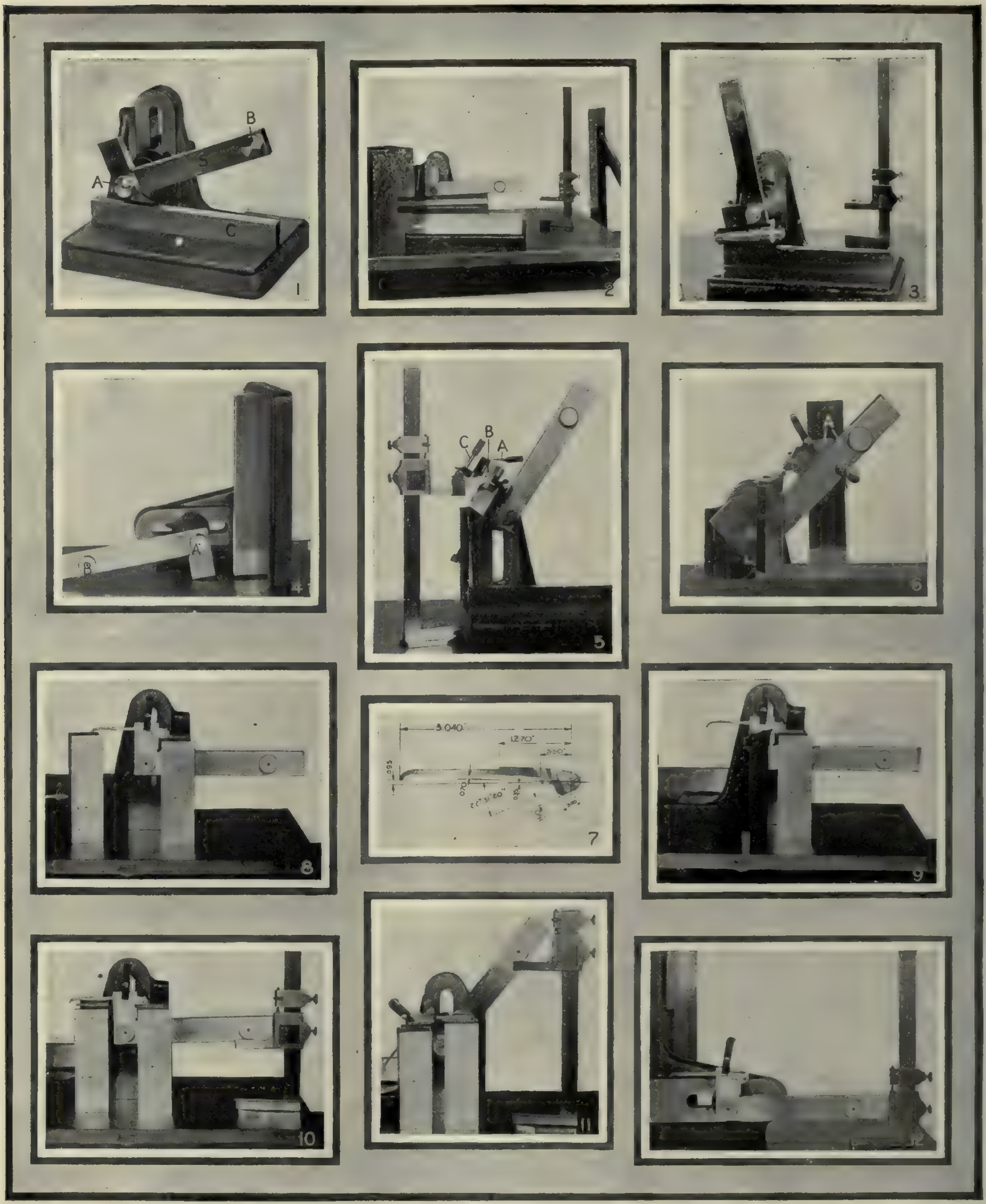


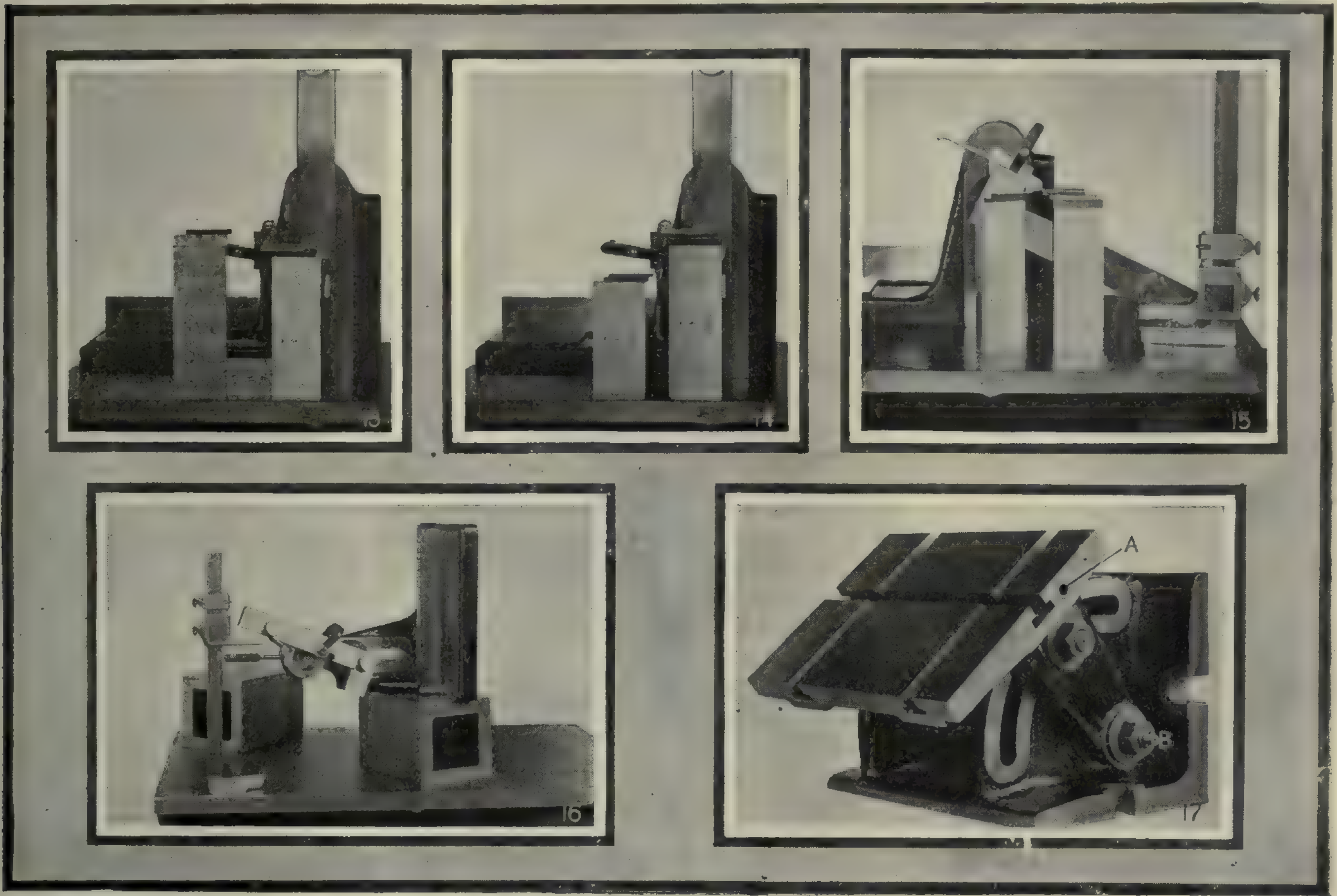
FIGS. 1 TO 12. VARIOUS APPLICATIONS OF THE SINE BAR

Fig. 1—Sine-bar fixture. Fig. 2—Bar set for testing a collet. Fig. 3—Checking up a gage angle. Fig. 4—More accurate method of placing. Fig. 5—Gage mounted on the sine bar. Fig. 6—Measuring an angle on a small gage. Fig. 7—Gage accurately finished all over. Fig. 8—Method of mounting the gage. Fig. 9—Measuring the face of the gage. Fig. 10—Measuring the under side of the arm. Fig. 11—Checking the 0.300 dimension. Fig. 12—Leveling the sine bar

the gage can easily be determined by setting the bar to the required angle of the base, as shown in Figs. 2 and 3.

Fig. 7 shows a gage that is very fragile and must be accurately finished all over. Only a few of the dimensions for which tests are given are shown, to avoid confusion. To have plenty of room to swing the piece, and measure, the sine bar is mounted on the back of the upright, and Fig. 8 shows the bar set level and the gage mounted with its point 0.095 in. above the center of the hole. This determines the center line as given on the drawing, while in this position the face, which should be 0.035 in. below the center line, is measured as shown in Fig. 9. Fig. 10 shows the bar set to the angle for the under side of the long slim part, or 2 deg. 33 min. 52 sec. This should bring this surface 0.07476 in. above the center of the hole, which can be measured while in this position.

The bar is now set, as shown in Fig. 11, to 22 deg. 31 min. 20 sec. and the 0.300 dimension checked. We now set the fixture on end and bring the sine bar level, as shown in Fig. 12; then bringing the fixture back on its base, we have the center line of the gage vertical, and we proceed to check the 0.550 and 3.040 dimensions, as shown in Fig. 13, and the 1.270, shown in Fig. 14. We now set the bar again to 22 deg. 31 min. 20 sec. and check the location of the 0.160 face from the hole and its relation to the center line. This is illustrated in Fig. 15.



FIGS. 13 TO 17. MORE USES OF THE SINE BAR

Fig. 13—Checking the 0.550 and 3.040 dimensions. Fig. 14—Checking the 1.270 dimension. Fig. 15—Checking distance of face to hole and relation to center line. Fig. 16—Checking gage clamped to sine bar. Fig. 17—Toolmaker's adjustable knee

TESTING ANOTHER GAGE

Fig. 16 shows a gage clamped to the sine bar and the fixture set on parallels as the gage extends back. The location of the hole in which the plug is inserted is checked at this setting, determining its relation with the larger hole in the end of the gage and to the lugs shown at the outer surface of the end. The angular spacing of these lugs can also be checked.

Our toolmaker's adjustable knee has a sine bar permanently incorporated in it, so constructed as to handle conveniently work that is too large to be measured readily on the sine-bar fixture. This tool is sufficiently stable to permit light machining operations being performed on the work while set on the fixture. It is especially suited for mounting work for finish grinding. This tool is illustrated in Fig. 17. Sine measurements are taken from a plug in the $\frac{5}{16}$ hole *A* and the $\frac{5}{16}$ projection of the stud *B*. On the end opposite from that shown are a graduated ring and vernier for setting to within 5 min.

Our regular 5- and 10-in. sine bars are made with provisions for clamping to work that would be too large to handle on sine-bar fixtures or the toolmaker's adjustable knee. They are also more convenient for the toolmaker to carry with him.

Crowning a Large Pulley

By W. W. Rickard

I will describe the method I used in crowning a job lot of split wood pulleys. It was in a little country shop, where the largest lathe was 16-in. swing, and the pulleys in question were about 30 in. in diameter.

I chucked a piece of pipe in the lathe a little longer than the bed, put the steadyrest as near the tail end of the lathe as possible, clamped the pulley on the end of the pipe, built a rest out of 2 x 4 scantling, made a turning tool out of an old file, and I was ready for the job, which was done satisfactorily and in good time. This is probably not a new stunt to most oldtimers.

PREMIUM SYSTEM for WORKERS
BONUS PLANS FOR WORKERS
PENSION SYSTEM FOR WORKERS
SAME OLD DAY RATE FOR FOREMEN
H P PALMER XVII

Giving the Foreman a Bonus

BY C. B. LORD
General Superintendent, Wagner Electric Manufacturing Co., St. Louis, Mo.

SYNOPSIS — *The method of calculating the premium paid to foremen by this company is unusual, is the result of a number of years' experience along these lines, and is a part of the general plan to tie the organization together for reasons of mutual interest.*

When I presented my article on Bonus for Foremen in the July 16, 1914, issue of the *American Machinist*, I stated that it was not presented as a finished system, but as one intended to be used to start the system did anyone so desire.

The payment of bonuses to foremen was not looked upon with as much favor at that time as it is at present, in fact it is now going through one of the three cycles as do all general movements in our country. Like the poem, we first abhor, then endure, then embrace, and I might add, we embrace so hard we usually maim or kill a good thing.

During the early part of the war the bonus matter was badly overdone, and is liable to be embarrassing now that business conditions have changed. I do not mean by this that we gave undeservedly but we gave unwisely as to method, we gave without regard to the share the recipient had in earning it, we did exactly that which we have been opposing for years in principle, paying all men the same, regardless of their ability or earning power.

We ourselves, as well, gave more liberally, but with method. When we wanted just to show our good will we gave a free-will Christmas gift, not associated in any way with a bonus. Two years ago we installed a new method of calculating bonus, which I think is more scientific than our first, and can be used either for monthly or yearly payments. We use it for the latter, as I have not as yet found any good reason to modify my objections to a monthly bonus.

It has always seemed to me that one of the fundamentals underlying successful management was the tying together of the organization as a whole, and that this could best be brought about by creating as many opportunities for mutual interest as possible. This community of interest should not end with the payment of the current bonus; neither should an exceptionally good year inflate nor an exceptionally unprofitable year unduly reduce the bonus paid, as more effort and interest is necessary and desired in subnormal years. It should, in short, be based upon the prosperity of the business as a whole over a period of time.

In line with the principles laid down above, the base of the premium is taken from the average of five years' percentage of profit on total business—a permanent stipulated amount for each per cent. The current year is always added and one year dropped. This method gives an equitable basis, lends permanence, and removes the temptation to inflate or reduce this item in fat or lean years.

Next in importance comes the efficiency of the different divisions—the creating of coöperation among the different foremen composing it, and the fixing in definite terms the efficiency of it as a whole—rewarding each only according to its merits, and not saddling it with the losses or deficiencies of another division.

GETTING FIGURES FOR DEPARTMENT EFFICIENCY

To arrive at the efficiency of the different departments, and of a division—which of course is a compilation of department totals—we use our monthly summary of departmental labor distribution reports. (Which are not as formidable as the title would imply.) The different headings in this report are: Estimated Cost, Actual Cost, Gain, Loss, Net Gain or Loss, Per Cent. Gain or Loss on Estimates. These are compiled from all jobs in the department.

It will be recognized that inflated gains may be shown by placing the premium allowances high, and while there can be no concerted work done in this direction, due to supervision of allowances exercised by the operating department, mistakes can and do occur, and no system is either complete or wise that does not take into consideration the obviously possible, as well as the probable, and introduce corrective factors.

Our second item then, is one-half the difference between 100 per cent. and the average of divisional percentage of savings, minus losses. This seems rather involved, but when untangled works nicely. Suppose a departmental saving, in percentage, to be 15 and the losses 3; the difference between 100 and 15 is 85; one-half of this is 42.5; deducting from the remainder the 3 per cent. loss we have 39.5 for an answer on which to base our amount.

Why all this roundabout way Why one-half the difference between 100 and 15 when a more obvious way would be one-half the savings minus losses? Inasmuch as we have two ways of making an actual loss—one by setting allowances high, which, while showing an apparent gain is really a loss, and the other by failure to meet the time allowance set—we have the peculiar condition of being able by our records to show gains by increase or decrease in savings, and of course, losses the same way. Apparently, the shop gets the best of it coming and going. Incidentally, this shows the uselessness of reports unless the factors are analyzed. Some cynic has said that reports to an executive are like candy to a child; merely designed to keep him quiet.

As our savings are based on estimates of actual labor plus premium, it is evident that a low percentage of saving, and a zero percentage of loss are desirable, and are what should be paid for, or penalized for lack of as the case may be, and as the low saving average is what we are paying for, some method must be found of doing this that does not make the amount paid for each per cent. so large that one per cent. either way will unduly reward or penalize. Of course, a uniform amount is desirable and is used throughout, and in the present case it is secured, and the other desired result is obtained by taking the difference between 100 per cent. and the percentage of saving shown, and dividing it by 2. This, minus losses, constitutes the second item.

I give here some actual figures taken from past records, showing how this actually works out. These are departmental totals, which of course are the basis of the divisional totals:

	Departments				
	M	W	CA	CM	X
Average savings compiled from monthly reports.....	18.9	5.8	4.2	15.4	8.4
Losses....................	0.0	0.0	1.0	3.3	9.5
	100.0	100.0	100.0	100.0	100.0
	18.9	5.8	4.2	15.4	8.4
Difference.................	81.1	94.2	95.8	84.6	91.6
One-half..................	40.5	47.1	47.9	42.3	45.8
Average losses.............	0.0	0.0	1.0	3.3	9.5
Total allowance.........	40.5	47.1	46.9	39.0	36.3

It will be noted that "M" department with 18.9 per cent. gain and no losses, received $7 less than "W" department with only 5.8 per cent. gain and no losses. "CA" and "CM" departments are selected because they show both gains and losses. It will be noted that the losses must be deducted from one-half the difference, and not from either the total difference, which would penalize only one-half, or from the average gain, which would reward instead of penalize.

It may be asked how both losses and gains may be shown by the same department. This is explained thus: The reports are monthly; for bonus purposes, the total gains for the year are divided by the number of months, 12; the total losses are treated the same way, to get the average for the year.

While theoretically and actually this system is laid out on the basis of a foreman receiving only what he deserves, the same factors enter into the reports that I mentioned a while ago—they do not tell the why of the losses. So it was decided that a foreman was entitled to the benefit of his gain to some degree, even though his losses be great. It is therefore possible for the average losses in a department to exceed average gains and still not unduly penalize him. This is shown under "X," which is an example.

The third item is meant to take care of the individual efficiency of the foreman, using the same base figures with the difference, that whereas in the second item the good departments carried the poor ones along and helped pay their losses, here each foreman reaps the benefit of his energies, or pays the penalties of his shortcomings.

The fourth item is a certain percentage of his monthly salary, also expressed in dollars. This takes into consideration his individual importance.

THE CORRECTING FACTOR

There is a corrective factor that enters into the next item. A certain foreman may receive a large salary, say for instance, the foreman of the toolroom or pattern shop. He is receiving this salary for his knowledge rather than for his executive ability. Again, we may have an efficient foreman of maintenance or test department, who receives a larger salary than some other departmental foreman, who has ten times the responsibility because of the number of men he controls. So we recognize the difference between importance of position, and responsibility, and in the fifth item we pay for the number of men in the department. Departments containing less than 25 men are not considered in this item, and we consider that this nicely balances the scale.

The foreman of the toolroom, and any other department that works on day rate only, and serves other departments, receives the average of the departments served in those items in which they are concerned in common.

The sixth and last item is arbitrary, being fixed by the General Superintendent, and takes into consideration improvement in department, lack of accidents, promises kept, relation of amount of day work to premium work, and general conduct of department.

The interest and coöperation of the nonproductive departments is secured by their receiving a percentage of the average paid to productive departments.

It is possible to use the system as laid out to pay bonuses to everyone in the employ, by fixing upon a percentage for each different class as outlined above. We might say we would pay nonproductive foremen 75 per cent., which we consider equitable; draftsmen and inspectors 60 per cent.; clerks, 50 per cent.; etc. We have no present idea of going beyond foremen, however.

The explanation of any well-thought-out system seems tedious and complicated, although sometimes it is only the verbosity of the writer, and so that it will not be necessary for anyone wishing to file it to wade through the entire article. I epitomize it below, and also show actual results from an old sheet, leaving off item No. 6 and changing item No. 1. It will be noted it varies from 228 to 117 for a full year, and a variation of $14 is shown in item No. 2. The 37 under item No. 2 is the toolroom—the average of all divisions, as the 40 is the average of item No. 3.

Item No. 1. Average of five years' percentage of profit on total business.

Item No. 2. One-half the difference between 100 per cent. and average of divisional percentage of savings, minus losses.

Item No. 3. One-half the difference between 100 per cent. and average departmental percentage of savings, minus losses.

Item No. 4. Percentage of monthly salary.

Item No. 5. Percentage of number of men. (Departments in which there are less than 25 men not considered.)

Item No. 6. Improvement in department. An arbitrary amount fixed by the General Superintendent.

CALCULATION OF FOREMEN'S BONUS

Name	Item No. 1	Item No. 2	Item No. 3	Item No. 4	Item No. 5	Item No. 6	Total
P. E	14	39	44	35	59		191
J. A	14	39	40	27	19		139
A. U	14	39	43	19	11		126
W. I	14	39	47	26	19		145
J. O	14	39	44	24	..		121
R. O	14	39	44	27	..		124
G. E	14	29	43	35	107		228
W. I	14	29	36	27	32		138
D. A	14	29	45	26	18		132
W. I	14	29	47	19	8		117
E. D	14	29	39	21	21		124
P. H	14	29	46	35	9	(Pro-rated)	22
C. A	14	29	43	23	37	" "	84
A. M	14	29	..	27	28	" "	64
H. E	14	..	44	30	11	" "	58
C. R	14	37	42	30	15		138
J. O	14	43	38	27	16		138
C. H	14	43	46	20	6		129
H. M	14	43	46	21	15		139
R. O	14	43	46	21	19		143
C. H	14	43	46	30	56		189

The bonus sheet worked out for the present year takes care of the unusual manufacturing conditions that have prevailed during the year perfectly, and shows a distinct difference between those departments that have been rushed and those that have not.

Perhaps all the items enumerated are not as important as we think them, but they give us a foundation upon which to base our standards. Perhaps the foremen do not require all the safeguards thrown around the different items, but it increases their respect for our achievement if they analyze it. Perhaps it would be just as well to hand them a lump, uniform sum, but would they appreciate it as much—if so, why was the proverb about the Greeks bearing gifts originated?

Reclaiming Rejected Shell Forgings

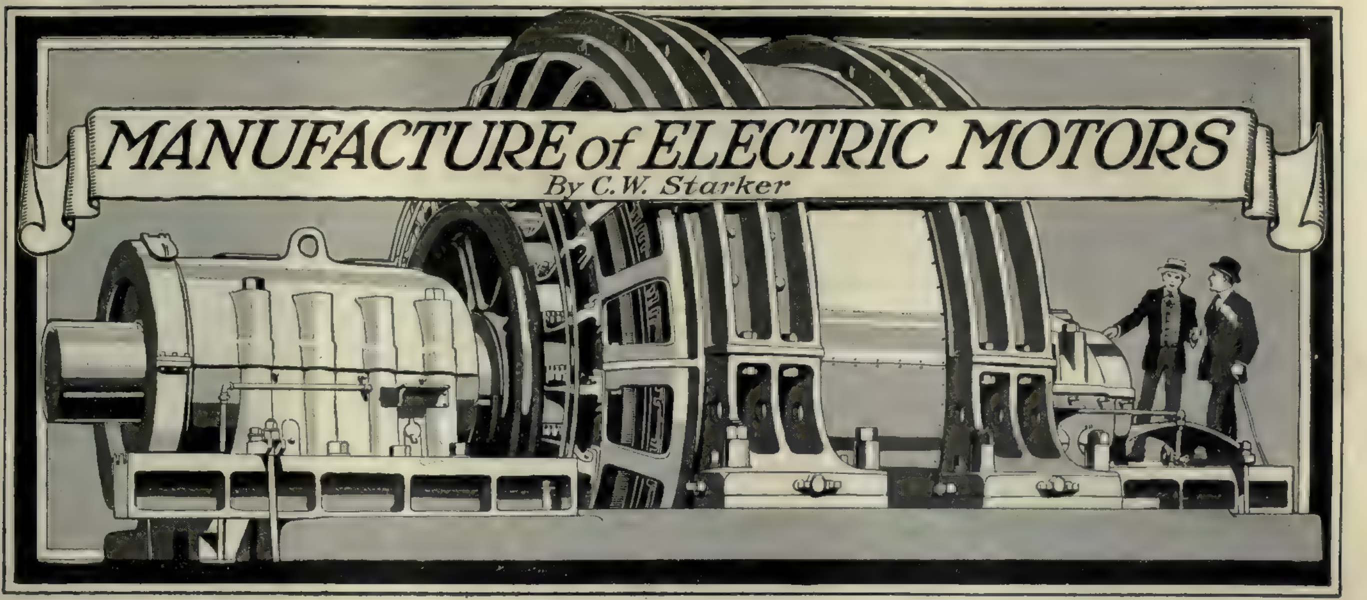
By W. L. Wilcoar

I read with great interest the article on "Reclaiming Rejected Shells," written by James Forrest, on page 474. In a plant where I was working we had some experience in reclaiming rejected shell forgings, but it did not turn out to be a paying proposition. However, the information gained may prove of value to someone who is up against the same problem.

The shell forgings in question were 9.2-in. shrapnel made complete in one forging operation, doing away with the draw bench that is sometimes used. The defect that we had the most trouble with was that of eccentricity. We were making the forgings, and another concern was doing the machining, so naturally the requirements were very strict along this line. We were continually having shells turned down on this account. Anyone familiar with the game knows just where to put his hand when trouble of this kind shows up. He will first satisfy himself that the press and tools are in good shape, and then he will look to see if the shell blanks have been thoroughly heated. As a general thing, he will find the trouble there. If in heating the shell blank preparatory to forging, the blank is not allowed to stay in the furnace long enough for the metal to be heated uniformly through and through, the punch will be forced out of center in the forging operation. The metal in the cold side will offer more resistance to being displaced by the nosepiece, and accordingly the wall is thick at that place. The punch, following the line of least resistance, moves over into the hotter and more plastic metal. No matter how rigid the press is, this action will occur, as there is enough spring between the nosepiece and the head of the press to kill the forging.

This lack of thorough heating was the trouble in our case; but we were behind with our contract and were running close to the heat margin, so that the blanks did not stay in the furnaces any longer than absolutely necessary, in order to save time in heating, thereby boosting production. Eccentric forgings occurred as the natural result. Under these conditions we were making shipments all right; but in the course of time the bad forgings began to pile up on us, and we began to cast about for some method of reclaiming them. Numerous methods and near methods were tried out, and at last we thought we had the problem solved. Great was the rejoicing until we found the error of our way, and then we were a sadder, but wiser, bunch of men.

The eccentric shell forging was reheated and put back into the press, and a flat-nose punch was run down on it so that the metal was forced toward the center of the forging, thereby greatly reducing the inside diameter and minimizing the effects of the eccentricity. Then the forging was again heated, replaced in the die on another press and the regular nosepiece forced into it. The forging thus reclaimed passed the inspectors all right, and orders were given to go ahead with the work. Then came the day of reckoning. The plant that was machining the shells cut some of them open and found that in the final reclaiming operation the nosepiece had sheared more or less of the metal as it went down and had carried it down to the front end of the forging, forcing it into the good metal so closely that it passed our notice when we cut open our test pieces. However, the flaw was there, and the forgings were irrevocably condemned. I might add in closing that, like many others, we were novices at this game, and in the beginning we had to learn much by the mistakes we made.



MANUFACTURE of ELECTRIC MOTORS

By C.W. Starker

V. Manufacturing Large Brackets

SYNOPSIS—*In motors of 100 hp. or less, which are manufactured in quantity, the use of pressed-steel brackets offers some interesting tool and manufacturing problems.*

A VERY interesting development in connection with motor construction is the pressed-steel bearing brackets, Fig. 43, large quantities of which have been manufactured and have given successful service for the past five years. These pressed bearing brackets are made from a special grade of steel, and are so designed that great strength is obtained with a reasonable weight of metal. The U-shaped arm section and the deep bell insure great stiffness. This is further increased by the flanged rim of double thickness obtained by doubling the metal back on itself. The flanged part around the housing also acts as a reinforcement. These housings are simple castings pressed into the bracket while it is hot, in such a way that the housing makes its own hole, and the flange shrinks to it. The housing has a flange that locates it.

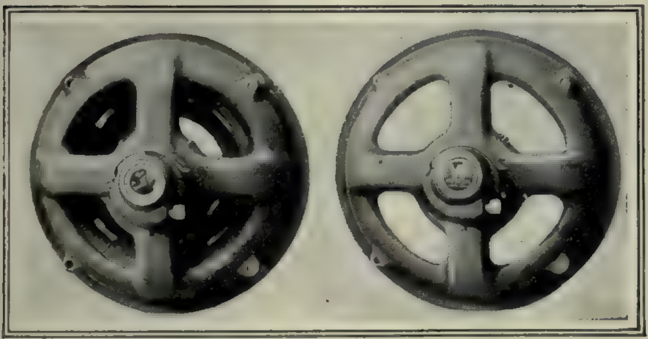


FIG. 43. PAIR OF PRESSED-STEEL BRACKETS

The very high tool cost on this type of bracket necessitates standardized design and large sales, in order to be successfully handled from an economical standpoint. Given these conditions, however, the pressed-steel bracket has wonderful manufacturing possibilities, for different housings may be inserted to accommodate different-sized bearings or different means of lubrication, and they may be adapted to ball or roller bearings.

The dies used for forming these steel brackets are made with either machinery-steel or tool-steel inserts at the points of greatest wear. The forming of the bracket is done on a 1000-ton steam-hydraulic press, and the piercing operations on a smaller press of the eccentric type.

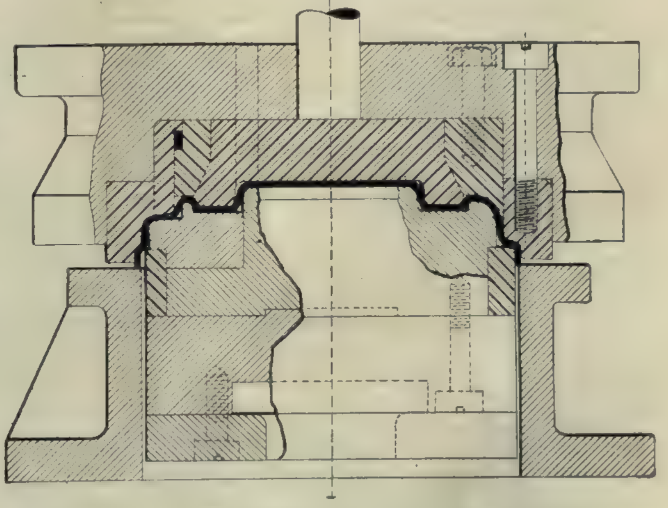


FIG. 44. CROSS-SECTION OF DIES FOR FORMING BRACKETS

A vertical motor with its special top and bottom brackets is shown in Fig. 45. The automatic scheme of lubrication used on both the alternating- and direct-current motors of this type is rather interesting. The top and bottom brackets are entirely independent of each other, so that trouble from leaky pipe connections is avoided. Each bracket has a large bearing pot cast integral with it. This contains a guide bearing and acts as an oil reservoir, and in the case of the upper bracket it also contains an oil-immersed ball thrust bearing. The oil, which fills the reservoir up to the level of the overflow gage, is, by the centrifugal action of the rotating motor parts, driven upward along the surface of the guide bearing and is returned to the bottom of the reservoir through suitable openings provided in the walls of the guide bearing.

Motors are often called upon to operate where excessive dust, acid fumes, etc., are present. In such cases entirely inclosed motors are required, but due to lack of ventilation such motors would have only about one-half the rating of open motors at the same temperature; therefore, provision is made on the motor brackets for radiating the heat produced inside of the motor. Both of the brackets as well as the hand-hole covers are provided, both inside and out, with fins or ribs, Fig. 46. This design has been found very effective, but the inclosed ratings are still considerably lower than open ratings.

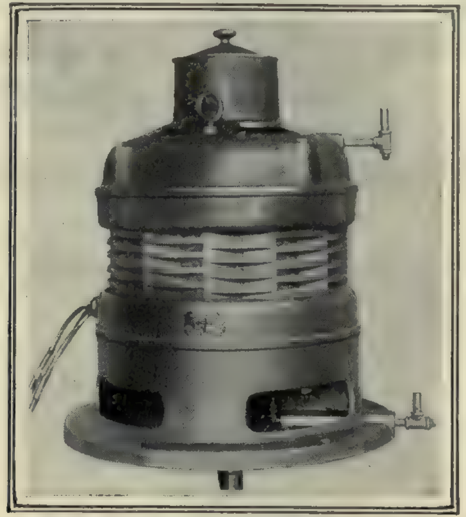


FIG. 45. VERTICAL TYPE OF MOTOR

The above conditions have developed the self-ventilated or forced-ventilated type of motor, shown in Fig. 47. The self-ventilated motor draws the air in by means of a fan mounted on the motor shaft inside of the bracket. The forced-ventilated motor receives its air supply from some outside source, such as a separately mounted blower. By these means, ratings equal to the open ratings are obtained.

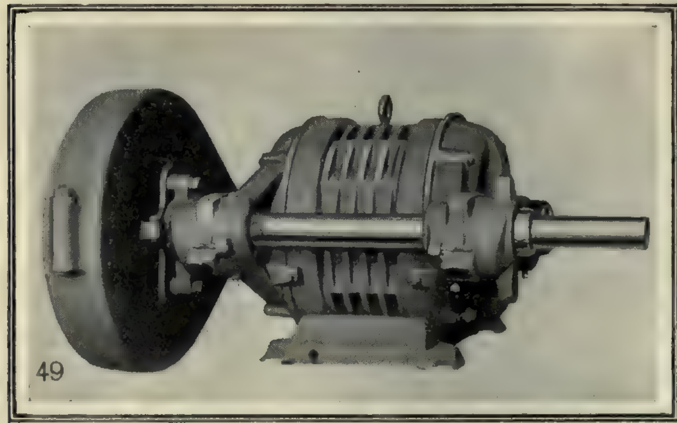


FIG. 49. SEPARATE SUPPORT BRACKETS ATTACHED TO MOTOR

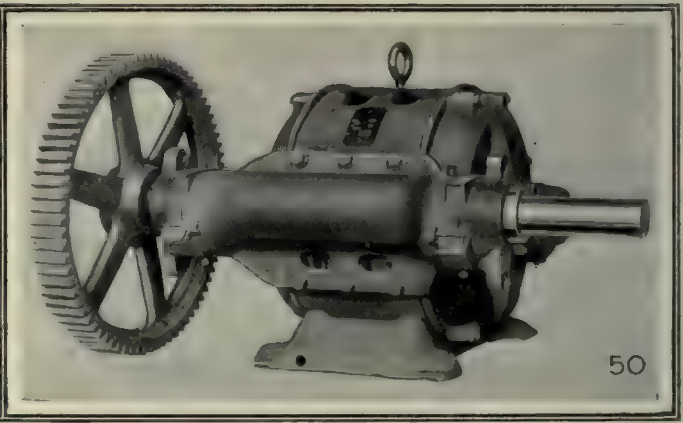


FIG. 50. SUPPORT BRACKETS CAST INTEGRAL WITH MOTOR BRACKETS

Owing to recent legislation, there is considerable demand for motors with safety devices that will protect both the motor and the employees. Such devices should be simple, unbreakable and offer the least possible obstruction to natural ventilation. A good example of these simple protective devices is illustrated in Fig. 48. Back-geared motors require a special type of bracket to support the countershaft. There are two styles of these brackets—one, which is cast integral with the bracket, Fig. 49; and the other, in which a separate casting is mounted on the frame of the motor. There is practically no difference between these two forms from the point of service, but there are manufacturing advantages that justify the two types of construction.

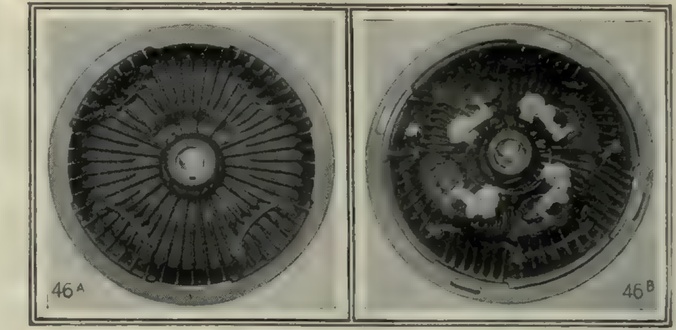


FIG. 46. BRACKETS FOR INCLOSED MOTORS

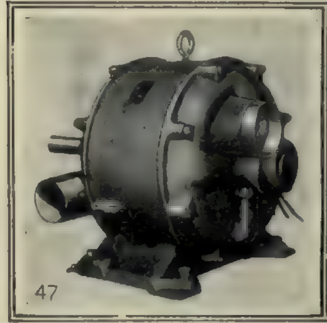


FIG. 47. MOTOR WITH FORCED VENTILATION

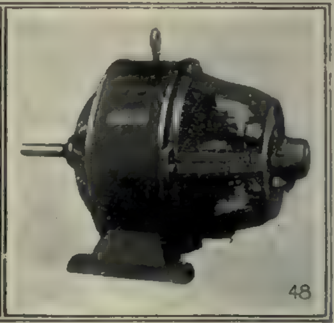


FIG. 48. SIMPLE SAFETY DEVICE

The bracket in Fig. 49 is especially adapted to motors of varying frame widths, as it is independent of this variation. Considerable care is required in boring the housing and bracket to assure accuracy in the center distance between gear and pinion. Geared service imposes very severe stresses on all parts, and for this reason a machined tongue is provided on the bracket, Fig. 50. This tongue engages a machined groove in the frame and takes up the stresses and hammering due to the gear action.

Manufacture of Type Bars for a Typewriter

BY FRANK A. STANLEY

SYNOPSIS — *These bars are of flat stock, are blanked from sheet metal and then finished on all edges by surface grinding. Exact dimensions are maintained and accurate surfaces produced cheaply, as 130 blanks are ground simultaneously. The piercing of the holes for the reception of the type rivets must also be performed with precision, and the press tools for the operation nest the blank accurately from the working end.*

NATURALLY, one of the most important members of any typewriting machine is the type bar that carries the character for doing the printing upon the paper. These type bars vary in number with the design of the machine on which they are used, ranging from 28 up to two or three times that number. Upon their general design, the method of their suspension and operation depend the flexibility and ease of operation of the typewriter, as well as the alignment of type and the consequent character of the work produced by the machine.

It has been pointed out in previous articles on the product of the Noiseless Typewriter Co., Middletown, Conn., that the type bars of its machines are made of flat stock cut out at the center to form a light member that floats easily forward and back, but which is rigid enough to perform its work with perfection and without liability of springing in the process. At the same time the form of type bar makes it possible to guide the type and control it up to the actual point of printing, so that it is in perfect alignment at all times, no matter to what usage the machine may be put. This is owing to the fact that each type has to slide into a guide controlling it on both sides and at top and bottom, permanency of alignment thus being always assured.

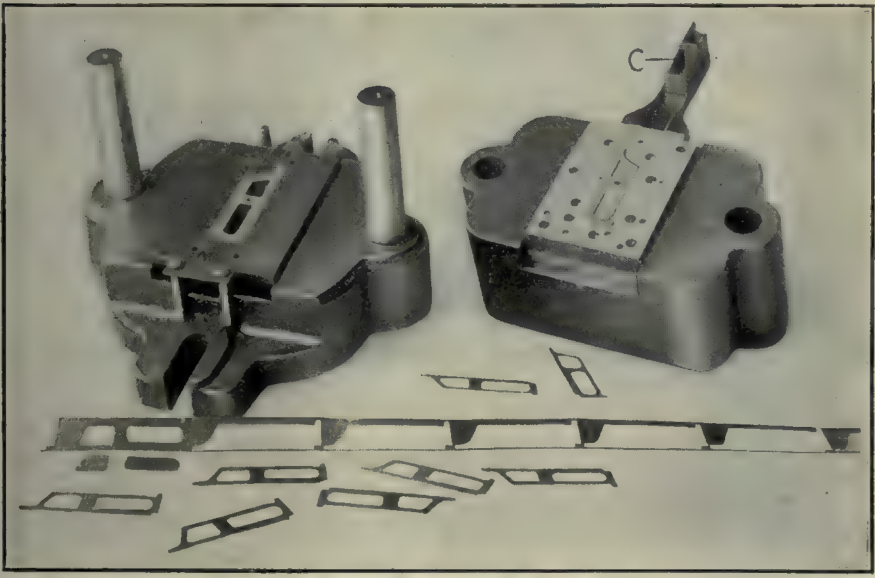


FIG. 1. PRESS TOOLS FOR BLANKING TYPE BARS FOR THE NOISELESS TYPEWRITER

As these type bars are made of sheet stock, they are a punch-press proposition. The work of blanking them and piercing the central holes for connecting the toggle-actuating mechanism by which they are slipped to and fro in the machine is performed in the press tools illustrated in Fig. 1. A detail of the blank is presented in Fig. 2. This drawing, with the several blanks seen in the center of Fig. 1, shows clearly this unique form of type bar.

Referring to Fig. 2, it will be seen that the type-bar blank is 3.685 in. long overall, has a height across the body of 0.90 in., and a height at the rear end, owing to the upper projection lug, of 1.050 in. To lighten and balance the bar, the greater portion of the stock in the middle of the material is punched out from either end, leaving a web at the center sufficiently wide for the rivet hole at the point where the toggle-operating mechanism is connected, almost one-half of the metal in the original blank being cut out in this way. These central openings are punched out at the same time the type bar is blanked and pierced at the center for the toggle-actuating mechanism.

Like practically all the punch and die work in this factory, the production of these type-bar blanks is carried on by subpress methods. Where work too large for the ordinary type of subpress is handled, pillar dies are used, as shown in Fig. 1, so that absolute alignment of punch and die can be relied upon in the operation of the press tools. It will be seen from the strip of scrap stock in front of the tools in Fig. 1 that little waste is made in the production of these blanks. They are closely placed in the strip of stock, and only the narrowest margin of material is left along the edge. The construction of the tools will be understood with a little explanation, as follows: The upper and lower members of this part of the tools are built up on very heavy die blocks, and large-sized pillars are used for guiding the upper member. Each tool—that is, each upper and lower member of the pair of dies—is made in two sections, the dividing line being directly through the central hole in the blank. The lower member carries the outside blanking punch, and the upper die carries the inside punches for punching out the two large openings in the type bar. The top die is fitted with a shedder that forces the blank back into the strip of scrap on the upstroke of the press. When the stock feeds forward again, the strip carries the blank with it. The next downstroke of the press causes the projecting member at the front of the upper die, Fig. 1, to strike the blank, which is still carried by the strip, and knock it through the scrap stock so that it falls down the chute into a box placed directly in front of the machine.

This projecting "knock-out" is shown more clearly in Fig. 3, where the tools are set up in the punch press. The knockout is simply a block of steel made in the form of the blank. As the strip of stock with the inclosed blank feeds under this, it merely presses down sufficiently to press one blank after another from the strip of stock.

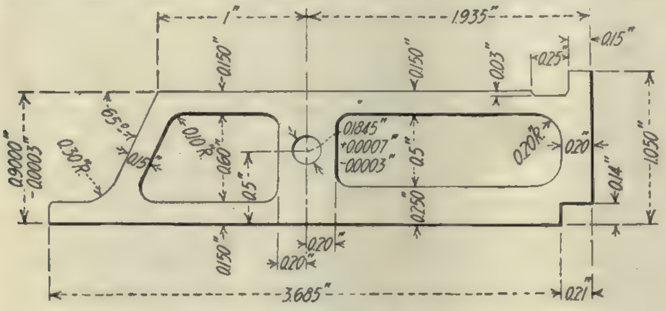


FIG. 2. TYPE-BAR BLANK

The strip is carried through the machine, where it is broken up into comparatively short strips of scrap.

The blanking portion of the lower die is supported by springs and is normally flush with the face of the die, as indicated in Fig. 1. The centers of the blank punched out (see Fig. 2), when punched down through the blank, fall through the holes in the lower die and out of the press at once, without being carried along by the stock. The arrangement of these supporting springs under the lower die, as well as the construction of the shedder for the top die, is of conventional type and needs no special description. It may be pointed out, however, that these tools are of heavy general construction, and the blocks on which they are mounted are equally well proportioned. The material handled is 0.028 in. thick and is tempered bandsaw steel, so that the material puts considerable work on the tools for the blanking of the type bar. It will be seen from Fig. 3 that a heavy type of press is used to operate these tools, and it will be found later on in this article that these type bars are taken through all the various processes by most precise methods, whereby accuracy of every point desired is obtained and a high-grade product assured in all respects.

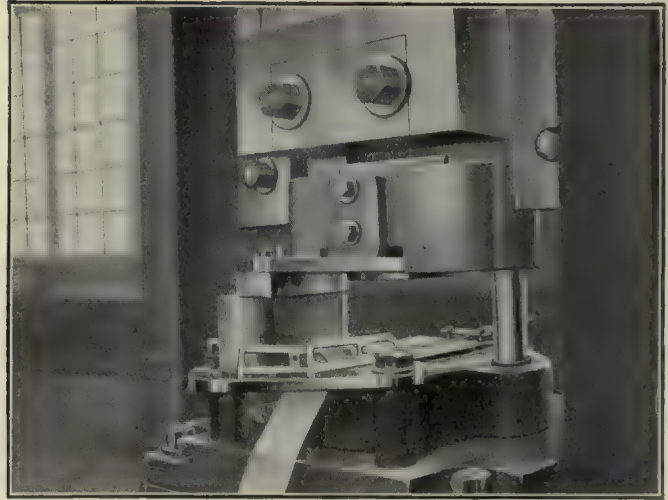


FIG. 3. THE TYPE-BAR TOOLS IN OPERATION

Turning now for a moment to a consideration of the method of operation of these type bars when assembled in a typewriter, it will be of interest to point out that each of the 28 type bars, when in the machine, must float to and fro in its bearings with absolute precision. Each and every one must pass at one end into the alignment guide, and all must operate so smoothly that, no matter at what angle they come in toward the center, they will do their work of printing and then return to normal position without colliding with any of the other bars, no matter how rapidly the operator may manipulate the keyboard.

As this is a double-shift machine, each type bar carries three characters, one above the other, so that the forward end of each type bar, against which the type proper are shouldered and seated for true vertical positions, must be absolutely square with the base and top of the type-bar body. Therefore the operations that follow the blanking out of this type bar are of a precision nature. In carrying them out, conveniently designed apparatus is employed. This is particularly true in the grinding, in which a large number of the blanks are simultaneously handled and the work is produced as accurately as any known commercial process can be carried through.

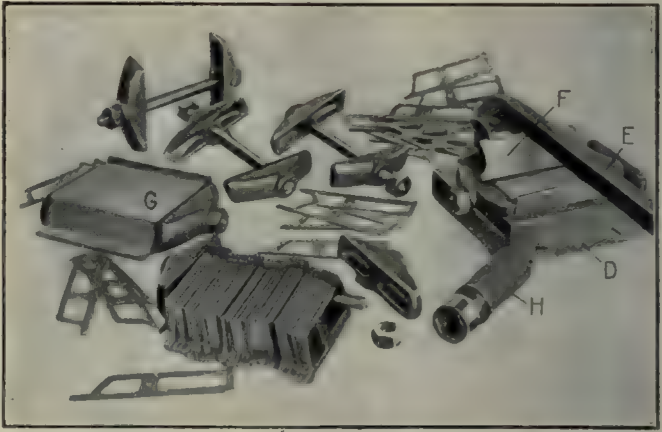


FIG. 4. FIXTURES FOR ASSEMBLING AND HOLDING 130 TYPE-BAR BLANKS FOR THE GRINDING OF THE EDGES

Following the blanking operation, the type bars are flattened and thus straightened from end to end. They are then ready for grinding to width and to length and to bring the front or working face truly perpendicular to the guiding bases, bottom and top.

DETAILS OF GRINDING OPERATIONS

In the blanking of these type bars about 0.010 in. is left to grind off—0.005 in. on each edge. Similarly, about the same amount is left at the front end to assure this coming square with the upper and lower edges of the bar. The blanks are handled on the grinders, 130 of them held at a time in a single fixture, so that they are really ground exactly as a solid block of the same area would be gone over by the abrasive wheel.

This series of 130 blanks, each 0.028 in. in thickness, give a width of about 3⅝ in., so that actually the group built up for grinding is practically square in superficial area, making a form in which to finish their edges.

The holders in which they are secured preliminary to the grinding process are illustrated in Fig. 4 and consist in each case of a pair of clamps tightened by a through bolt pivoted at one end to one of the clamps so that there are few members to fall apart when the apparatus is completed.

In the foreground is a group of these blanks built up and slipped over the through bolt ready for tightening between the clamp ends. At the right will be seen a fixture under which the loose set of blanks and the clamping outfit, still untightened are placed to adjust the front ends to an even line before tightening up the clamp. This might be called a locating fixture and consists of a block *D*, Fig. 4, with upright stop plates at one side and one end, as shown. There is also a lever *E* pivoted at the back end, which carries a V-contact shoe pressed upward by a spring, so that another V takes a bearing upon the blanks and they are crowded forward against the locating edge at *D*. The 130 blanks placed between the clamps, which are tightened easily, are placed under this lever and the lever then pulled down. The V-shoe is thus crowded forward and presses all the type-bar blanks against the gaging surface at *D;* and while the lever is still held down, the clamp nut is tightened and the series of sheet-metal blanks gripped together as a single unit with their lower edges and front edges in line for grinding.

The similar clamping fixture at *G* is shown all set up with the blanks ready to put on the surface grinder. The tool at *H* is a socket wrench with a knurled handle for tightening the clamps. This, while giving sufficient grip for the purpose, makes it impossible for the operator to bind the work so tightly as to cramp and spring the bars.

It is of course essential in putting together so many blanks as are here placed in one fixture to know that there is no burr or dirt on their sides or edges. Otherwise there would be more or less distortion and irregularity in the clamping up of the entire series. To obviate the possibility of trouble of this kind the blanks are all thoroughly cleaned, and the flattening process which follows this blanking operation assures the edges being free from troublesome burr. It is hardly necessary to point out after an inspection of Fig. 4 that the gripping holders in which these blanks are secured are of the floating type, the through bolt being loosely pivoted to one clamp—and the loose clamp very loose indeed—so that there is no possibility of any of the members gripped being cramped or distorted.

Figs. 5, 6 and 7 illustrate the grinding operations on top, bottom and ends of the type-bar blanks. Referring to the first of these grinding operations, as shown in Fig. 5, it will be seen that two fixtures filled with the 130 blanks each are held on the magnetic chuck for the grinding of the top. In Fig. 6 four fixtures are illustrated holding the work bottom side up for the grinding of the bottom, this being done on the same magnetic vise as seen in Fig. 5. To grind these bottoms, the work is placed lengthwise in order to grind in the same direction as the type bar slides when in the typewriter. The first grinding operation on the upper surface, Fig. 5, is done crosswise of the blanks in order to permit the wheel to clear the shoulder which is located at the end of each blank.

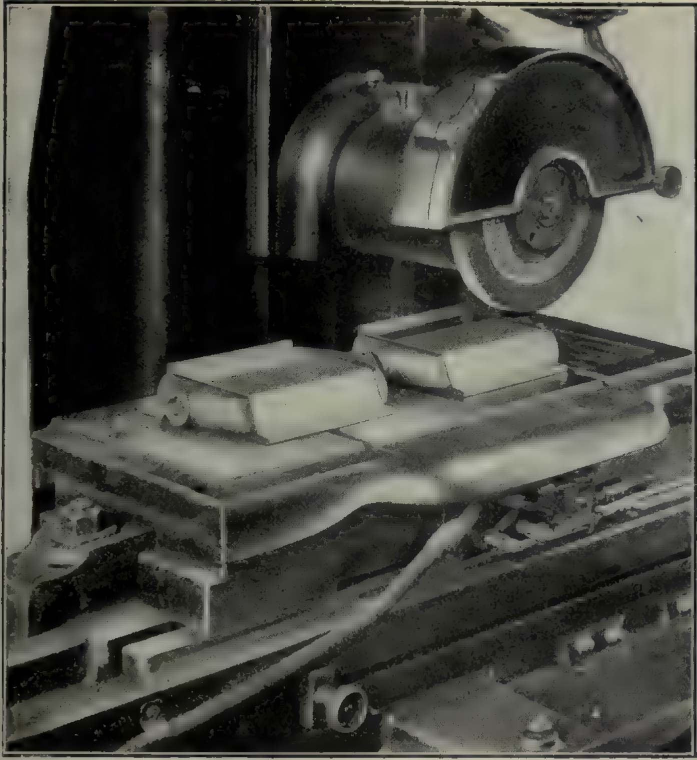


FIG. 5. GRINDING THE TOPS OF THE TYPE BARS

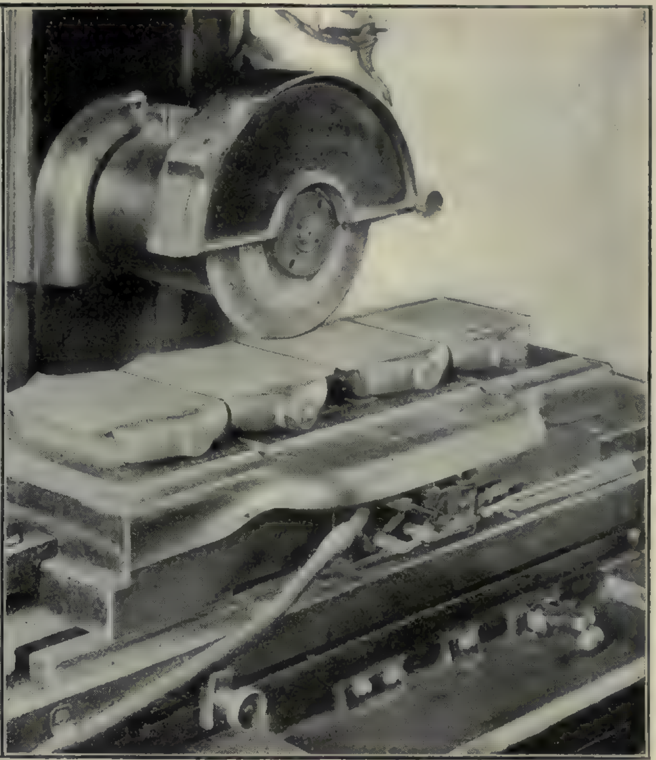


FIG. 6. GRINDING THE BOTTOM OF THE TYPE BARS

After the bottoms have been ground lengthwise, Fig. 6, the work holder is again turned over and the tops of the type-bar blanks again ground for the finishing touch. This final grinding process removes about 0.00025 in. The last grinding operation—finishing the ends to fit them for the reception of the type itself—is seen in Fig. 7, which shows a solid block, truly square on the bottom and side faces, against which the work is secured by bringing up the flat arm at the front of the picture. The area of surface thus presented to the wheel is of course quite small, and it takes only a few minutes to finish the end properly.

In grinding the top of the bar in the second operation to bring it to height, a regular gaging fixture is used for testing this height, and with this fixture only

0.0002 in. leeway is admitted. The blank must be either 0.9 in. exactly or 0.9 in. minus 0.002 in.

The fitting of the type to the end of the type bar is an important operation, involving some interesting methods and fixtures.

There is, however, one more point to this operation which it may be well to describe in connection with what has gone before in reference to making these type bars—namely, the piercing tools for the three holes at the front end of the type bar, to receive the rivets for later fixing the type in place. The piercing tools, Figs. 8 and 9, used in conjunction with the tools for making the corresponding holes in the type body proper, assure the type being so fixed upon the end of the type bar that it can never be displaced or loosened in any manner.

The method of nesting the work will be apparent, as it is here shown with the lower, or bearing, edge pressed against the stop guide at the back by the two spring punches *QQ*, which apply sufficient pressure to hold the blank in nest *A*, and against the top surface without likelihood of springing. The endwise position of the work relative to the dies is determined accurately by the slide *R*, which is pressed forward against the action of the pressure spring by the taper plunger *J* carried by the punch block. In Fig. 8 this punch block is seen descending, and the taper plunger is about halfway down. Just before the piercing plungers have reached the work, the taper plunger brings a straight portion of its body against the rear end of the slide *R*, Fig. 9, holding this in position and consequently holding the work at the exact point for piercing the three holes at a definite distance from the front, or working, end of the type bar. This position, being the work of the combination slide *R* and the plunger *J*, is further aided by the pressure pad *H*, which is forced down on the work and holds it steady during the lift of the punches.

The arrangement of the three piercing punches is shown clearly in the elevation, Fig. 9. They consist of drill rods turned down at the end to form a light punch and have a head at the rear end to retain them in their guide bushings. The latter are fitted securely in the punch carrier and are long enough to give the piercing punch proper support for the greater portion of their length. Immediately behind the head of the piercing punch is a short plug about 1½ in. long, of ¼-in. diameter, and behind this is the head of the screw. It is therefore an easy matter to adjust the punch to strike the work at the desired instant, and the three punches can be staggered for giving the shearing action as desired.

The method of setting the guide bushings will be apparent upon inspection of the plan view and the accompanying elevation, showing the two members of the press tools, Fig. 9, so that little further explanation will be necessary. These tools are of course guided by pillars, so that they are operated similarly to subpress tools.

Referring to Fig. 8, an interesting gaging device is shown at the right upon the stand, this being the test gage, not only for the accuracy of the type bar itself, but for testing the placing of the rivet positions relatively to the front end and to the bottom of the bar. This gage has a nest at the top, made to accurate outlines to correspond with the blank itself and with location holes corresponding to the rivet holes and the larger holes pierced near the center of the type-bar blank. This nest is formed on the top of a pad that operates against spring pressure. The test is to place the blank upon the nest pad and push the whole thing down to see if the outer edges at the bottom and ends will just slide past the corresponding shearing edges of the test-gage body. This corresponds closely to what might be called the thumb-nail test, as commonly applied in the case of a flush pin gage, where the thumb nail is passed over two edges supposed to be flush and where a fraction of a thousandth discrepancy is easily detected if there is any lack of uniformity. Such is the case here. If the end of the type-bar blank or if the lower edge should project at any point by even 0.0001 in., this would interefere with the punches descending if pressed lightly with the finger.

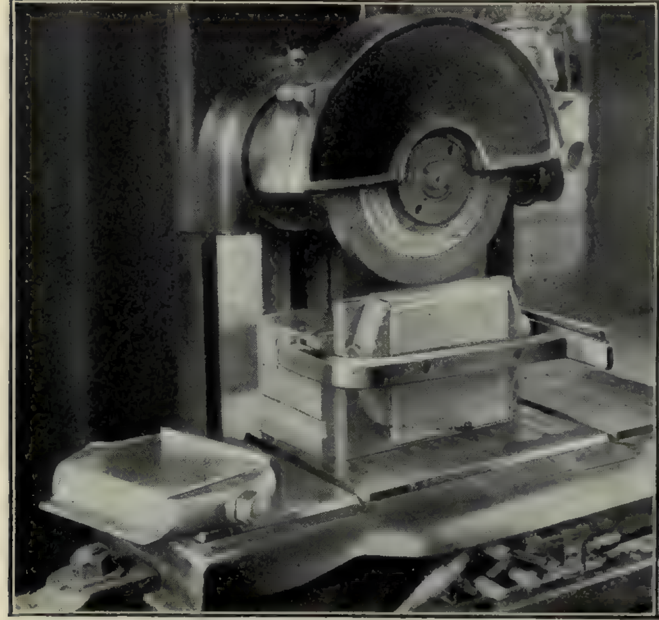


FIG. 7. GRINDING THE FRONT ENDS OF THE BARS

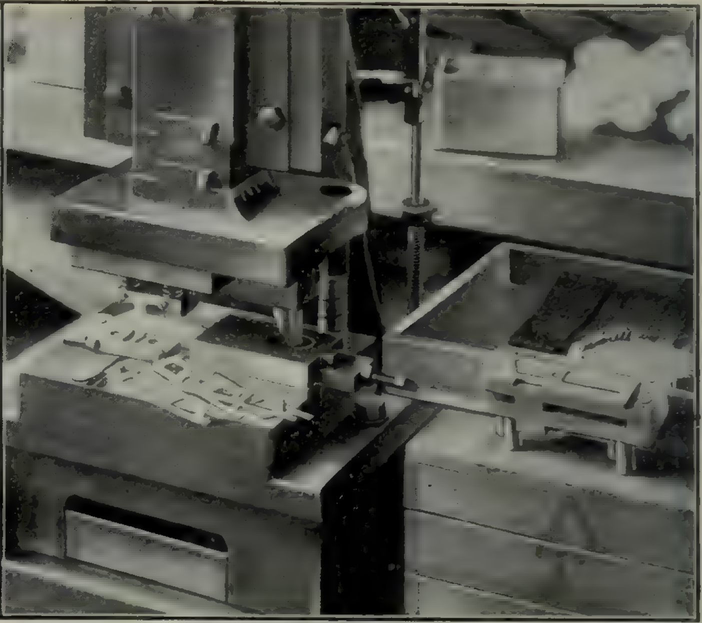


FIG. 8. PRESS TOOLS FOR PIERCING THE THREE HOLES

The punch-press tools which prepare the work for this test gage are so accurately made that there is little opportunity to throw out work which reaches this point. It does, however, provide a final gaging means before the type body is assembled on the type bar; and in so far as such a test can be established without too great expense, it may mean the elimination of considerable difficulty in further processes in connection with assembling operations. For this reason it is always desirable, where much work of this nature is going through a shop, to test the accuracy at various other times as well as at completion.

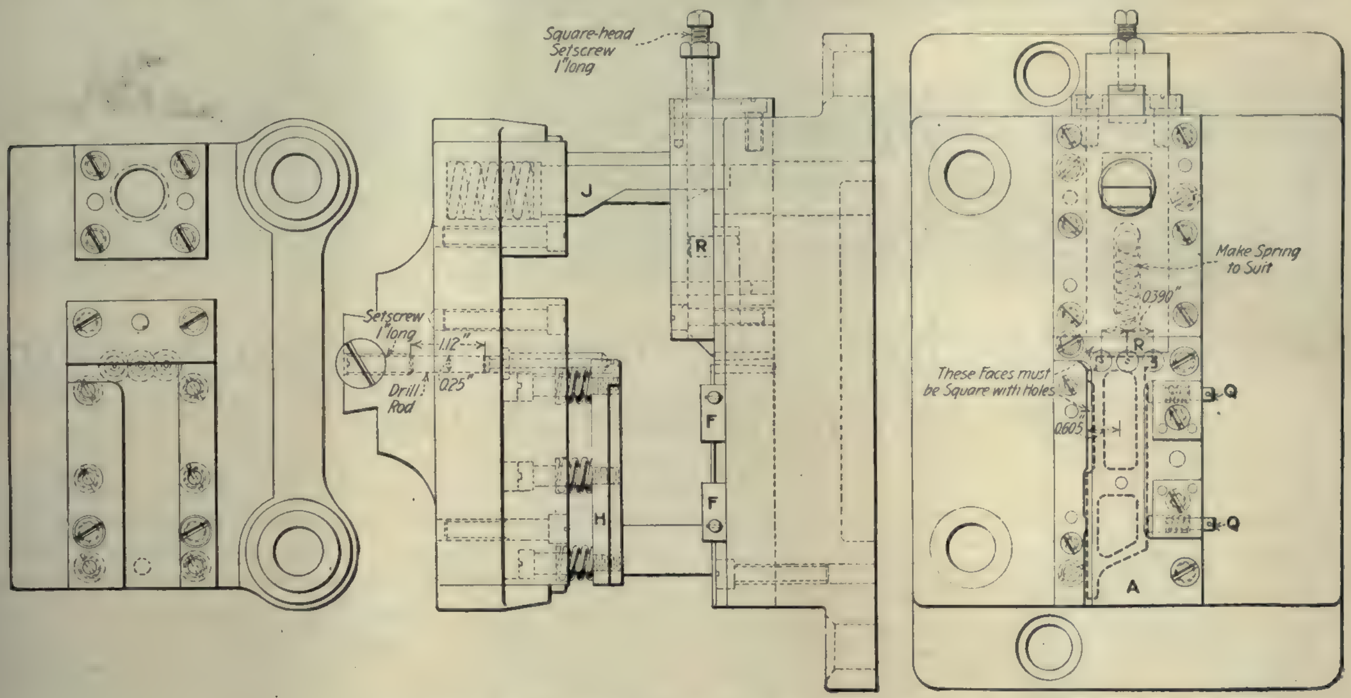


FIG. 9. DIE FOR PIERCING RIVET HOLES

Selling American Machine Tools in Europe

By C. E. Carpenter

First Vice President, Allied Machinery Co., Paris, France

If the subject of "Selling American Machine Tools in Europe After the War" is of sufficient interest to readers of the *American Machinist*, I would like to add to the remarks of Messrs. Knowlton and Woods, which were published recently in the *American Machinist*, a statement to the effect that both the native son and the international house will be in danger in failing in their task unless they accustom themselves to carrying liberal stocks of machines in Europe.

The success of German machine-tool builders in other European countries prior to the war was due not alone to price, but to their ability to make quick deliveries. The reason for this was partly their proximity to customers, partly their willingness to grant favorable terms of payment and partly their habit of carrying, through their agents, large stocks. If their agents could not afford to invest large sums, the manufacturers helped them with consignment stocks.

The principal disadvantage under which most American manufacturers worked before the war was that, with a few exceptions, their agents did not carry a sufficient number of machines in stock. In order to obtain the exclusive right to sell a certain machine in his territory, the average agent was accustomed to purchase a few machines for stock. Instead of replacing these when sold, the agent would as a rule defer further purchases of machinery until he had obtained equivalent orders.

The outcome of this almost universal business procedure was an aggregate loss to American manufacturers of a very large amount of business. The European machine-tool buyer, like all consumers of merchandise, prefers to buy a machine which is ready for delivery in Europe, and frequently he is not unwilling to pay a higher price for the service of quick delivery. In fact, when a machine is urgently needed, the question of delivery is of considerably greater importance to the buyer than the nationality of the agent from whom it is purchased.

I believe it can be conservatively stated that the success before the war of the German machine-tool agents who handled some makes of American machine tools in foreign countries was due, in most part, to an understanding on their part of the immense advantage of carrying stocks. It was certainly their practice throughout the world to invest large sums of money in this manner, and in every field in which they operated they assumed and held the leadership.

Therefore, if the native son, as well as the international house, is to render the greatest measure of service to American manufacturers, he or it, as the case may be, must start with a well-defined policy on this one point. On the other hand, the manufacturer for whose hand and dowry the native son and his bugbear, the international house, may compete, must bear in mind that his would-be agent's success will depend in large measure upon his ability and willingness to invest a considerable amount of capital in stocks of machines.

Feeding and Watering the "Bird"

Selecting Mechanics for the Royal Flying Corps of the British Army

By FRED H. COLVIN

SYNOPSIS — *The great need for mechanics for the flying corps makes vigorous recruiting necessary. The selection of men is an important problem. The kinds of men needed and the methods of "trade testing" followed by the British army are of special interest at this particular time.*

CONSIDERABLE discretion must be exercised in the selection of mechanics for the flying corps, as so much depends upon the mechanical condition of the airplane. Men who apply for enlistment in this department are questioned carefully by the officer in charge and are then tested as to their proficiency in their respective lines before being accepted for service. This is called "trade testing," and is accomplished by requiring the applicant to perform the various kinds of work in which he claims to be proficient.

Testing Applicants

Applicants who desire to be fitters or machinists are questioned regarding their knowledge of motors and of such machinery as they will be obliged to handle. Their ability to use the lathe and similar tools is ascertained by putting them at work on a lathe mounted in an autotruck machine shop such as is actually used behind the lines on the western front. Here the men must satisfactorily show that they understand how to do the kind of work which will be required of them. If the applicants are not qualified as fitters, they are classed as helpers, with the possibility of being advanced later if they progress.

Carpenters or cabinet makers are tested in the making of dovetail and other joints, and if they pass this satisfactorily they will be employed to repair the various wooden parts of the airplane, such as the fuselage, wings, wing struts and landing gear. Sailmakers and those having training in the making of tents, overalls or other garments, are employed to cover planes and do similar work. For testing these, a small section or panel of a wing is utilized, the applicant being requested to sew up an L-shaped tear. The neatness with which this is done shows his experience.

In a similar way sheet-metal workers are tested by being required to cut, shape and solder several small sheet-metal pieces of various designs so as to show whether they are capable of repairing or replacing some of the sheet-metal parts of an airplane, such as engine hoods, gasoline tanks, radiators or other parts of similar nature.

Military Training

After the men have been selected, they are enlisted in the regular way and given a certain amount of military drill, principally for the sake of instilling in them an understanding of the necessity for discipline and a sense of responsibility regarding the quality of the work and the necessity of having it done promptly. They are instructed in the construction of internal combustion motors in general and in the particular types in use in the camp at which they are to be stationed, and receive considerable information which will help them to perform their various duties.

When the men who are assigned to each "flight," are thoroughly trained to the work, they become extremely proficient. Each man has a certain part of the work to handle in dismantling or disassembling a machine that may be in need of repairs for any reason. When a student makes a bad landing and crumples his running gear under the wings, it takes but a very few minutes for the repair crew to take the wings off the body, or fuselage, after which the machine is taken to the hangar for repairs. Each man is responsible for a certain portion of the work, and all connections are quickly taken out so that the various parts may be separated easily.

The headpiece shows the way the "birds" are supplied with food and water. This view taken at the secondary training camp at Borden, Canada.

Inspection of Munitions

By JAMES FORREST

SYNOPSIS — *A most important part of any repetition job is to have an intelligent and well-versed force of inspectors in action at the beginning of the output to decide on what shall pass. This is especially true on munition work, where there is a necessity for prompt and accurate decisions as to what can go and what cannot go.*

At THE present time, when so many firms are taking up new contracts for the supply of ammunition and other war supplies, a few words on the inspection side of the question may not be amiss.

There have been lots of thousands of shells, not to mention other supplies of war, held back and consigned to the scrap heap, which, it was discovered on later investigation, could have been repaired at very slight cost and delay. There have been thousands of others that were scrapped for some defect which seemed highly important at the time, but which afterward turned out to be imaginary.

Those firms which had foresight and storage room and a knowledge of governmental methods were wise enough to have these "scrapped" shells well oiled or greased, and put away where they could be found when the standard changed again.

A great number of the delays in delivery, and consequent misunderstanding and ill feeling, were caused by the incompetence of the inspectors that foreign governments themselves furnished. At the start of manufacture a great many of these men did not know what constituted a reasonably accurate shell with a reasonably good finish, and they were not in a position to educate the men who had been chosen by the contracting firm to prepare the shells for final inspection by the foreign representatives.

When a few shells had been produced which seemed to meet their requirements, oftentimes they would make a sudden change in these requirements without consideration of the fact that there were hundreds of partly completed shells on the way and that tools and gages had been made and were settling down to standardization. In many cases the change had to be made to meet some minor technicality that did not affect the finished shell in the slightest degree, but no amount of argument or presentation of the facts by intelligent men produced any effect, and all that could be done was to swallow the pill and begin all over again.

When this condition occured once or twice on each operation and a dozen times on some, it gives an idea of how much could have been saved in time, money and heart-breaking work that goes against the grain of all mechanics accustomed to know exactly what they are working for and to drive straight ahead for it.

The fallacy of all the straight-laced, cut-and-dried inspection methods of incompetent men is well shown in the acceptance of the same shells which they consigned to the melting furnace a year ago, but which a far-seeing organization preserved till a more auspicious occasion. These same men have now acquired some knowledge of the difference between what constitutes a shell that will fulfill its ultimate purpose and one with limits running in thousandths of an inch and a superfinish like a gear-tooth caliper.

In any scheme of operations, and especially on rapid repetition work like munitions, it is absolutely necessary to have a corps of inspectors who know exactly what is wanted and who can decide unhesitatingly at any stage in the sequence of operations whether the product comes within the allowable limits of dimensions and finish or is irrevocably scrap. If incompetence and trifling with established standards come into play at the head of the inspection staff, their effect is transmitted all the way down the line, until there is nothing but chaos, and those responsible for production do not know what to produce.

In any scheme of production on a large scale where the personal equation of the inspector is likely to come into play, and especially on such a requirement as a certain degree of finish that cannot be covered by the use of gages, there is bound to be great confusion at any time a change of inspectors takes place. There should always be a fully trained man who has been intelligently taught the pros and cons of the inspection of the particular product by a competent instructor, ready to take the place of any inspector whom it becomes necessary to transfer or eliminate.

The best way to transfer this information to the various inspectors who are being initiated is to have a sample of the product at each step on the way to completion, which has had the O.K. of the chief government inspector stamped on it, put in the chief inspector's office as a standard to be referred to in all cases of dispute and also as a reference for the new inspectors when they first take up their duties. There ought also to be sample shells that show those diminutive but vital defects in the metal not easily noticed, but which recur from time to time and are pitfalls for the uneducated inspector.

A thorough knowledge by the inspector of the cheapest method of repairing a shell with certain defects is also a great help toward quick handling, for by noting on the shell the method of repairing, the inspector can save a great deal of delay consequent on reinspection and time spent in deciding all over again what has to be done to overcome the defects.

A great deal of confusion at the opening of the shell contracts was caused on account of the government inspectors coming to a strange country, where there were different methods of manufacture from those they had been accustomed to, with a very vague idea of the requirements of their own government. They had their standards to make after they arrived and after manufacture had begun.

The secret of establishing harmony in a scheme of operations tending to a finished product is to present at the earliest possible moment two series of samples for the consideration of the final authority, and after acceptance have one set returned to be placed on sample by the firm furnishing the product, there to stand for the easily accessible standards of exactly what will meet the requirements of those with the final authority of acceptation or rejection.

MAKING CHANGES

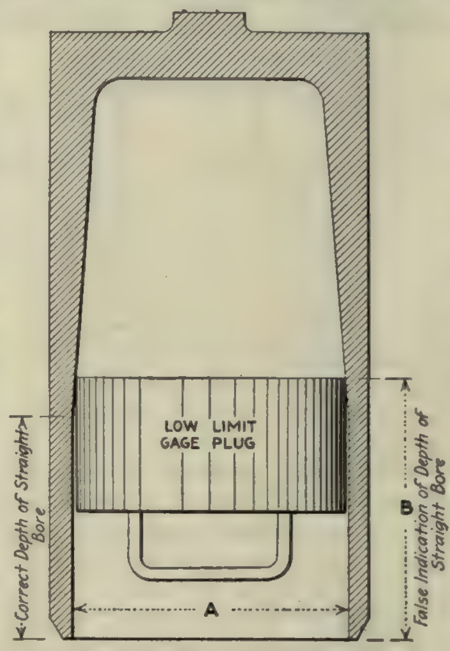
Should the foreign representative desire to make any change at any stage of the operation through advices from the battlefield or by reason of other tests, these changes can be referred to in terms of the corresponding sample and made accordingly. A new set of samples is made incorporating the changes, and the superseded ones are also preserved, as it is almost always found necessary to refer to them in the progress of the job. In this way, there is no confusion, nothing is upset, and the firm has a concrete basis for argument toward compensation for departure from contract, which it would not otherwise have.

Nothing could have had more appearance of the ridiculous than what took place when foreign shell contracts first opened up in the United States. Hundreds of firms the whole country over, some of the largest in the world, undertook to make something that would please the representatives of foreign countries, when these representatives themselves did not know what they wanted. The procedure was, in a generality of cases, to go on and on, making something in large quantities, then by a long process of stops and starts and weeding out here and putting in there, finally to alight on something approaching their desires.

The product might run along on this basis for a day or two, or maybe a week or two, when suddenly without any warning there would be consternation on the officials' faces and the word would go round that the Russian, French, British (or whatever nationality was concerned) inspector was on his high horse and was rejecting everything presented to him.

Then there would be a changed standard again for a while, in spite of the fact that the shells presented at the wholesale rejection were better than any ever presented before, or at least as good. This would all happen because the inspector in the meantime had received fresh instructions from his government or perhaps had discovered something that he ought to have known and guarded against before.

As one example of shortsightedness and of the sacrifice of essentials to meaningless trifles, the requirement on the length of the straight part of the bore of a certain shell illustrates the point well. On the bore *A*, in the cut there was 0.6 mm. allowance between maximum and minimum gages, and the method of trying the depth of the straight part of the bore *B* was to drop the plug gage down until it was stopped by the taper of the bore, then measure to the top of the shell. This would have been all right; but as the plug used was a minimum and all shells were at least over the minimum, it can readily be seen that the plug gage would always go down beyond the net length of the straight bore before it was stopped on the taper by a diameter equal to its own. If a shell was bored up to the maximum diameter on the straight part of the bore, it meant, with the taper on this shell under consideration, that the plug gage would go down 11.6 mm., or about $\frac{7}{16}$ in. below the end of the straight part before it was stopped on the taper by a diameter equal to the minimum gage. There were hundreds of shells scrapped for this one point alone, shells which theoretically and practically came within all limits set by gages and yet were scrapped because of a false system of measurement. Needless to say, the method was discontinued; but someone had to stand the loss.


LOW LIMIT GAGE PLUG
A
B
Correct Depth of Straight Bore
False Indication of Depth of Straight Bore

GAGING WITH A MINIMUM PLUG

By far the greater number of conflicts between the various inspectors was on account of the quality of the finish, and the contracting firm's inspectors had to keep a close watch on the product and never allow this to fall below the standard set by the sample shells. But there should be no difficulty on this point if those responsible keep a close watch on the cutting quality of the various heats of metal in the shells as regards carbon content, hardness and homogeneity, and have the proper allowances made on the cutting angles, rake and hardness of the steel used for cutting. For the same reason particular note should be taken of the proper proportions of the cutting compound that gives the best results on the various qualities of forgings.

If these points enumerated are carefully considered and the inspectors educated toward a degree of standardization and agreement by the above methods, things will tend to resolve into clearness and smoothness at an early stage of the contract.

The foregoing applies to all repetition work on whatever scale, and with more significance the more complex the article manufactured.

Daylight in the Modern Shop

By C. E. CLEWELL
Assistant Professor of Electrical Engineering, University of Pennsylvania

SYNOPSIS—*This article discusses some of the fundamental aspects of daylight planning for the shop, pointing out the effect on the amount of light transmitted into a building through the windows due to the angle at which the light strikes the glass, and shows that adjacent tall buildings may have a great influence on the amount of light usefully transmitted into shop spaces. The very large changes in exterior illumination are outlined with special reference to their effect on probable artificial lighting requirements, if the window area is not fully adequate. Charts are used to show the large variations in present practice in the ratio of window area to floor area, and modern sash design is illustrated by a number of views of existing plants.*

THE enormous differences between daylight conditions within a shop and those out under an open sky are perhaps not fully realized. Tests in Great Britain have shown that in some shops which depend entirely on side windows for natural light, the amount of daylight at the center of the building may be as small as one ten-thousandth of the amount that exists outside of the building under an open sky.[1] This difference between the inside and outside illumination at any given time may be used as a measure of the efficiency of the window openings in lighting the interior of the shop.

The British committee just referred to outlines the suggestion that the ratio of interior to exterior illumination at a point within the shop be termed the "daylight factor" for the given point. Its tests show that this factor seldom reaches a value as high as 10 per cent. and that the mean values for a large number of plants investigated range from about 0.25 to 2 per cent. If we use these results as an indication of the efficiency of much of the present-day window arrangements, they show that the interior illumination may be from one-fiftieth to one four-hundredth of the exterior value. The fact that shop windows admit, in general, such a very small proportion of the exterior light into the building leads naturally to a brief consideration of some of the factors on which the admission of daylight through windows depends.

When light from the sky strikes plain window glass squarely, it is practically all transmitted through the glass except that which is directly absorbed by the glass, the amount of the absorption being given as about 10 per cent. However, when the light strikes the glass at an angle with a perpendicular to the glass surface (called the angle of incidence), some of it is reflected away from the surface and is thus not transmitted through the window. These relations[2] are shown by Table I, from which it will be observed that for very large angles of incidence—that is 70 and 80 deg.—the part of the light incident upon the front surfaces of a window which finds its way into the building is very greatly reduced.

This principle is not so very important where the shop windows face an unobstructed horizon, which assures that the sky, as the source of light, can be seen from all parts of the shop interior. In such a case much of the light from the sky strikes the win-

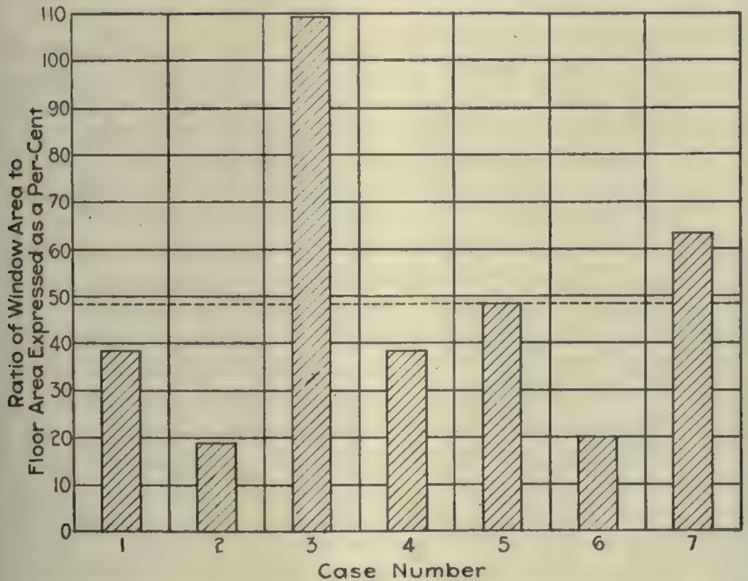


FIG. 1. RATIO OF WINDOW AREA TO FLOOR AREA FOR SEVEN TYPICAL FACTORY BUILDINGS

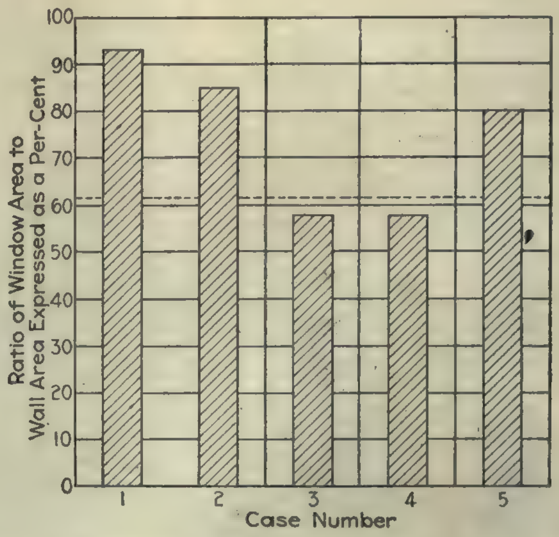


FIG. 2. RATIO OF WINDOW AREA TO WALL AREA EXPRESSED AS A PER CENT.

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[1] These results are found in the first report of the Departmental Committee on the Lighting in Factories and Workshops, appointed in Great Britain by Parliament (1915).

[2] Based on paper by L. B. Marks before the I. E. S.-Johns Hopkins lecture course in 1910.

dows more or less squarely and is hence transmitted effectively into the building. On the other hand, if there are tall buildings adjacent to and near the shop, they may cut off most of the visible sky from its windows except that part of the sky overhead which sends light down between the buildings. It is evident that in such a case practically all the light that strikes the windows is received at such large angles of incidence that only a small proportion is transmitted through the glass, as indicated by Table I.

TABLE I. PERCENTAGE OF INCIDENT LIGHT TRANSMITTED INTO BUILDING

Angles of Incidence, Deg.	Per Cent. of Incident Light Transmitted Through Windows	Angles of Incidence, Deg.	Per Cent. of Incident Light Transmitted Through Windows
0	90.0	50	83.0
10	89.5	60	78.0
20	89.0	70	69.5
30	88.0	80	50.0
40	86.0	90	0.0

Under such circumstances the daylight factor for the shop interior is likely to be very low unless some special form of glass is provided, at least in the upper part of the window sashes, for redirecting this light more usefully into the shop. Roughed, ribbed and prism glass may be employed for this general purpose. Furthermore, if the front surface of the opposite near-by building is light in color, the light sent into the shop will be somewhat increased by the reflection from this light surface. As a general proposition, however, the daylight problem is considerably complicated when buildings are very close to one another, so that the light from the sky can reach the windows only from points nearly overhead.

Ratio of Window Area to Floor Area

From what has just been said, it follows that the window area is not in itself the only factor that determines the interior daylight conditions. A given window area, which might be entirely adequate for a shop out on open ground and with no surrounding obstructions, might be very inadequate for another shop of equal floor area, but which was surrounded with near-by tall buildings that cut off practically all visible sky from the shop windows except that nearly overhead. For this reason it is very important to exercise considerable care in sizing up the daylight facilities of an existing plant, or the plans for a new building, on a basis merely of the ratio of window area to floor area.

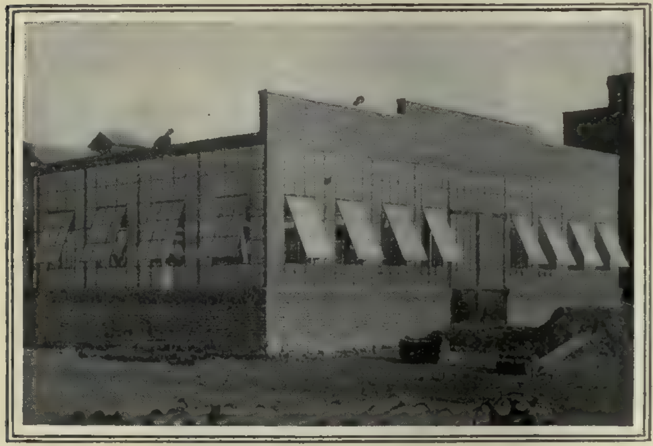

FIG. 3. A BUILDING OF THE MERCER AUTOMOBILE CO., SHOWING THE USE OF LUPTON PIVOTED SASH

On the other hand, if due care is exercised in taking all the factors into account, the ratio of window area to floor area may sometimes be used as a check on the probable degree of success to be expected from given window openings. One of the larger sash manufacturers[3] cites a range for this ratio from about 20 to about 110 per cent., based on seven typical cases, with an average of about 50 per cent., as in Fig. 1.

Investigations[1] in Great Britain, which include a large number of shops of various kinds, indicate an average for this ratio of about 40 per cent. for shops with roof lighting only and also for those with a combination of roof and lateral or side window lighting. These observations seem to show, further, a considerably lower value for the ratio (somewhat less than 20 per cent.) for shops with side windows only, this probably being due to the limitation of the observations, in the main, to older shops with inadequate window areas.

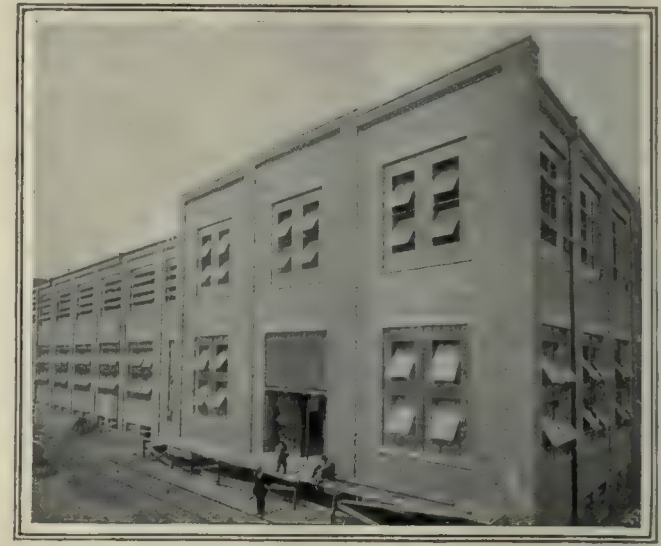

FIG. 4. A BUILDING OF JOHN A. ROEBLING'S SONS CO., SHOWING LUPTON PIVOTED STEEL SASH OF ANOTHER TYPE

There is a general tendency in modern shop construction to utilize as much of the side wall area for window openings as the mechanical conditions of the wall will permit. A good idea of this tendency is gained by a study of the ratio of side window areas to side wall areas in modern buildings. Experience of one representative sash manufacturer[4] shows an average value of about 60 per cent. for this ratio with ranges from about 57 to about 93 per cent., based on a number of typical plants. These relations are shown in Fig. 2. It is to be noticed in this diagram that case number 4 refers to an average of 18 buildings erected by one construction company, so that the average shown by the dotted line in this diagram is actually an average of 22 cases.

A good way in which to gain a better understanding of the effectiveness of these large wall window areas is to consider the exterior daylight conditions on which any system of windows must depend for its net result in illuminating the shop interior. The results of tests[1] in Great Britain for typical days in June, September and December are given in Table II, where the exterior intensities of the daylight are expressed in foot-candles. This unit is defined in the Code of Factory Lighting[5] as the lighting effect produced upon an object by a standard candle at a distance of 1 ft. For rough benchwork an intensity of from two to four foot-candles is usually required for satisfactory vision.

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[3] Based on figures submitted by D. Lupton's Sons Co., Philadelphia, Penn.

[4] Based on figures compiled by the Detroit Steel Products Co., manufacturer of "Fenestra" steel sash.

Hence, the exterior intensities given in Table II are seen to be very large by comparison with the required values for satisfactory vision in the shop. Notice, also, the greatly reduced values for the typical day in December as contrasted with the June day. The much shorter days in December are evidenced by the fact that the exterior illumination is practically zero until between 7 and 8 a.m. and is again zero before 5 p.m.

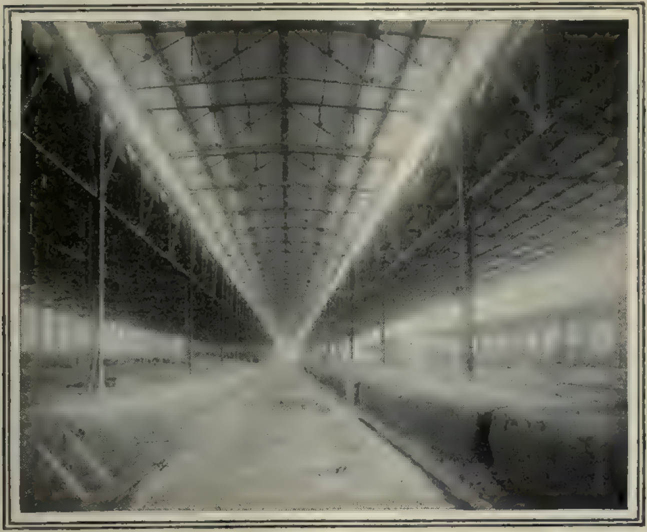

FIG. 5. INTERIOR OF EDWARD FORD PLATE GLASS CO., SHOWING INTERIOR LIGHTING OBTAINED WITH U. S. STEEL SASH

APPLICATION OF THE TABLE

An interesting application of the figures in Table II may be made by assuming a given daylight factor for a point within a shop and prescribing a certain minimum of illumination for the work, on the basis of which we may determine the approximate times when artificial light will be required. To illustrate this point, refer to Table II, where it will be observed that at 7 a.m. the exterior intensity is roughly 1000 foot-candles. For an assumed daylight factor of 0.2 per cent., the interior illumination at the given point will be about 1000 × 0.002, or two foot-candles. If the prescribed minimum intensity to be maintained for the work is three foot-candles, then some artificial light will be required, as indicated in Table III for 7 a.m. Similarly, it may be shown that the intensity due to the daylight is three foot-candles or over at 8 a.m. and on throughout the typical June day until about 5 p.m., when it falls below three, and again some artificial light is required.

TABLE II. INTENSITIES OF EXTERIOR DAYLIGHT FOR DIFFERENT HOURS OF TYPICAL DAYS

Hour of the Day	Approximate Exterior Daylight Intensities in Foot-Candles June	September	December
5 A.M	250	0	0
6 A.M	500	200	0
7 A.M	995	500	0
8 A.M	1,750	800	100
9 A.M	2,700	1,250	250
10 A.M	3,500	1,550	500
11 A.M	3,900	1,750	700
12 M	4,050	1,800	750
1 P.M	3,900	1,750	700
2 P.M	3,500	1,550	500
3 P.M	2,800	1,250	250
4 P.M	1,800	800	50
5 P.M	1,000	450	0
6 P.M	500	200	0
7 P.M	250	0	0

TABLE III. APPROXIMATE ARTIFICIAL LIGHTING REQUIREMENTS FOR VARIOUS HOURS OF THE DAY *

Hour of the Day	Approximate Artificial Lighting Requirements June	September	December
7 A.M	Artificial light required	Artificial light required	Artificial light required
8 A.M	Daylight adequate	Artificial light required	Artificial light required
9 A.M	Daylight adequate	Artificial light required	Artificial light required
10 A.M	Daylight adequate	Daylight adequate	Artificial light required
11 A.M	Daylight adequate	Daylight adequate	Artificial light required
12 M	Daylight adequate	Daylight adequate	Artificial light required
1 P.M	Daylight adequate	Daylight adequate	Artificial light required
2 P.M	Daylight adequate	Daylight adequate	Artificial light required
3 P.M	Daylight adequate	Artificial light required	Artificial light required
4 P.M	Daylight adequate	Artificial light required	Artificial light required
5 P.M	Artificial light required	Artificial light required	Artificial light required

* This table is based on exterior daylight conditions as in Table II and on an assumed daylight factor of 0.2 per cent, also on the assumption that an intensity of three foot-candles must be maintained at the work at all times.

It is interesting to notice in Table III that under the assumed conditions the artificial lighting requirements increase for the later months in the year, and that finally in December artificial light must be used throughout the entire day to supplement the inadequate natural light. This is perhaps a somewhat extreme case brought about because of the assumed conditions that were taken, but it is not uncommon to find such a state of affairs within some older shops where the windows are very inadequate and where the daylight during winter months is very poor at central portions of the building. Of course, if the daylight factor has higher values than 0.2 per cent. for positions in the shop nearer the windows, Table III will be modified accordingly with correspondingly less requirements for artificial light for these better-lighted portions of the floor.

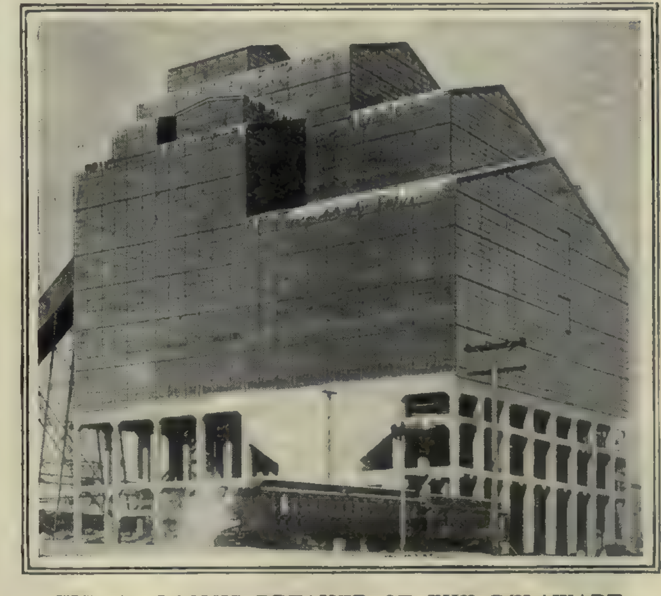

FIG. 6. LOOMIS BREAKER OF THE DELAWARE, LACKAWANNA & WESTERN R.R., SHOWING FENESTRA CONSTRUCTION

Window area is 93.5 per cent. of total side-wall area

Under actual shop conditions charts like Table III may be prepared, somewhat like schedules, showing the probable hours of the day when artificial light will be required for different parts of the shop, provided simple tests of the daylight factor have been made and the values of exterior illumination similar to Table II are available. It must be remembered, however, that any schedule like Table III is subject to large modifications in case of cloudy or foggy days, when the requirements for artificial light will naturally be increased.

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[5] This code has been prepared and issued by the Illuminating Engineering Society, 29 West 39th St., New York City.

Some of the recent developments in shop-window design and construction are shown in Figs. 3 to 7, from which it is very evident that present-day practice tends to a high percentage utilization of available side wall areas for window openings. These views also convey the idea that there is a close relation between the problems of natural lighting and of ventilation.

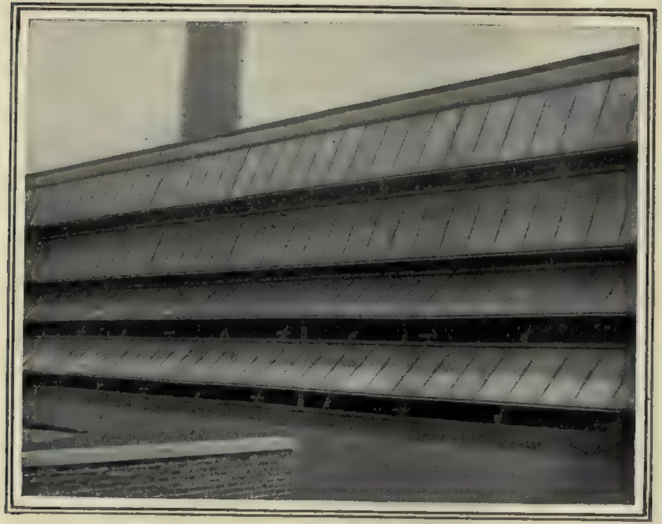


FIG. 7. ERIE MALLEABLE IRON CO. BUILDING, SHOWING THE POND CONTINUOUS STEEL SASH

Figs. 3 and 4 are included to show the application of pivoted sash. In Fig. 3 the "top hung" type is shown, with which there is no projection into the shop when the sash is open. In Fig. 4 the centrally pivoted type is illustrated, and the slight projection of the upper part of the sash into the building, when open, is clearly indicated. The advantage of sash like that in Fig. 3 over that shown by Fig. 4 is the freedom of any interference when opening the sash, in case the work or materials are stored or even temporarily placed immediately next to the inside wall surfaces.

Fig. 5 gives an unusually good impression of the added interior illumination produced by roof windows as a supplement to side or lateral windows alone. In a building like this, the width is so great that the illumination of central portions of the plant would usually be very poor if dependence were placed solely on the remote side windows. The roof windows tend to smooth out the daylight intensities and make them more uniform throughout the entire shop area. Fig. 6 is included merely to give an idea of the extreme utilization of wall areas for windows in some cases, the ratio of side window area to side wall area in this instance being about 93 per cent.

Fig. 7 is a somewhat close view of the Pond patented continuous sash as used in conjunction with the Pond truss. The long lines of sash arranged as units are operated by hand or power.

Improved Drawing-Board Cover

By M. Bass

In a great majority of drafting rooms the ordinary buff drawing paper is used to cover drawing boards. It is not long before the paper is soiled and marked up with pencil marks and ink spots. There is also another disadvantage—in damp weather the paper becomes loose on the board, making it disagreeable to work on.

A good way to do away with all this is as follows: Cut the paper the required size and rub over it with a damp cloth. The water on the paper will make it expand. Then tack the paper to the board. The tacks should be about 2 in. apart. In a little while the paper will tighten up and dry, when a coat of shellac should be spread over it.

A drawing-board cover treated in this way will never loosen up in damp weather, and it is hard to write on, therefore the cover will always look tidy and clean. In case some ink spots or other stains get on it, they can be washed off without any trouble.

It takes a little longer to put on a cover like this, but it is worth while, considering how much longer it lasts than the other kind. The only reason for ever taking the cover off is on account of so many tack holes; but for these, it would last indefinitely.

Smokes for Pennsylvania R.R. Men in the Army

The Pennsylvania R.R. has inaugurated a plan whereby every Pennsylvania R.R. man who goes to France with either the army or the Marine Corps, or who enlists in the army, will from time to time, probably as often as once a month, receive from another Pennsylvania R.R. man at home a package of tobacco and cigarettes. Each package will contain a self-addressed post card from the employee whose contribution provided the gift.

This arrangement has been made possible by the organization of the Pennsylvania Railroad Tobacco Fund, the object of which is to maintain personal contact and the spirit of fellowship between those who go and those who stay.

More than 2500 employees of the Pennsylvania Lines East of Pittsburgh have already enlisted. Some of these are already in France, others are on their way, and the remainder are preparing to go. By means of this tobacco fund several thousand Pennsylvania men, both at home and abroad, will be placed in touch with each other every month.

This is given as a suggestion of what may be done on a much smaller scale in some of the large machine shops of this country, or such a fund can be provided by communities in which there are a number of small shops. The main thing is to keep the personal contact between the men at home and those who are fighting our fight on the other side. One interesting feature of this and some of the other smoke funds is that many men who never smoked are contributing cheerfully in order that the boys on the other side may be made as comfortable as possible and that they may know that they are being thought of by those at home.

Tools For Hollow Milling a Drop-Forging

BY HARVEY H. DUGDALE

HAVING read in Vol. 46, page 251, an article by Hugo F. Pusep describing an adjustable hollow milling tool, I am prompted to describe an adjustable hollow milling tool and jig that have been in successful use for about seven months.

Fig. 1 shows one of the pieces of work done with this tool. The pieces were drop-forgings, and there were eight different kinds, in which diameters varied, as did also the distance of the trunnions from the center line.

In this particular case the trunnions were to be milled to 0.492 in. in diameter by 1.25 in. long, one trunnion on each end of the bar. This work had at one time been done on a vertical-spindle drilling machine, in much the same manner as that described by Mr. Pusep, but the product was unsatisfactory as to quality and quantity. The limits on the 0.492 diameter are ±0.002, and these could not be maintained. The work also came out rough, due to the shake in the drilling-machine spindle. The production was also low, because only one end of the bar could be milled at one time.

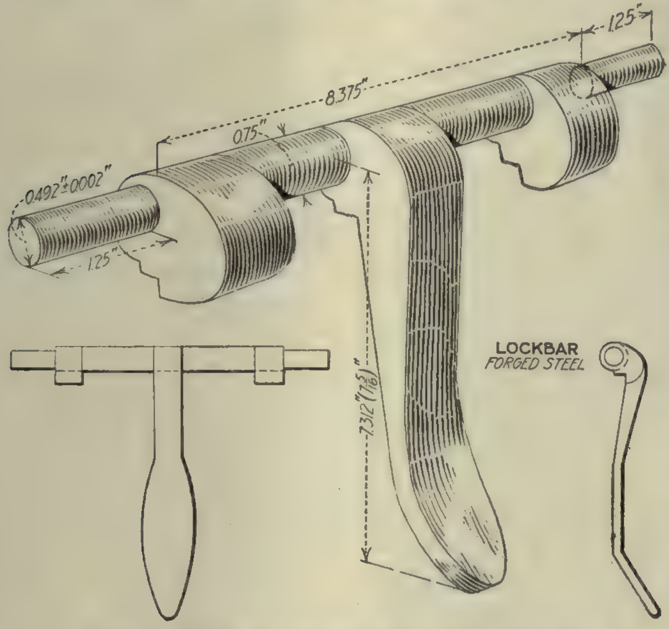


FIG. 1. LOCK BAR TO BE HOLLOW MILLED

So this fixture was designed for a Garvin No. 3 two-spindle horizontal drilling machine, so that both ends of the bar could be milled simultaneously. Two fixtures and four milling tools were made for two machines placed close together, one machine taking a roughing cut, the other a finishing cut. One man operates both machines.

Hollow Milling Tool

Fig. 2 is a cross-section of the hollow-milling tool, which is shown assembled in Fig. 3. Figs. 2 and 3 show the mill with four ¼-in. blades or tools, but these were afterward changed to three 3-in. blades.

In Fig. 2, *A* is the body, *B* the blades or tools, *C* the clamping nut, *D* the adjusting nut and *E* the check-nut. The tools *B*, fitting snugly in the slots, are held securely on their tapered seats by the clamping nut *C*, which screws on a 12 pitch U. S. Standard thread on the body. The blades are backed up and adjusted by the adjusting nut *D*, the face of which is ground concave, so that there is a straight thrust on the blades. The adjusting nut is secured by the check-nut *E*.

There is a ¾-in. lift to the blades, as the adjusting nut can be screwed forward, thrusting the blades outward until the nut *D* comes to a stop against the shoulder of the body *A*, on which the clamping nut *C* is screwed. The clamping nut *C* is counterbored out to the bottom of the thread in the back end, so that the adjusting nut *D* is free to move forward and into the clamping nut. The clamping nut has to be long, as it runs in a hardened-steel bushing in the jig and has to have 1.25-in. travel. The bushing could be made no longer, as our longest piece of work cramps us for room.

Details of the body *A*, Fig. 2, are given in Fig. 4. It is made of forged steel with a No. 4 Morse taper shank to fit the drilling-machine spindle. The three 0.3-in. slots that receive the blades are placed 120 deg. apart and 0.05 in. ahead of center. They are milled at an angle of 18 deg. to the horizontal and through the threaded collar that receives the clamping nut. The $\frac{9}{16}$ hole in the center is reamed, as the gage for setting the tools is inserted here.

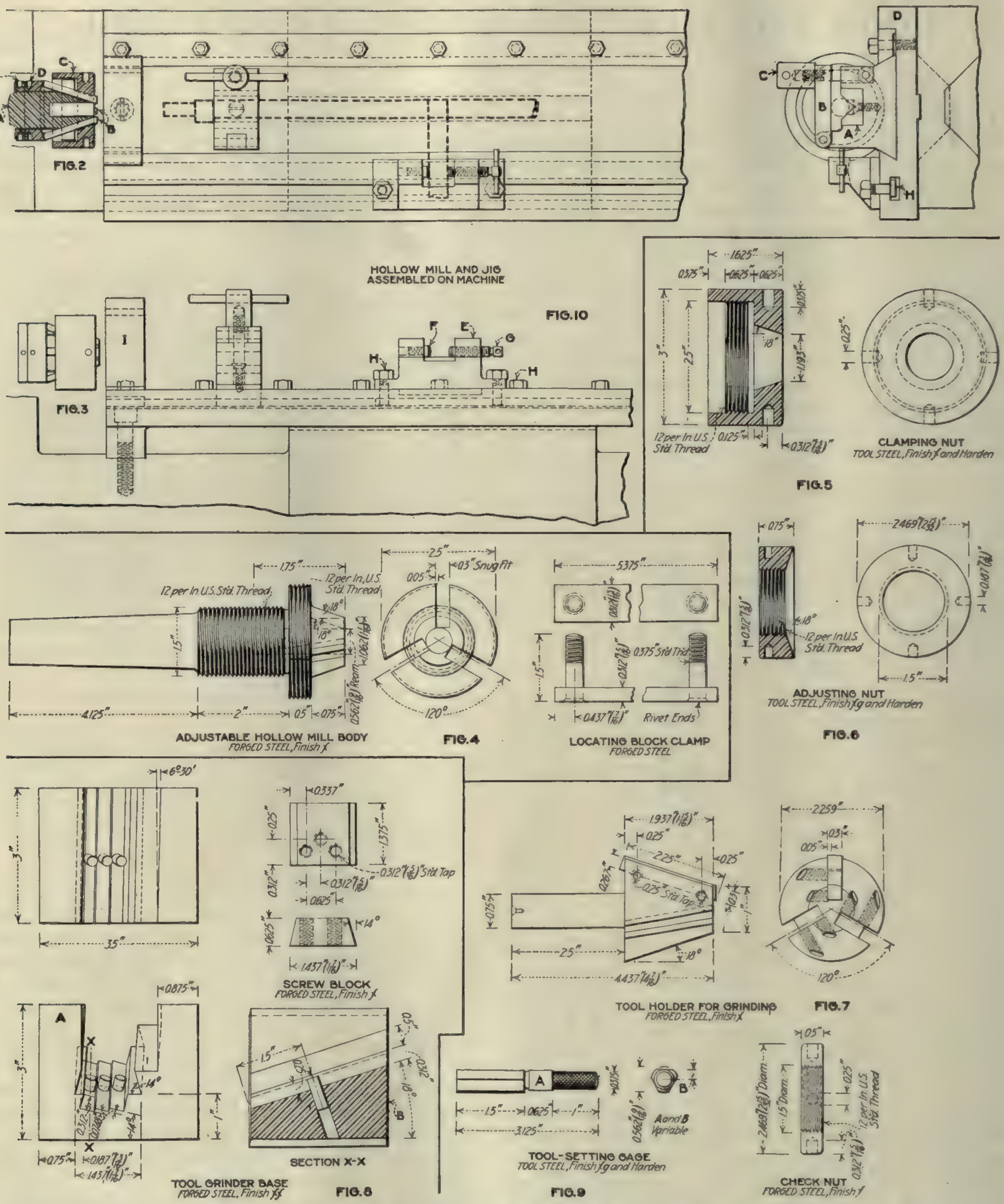
Fig. 5 presents details of the clamping nut *C*, Fig. 2, showing the 18-deg. clamping surface. It is made of tool steel, hardened and ground. Fig. 6 gives details of the adjusting nut *D*, Fig. 2, showing the 18-deg. concave surface. This is also made of tool steel hardened and ground.

Blade-Grinding Fixture

To grind the blades quickly and uniformly, two holders were designed. The holder in Fig. 7 is used in a Landis grinding machine for the first grinding, which gives the convex surface to the top of the blade on which the clamping nut *C*, Fig. 2, acts. It also gives the convex surface to the back of the blades on which the adjusting nut acts, and squares up the front, or cutting, edge of the blades. The blades, which are held in the holder by ¼ headless setscrews, are in sets of three and have the same position as in the hollow mill. The top surface of the blades is ground to a little smaller diameter than is the clamping nut with which the blades come in contact.

As the blades become dull, they are reground and moved forward, the larger diameter of the blades coming in contact with a smaller diameter in the clamping nut. Therefore, the blades are ground to a smaller diameter to start with, so as to insure a line contact at all times.

The set of blades is next placed in the toolholder shown in detail in Fig. 8. The tools are placed in the grooves with the back ends against the fine stop. The dovetail screw block is slipped into place, and the blades are held securely by the three $\frac{5}{16}$ setscrews in the screw



FIGS. 2 TO 10. DETAILS OF TOOLS AND PARTS

Fig. 2—Hollow-milling tool. Fig. 3—The assembled tool. Fig. 4—Details of tool body. Fig. 5—Details of clamping nut. Fig. 6—The adjusting nut. Fig. 7—First blade-grinding fixtures. Fig. 8—Second blade holder. Fig. 9—Tool-setting gage. Fig. 10—The work holder

block. Tools are ground on a surface grinding machine. Setting the toolholder on the face *A* and passing back and forth under the wheel give the necessary clearance to the blades for turning the diameter of the work. They are not brought down to a sharp point, but are ground straight back for about $\frac{1}{32}$ in. The tools will stand up better and turn out smooth work. Setting the toolholders on the face *B*, and grinding, give the necessary clearance for facing the square shoulder on the work. By these means the blades are ground very rapidly and in sets of exact uniformity.

The tool-setting gage is illustrated in Fig. 9. The dimension *A* is the size to which the blades are set. The $\frac{9}{16}$ diameter slips into the reamed hole of the body, Fig. 4, and has three flat sides milled on it so that it may be withdrawn after the blades are set. The gage is made of tool steel, hardened and ground.

WORK HOLDER

The jig for holding the work is shown assembled in Fig. 10. Partial plan, side and end views are given. The jig is bolted directly to the machine by four screws in the center portion and one at each end. The work rests in the V-blocks *A*, one of which is shown and is held by the swing clamp *B*, which in turn is held by the swing bolt and nut *C*. The V-blocks *A* are made in separate pieces so that they can be shimmed up to accommodate different diameters of work. The entire clamping block is adjustable to the whole length of the jig, sliding in dovetail ways and held for the gib *D*.

The work is located in the block *E*, being brought up against the hardened-steel pin *F* by the setscrew *G*. The locating block is also adjustable to the whole length of the jig, sliding in a keyway and being clamped by the tie-bolts and clamp *H*.

In order to insure a smooth finish and hold the work to close limits, the clamping nut of the hollow mill runs in a hardened-steel bushing in the bearing stand *I*. This bearing stand is also adjustable to the whole length of the jig, sliding in the same dovetail ways as the clamping block.

As stated in the beginning of this article, these hollow mills and jigs have been in use for about seven months and have given the best of satisfaction. The work comes out within the limits and is smooth, a difficult thing in hollow milling.

The operator clamps a piece of work in the roughing machine, brings both spindles forward to the work and throws in the feed. He then turns to the finishing machine, takes out the finished piece and puts in a roughed one. By this time the spindles in the roughing machine have moved forward the required distance, the feed trips, and the spindle, being weighted, returns to the starting position. A full stream of coolant is kept playing on the work.

Proper Use of Diamond-Tool Holder on Grinding Machines

BY HOWARD W. DUNBAR
Norton Grinding Co.

An article by R. C. Fetch, on page 58, describing a simple diamond-tool holder for use on a Norton machine, has attracted the writer's attention. For fear that some users of Norton grinding machines may innocently follow Mr. Fetch's suggestion to their regret, the following illustrations, with criticisms of the arguments in the above-mentioned article, are presented.

Every attachment on a well-designed machine tool is valuable, if properly used, and generally takes certain shapes and forms because of definite requirements to be met. The diamond-tool holder carried on the center of the footstock of Norton grinding machines takes its form for such reasons. If properly fastened to the center and the supporting member, it in itself cannot chatter. However, the diamond is not supported in this body member, but rather in the end of a bar, which in turn is clamped into the body. This bar, being the weaker of the two members, naturally would be the part that would vibrate, if any vibrations occurred.

The principles back of wheel truing in later-day ideas have taught grinding-machine engineers that the diamond should be supported in a more or less flexible mounting, because under such conditions the life of the diamond is very much greater. In truing devices for larger types of machines, this discovery has led us to mount the diamond in a flexible member, rather than in a rigid body, when supplying a device for truing the radius as well as the face of the wheel, as shown in Fig. 1. By so doing, when the diamond comes in contact with a lump or hard spot in the wheel, the mounting yields slightly and saves the diamond; the spring is stiff enough, however, to make a perfectly true face when the final light truing cut is taken.

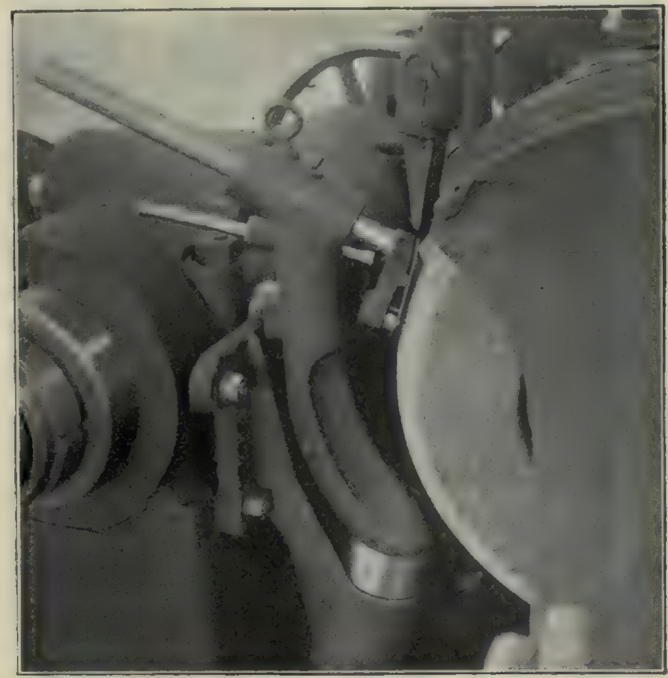


FIG. 1. WHEEL-TRUING DIAMOND SET IN FLEXIBLE MOUNTING

Mr. Fetch's closing argument is that the time alone consumed in taking the holder on and off fully compensates for his design. The holder used and furnished with the Norton grinding machine is not intended to be removed from the footstock center; when once fastened, it remains there permanently, and the diamond rod is taken in and out when the truing operation is necessary.

Further, in the simple form of holder described in the article it is necessary, when grinding large-diameter pieces, to run the wheel from the diameter of the work being ground into the diamond. In the Norton regular truing device the diamond is extended out of the holder the proper distance to meet the face of the wheel at the same point where the wheel was grinding, so that no time would be lost running the wheel in for truing and back to the diameter being ground.

In Fig. 2 a hole in the side of the diamond rod at *A* is illustrated for the purpose of receiving the diamond nib when it becomes necessary to true the side instead of the face of the wheel. This is frequently necessary in grinding operations such as finishing crankshaft pins, or where the wheel must be fed in between two shoulders, and therefore must be the correct width. This is not possible in the device described in the article. Mr. Fetch's device would serve the purpose of tiding the operator over until a new body could be procured to replace the old one in case of accident, but would hardly serve the purpose that the diamond truing device furnished with the machine is intended to serve.

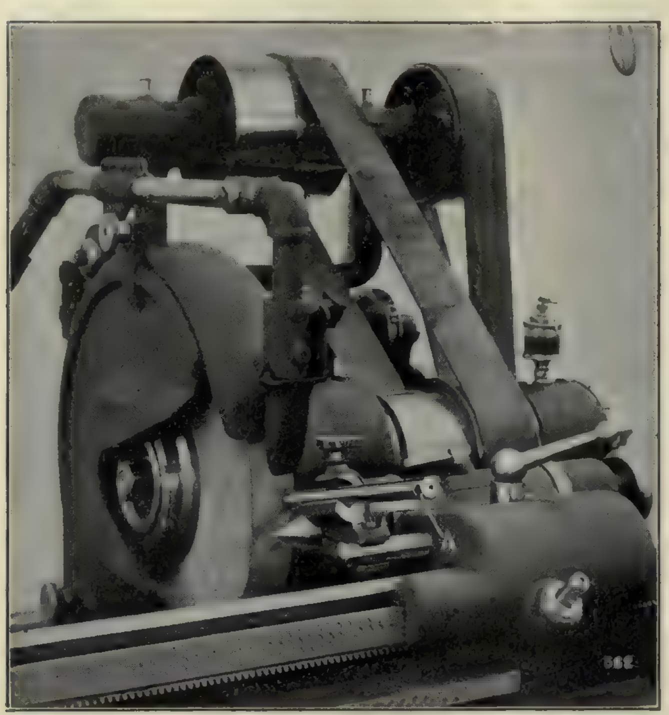


FIG. 2. ROD MAY BE USED TO TRUE SIDE OF WHEEL

Priority in Iron and Steel Orders and Work Fixed by War Industries Board

The Priorities Committee of the War Industries Board of the Council of National Defense has made public the contents of its first general priority circular, giving instructions as to priority in orders and work for all individuals, firms, associations and corporations engaged in the production of iron and steel and in the manufacture of products thereof. About 25,000 copies of the circular have been sent to manufacturers in all parts of the United States, requesting them hereafter to observe the regulations, giving priority in accordance with certificates to be issued by the committee. The circular is signed by Judge Robert S. Lovett, chairman, and is approved by the Secretaries of War and the Navy.

DIVIDED INTO THREE CLASSES

Under these regulations, all orders and work are divided into three classes: Class A, comprising "war work; that is to say, orders and work urgently necessary in carrying on the war, such as arms, ammunition, ships, etc., and the materials required in their manufacture." Class B, comprising orders and work "which while not primarily designed for the prosecution of the war, yet are of public interest and essential to the national welfare, or otherwise of exceptional importance." Class C, comprising all orders and work not embraced in class A or class B. All orders henceforth will be classed as class C unless covered by certificates of the Priorities Committee. No certificates will be issued for class C orders.

Order and work in class A will take precedence over those in class B, and both these classes will be given priority over class C, irrespective of the date the orders were received. Class A and class B will in turn be separated into subdivisions to be designated as class A1, A2, A3, A4, etc., and class B1, B2, B3, B4, etc., each composed of orders within the class which are regarded respectively as of greater moment and to be given precedence in accordance with its serial number. All materials required in the manufacture of an article or in prosecution of any work will be entitled to take the class of such article or work unless otherwise specified.

For the administration of the regulations, certificates will be issued by the Priorities Committee upon application, specifying the classification of the order of work. Certificates of a subsidiary nature will be issued upon request for the furnishing of material and articles required in manufacturing the article or prosecuting the work ordered. War orders of the Allies as well as of the United States will be placed in class A. In the case of those already contracted for, all orders placed prior to the date of the circular by the War or Navy Departments or the Emergency Fleet Corporation of the United States will be classed as subdivision A1 of class A, unless otherwise ordered. Orders already placed by the Allies for war materials will be classed as subdivision A2 of class A, unless otherwise ordered.

MAKING OF APPLICATIONS

Applications for class A certificates will be made to the committee by the contracting officer or agency of the United States, or in the case of the Allies by their authorized agent. Applications for subsidiary certificates covering materials, articles or work required in the manufacture of class A products will be made by the contractor to whom the principal class A certificate has been addressed.

Applications for class B certificates will be made to the committee by the individual, firm or corporation for the expedition of whose contract the priority order is desired, while subsidiary certificates for materials will, as in the case of class A certificates be applied for by the contractor to whom the principal class B certificate has been addressed.

The Priorities Committee is composed of Robert S. Lovett, chairman; Maj. Gen. J. B. Aleshire, George Armsby, Rear Admiral N. E. Mason, Edwin B. Parker, . Leonard Replogle and Rear Admiral A. V. Zane. R. T. Demsey is executive secretary.—*Official Bulletin.*

Three Commodities Added to Exports Embargo List

The Exports Administrative Board has announced that, in addition to the commodities listed in its notice of "Articles Requiring Export License," published on Sept. 18, the following, controlled by the second division of the President's proclamation of Aug. 27, 1917, require licenses before being exported to any country of the world: Brass, bronze, caustic soda.

A Study of Velocity Diagrams for Shapers and Slotters—II

By A. LEWIS JENKINS
Assistant Professor of Mechanical Engineering, University of Cincinnati

SYNOPSIS—*This concluding installment of Professor Jenkins' article takes up the application of the method of instantaneous centers to quick-return mechanisms as applied to shapers and slotters, and also outlines the construction of velocity-ratio diagrams as an alternate method.*

IN THE mechanisms shown in Figs. 10, 12, 14, 16, 18, 20, 20*a*, 22, 24, 26 and 28, the link P_1A is the driving crank attached to the bull wheel, and P_2Q is the slotted bar, which oscillates about the point P_2 is not fixed in Figs. 14, 16, 20 and 26, but is used to designate the instantaneous center of the pendulum or slotted bar; and P_2P_1 is the line of centers. These latter mechanisms may be considered the same as the others with the exception that the center around which the pendulum rotates moves instead of being fixed. For any position the pendulum may be considered as rotating around the point P_2 regardless of whether it is fixed or not. The line AK is drawn perpendicular to the slot and represents the position of the center line of the coupler, as explained for Fig. 4. P_1T is drawn parallel to the line connecting K and Q. ST and P_2N are drawn perpendicular to the direction of motion of the ram R. In all cases the line ST represents the linear velocity of the ram when P_1A represents the linear velocity of the crankpin A about the center P_1. To prove this statement, let

W_1 = Angular velocity of P_1A about P_1;
W_2 = Angular velocity of the slotted bar P_2Q, or P_3Q about the center P_2;
Va = Linear velocity of A about P_1;
Vq = Linear velocity of Q about P_2;
Vr = Linear velocity of the ram R.

By the theorem for velocity ratio in link work and similar triangles,

$$\frac{W_1}{W_2} = \frac{P_2K}{P_1K} = \frac{P_2Q}{QT}$$

Since the linear velocity is equal to the product of the angular velocity into the radius,

$$Va = P_1AW_1$$
$$Vq = P_2QW_2$$

and their ratio is

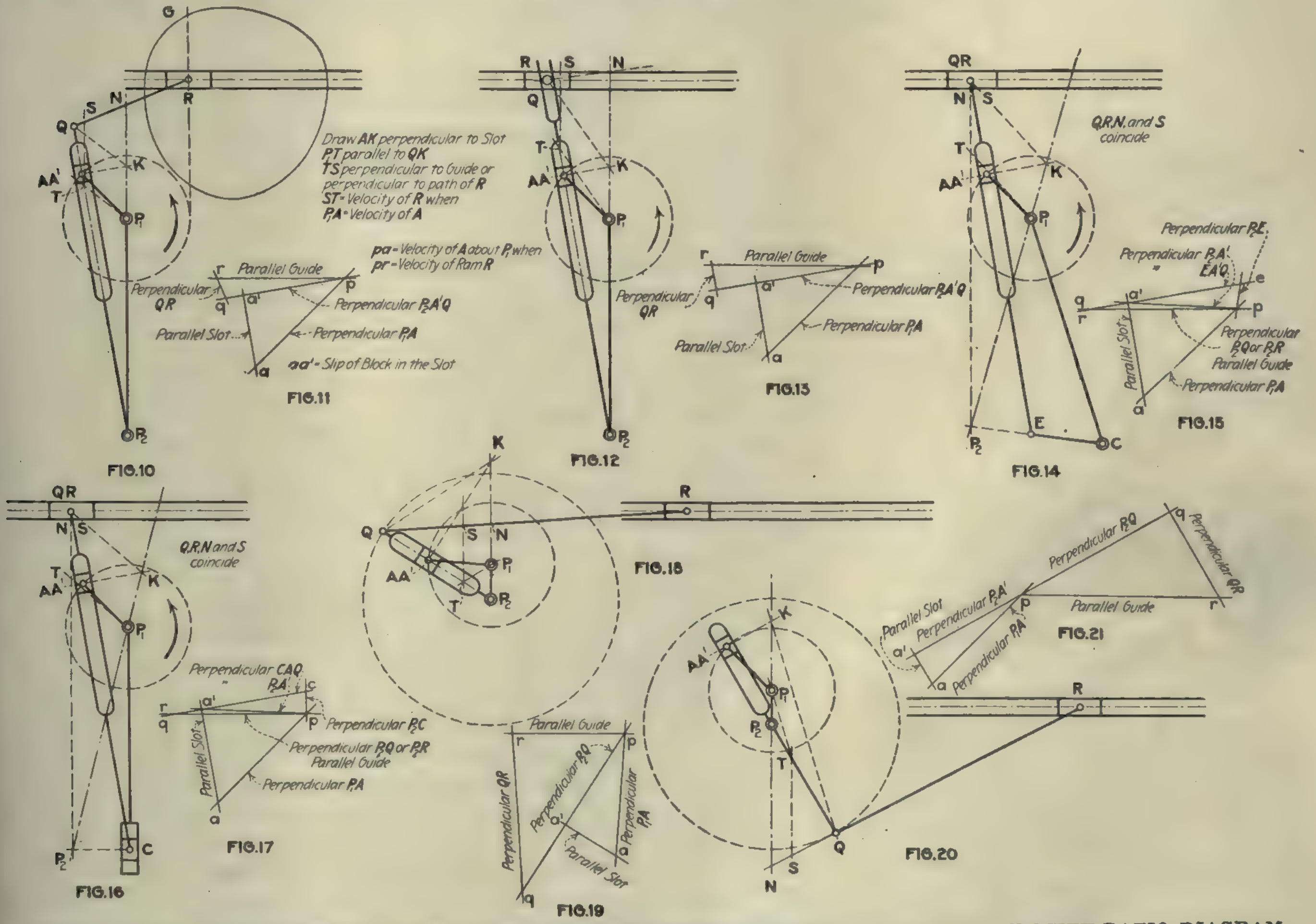


FIG.10

FIG.11

FIG.12

FIG.13

FIG.14

FIG.15

FIG.16

FIG.17

FIG.18

FIG.19

FIG.20

FIG.21

FIGS 10 TO 20. APPLICATION OF THE INSTANTANEOUS-CENTER METHOD AND THE VELOCITY-RATIO DIAGRAM TO QUICK-RETURN MECHANISMS

$$\frac{Va}{Vq} = \frac{P_1A}{P_2Q} \times \frac{W_1}{W_2} = \frac{P_1A}{P_2Q} \times \frac{P_2Q}{QT} = \frac{P_1A}{QT}$$

This proves that the line QT represents the linear velocity of the point Q to the same scale that P_1A represents the linear velocity of A.

From the theorem applied to the linear velocities of A and B in Figs. 1 and 5 and by similar triangles,

$$\frac{Vr}{Vq} = \frac{P_2N}{P_2Q} = \frac{ST}{QT}$$

This equation divided into the one immediately above gives

$$\frac{\dfrac{Va}{Vq}}{\dfrac{Vr}{Vq}} = \frac{\dfrac{P_1A}{QT}}{\dfrac{ST}{QT}}$$

or

$$\frac{Va}{Vr} = \frac{P_1A}{ST}$$

which proves that if P_1A represents the linear velocity of the point A about P_1, then ST represents, to the same scale, the velocity of the ram R.

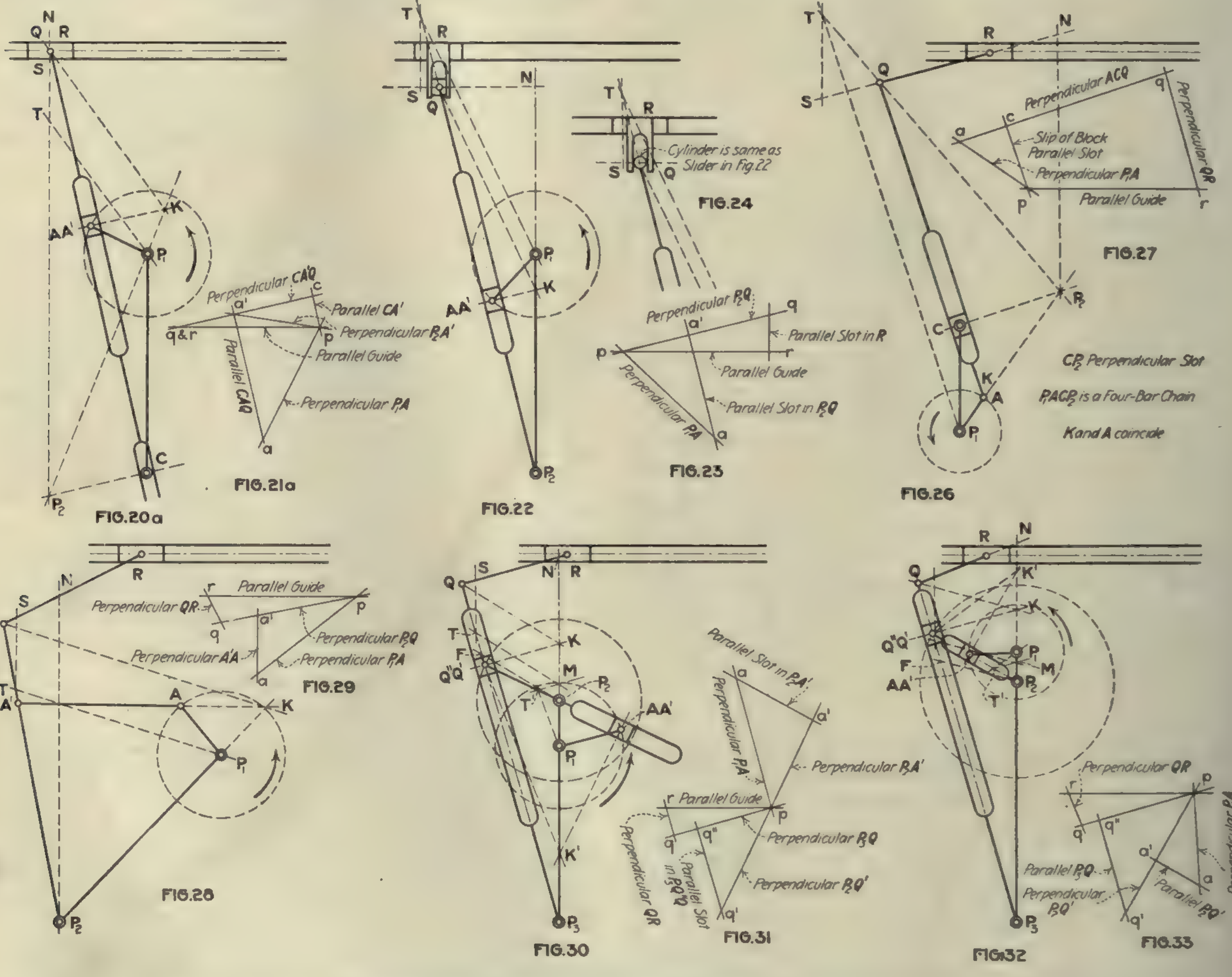
In constructing the diagram as shown in Fig. 10, the ordinate RG is made equal to ST for a sufficient number of positions to determine the curve for both strokes. In locating the line ST it is only necessary to draw the lines AK, P_1T and then ST; or merely to locate the points K, T and S without actually drawing the lines.

In Figs. 30 and 32 the pendulum P_3Q is driven by the crank P_2Q' that has a variable velocity imparted to it by the crank P_1A, which runs with a constant velocity. It is easily seen that these mechanisms give a compound effect in producing a quick return. In Fig. 30 the effects of the two quick returns act together when the point P_1 is below P_2. If P_1 is above P_2, then the effects of the two motions tend to neutralize each other. In Fig. 32, P_1 is above P_2 and the quick-return motions act together. If P_1 were below P_2, they would tend to neutralize each other and thereby cause the quick-return effect to be lessened. Regardless of whether the point P_1 is above or below the point P_2 in either Fig. 30 or Fig. 32, the analysis is the same.

In the construction, AK' is drawn perpendicular to the slot in the link P_2A; K' and Q' are connected and P_1T' is drawn parallel to $K'Q'$. It has been shown that

$$\frac{\text{Linear velocity of } Q' \text{ with respect to } P_2}{\text{Linear velocity of } A \text{ with respect to } P_1} = \frac{Vq'}{Va} = \frac{Q'T'}{P_1A}$$

The line $Q'K$ is drawn perpendicular to the slot in P_3Q; a line is drawn through K and Q; P_2F is drawn parallel to KQ; P_1T' is parallel to $K'Q'$, the point T' lying on the line P_2Q'; $T'M$ is parallel to $Q'K$; MT is



FIGS. 20 TO 33. VARIOUS MECHANISMS AND DIAGRAMS FOR QUICK-RETURN MOTIONS

parallel to QK, and ST is perpendicular to the line of stroke of the slider R. Then

$$\frac{W_2}{W_3}=\frac{P_3K}{P_2K}=\frac{P_3Q}{FQ}$$

$$\frac{Vq'}{Vq}=\frac{W_2P_2Q'}{W_3P_3Q}=\frac{P_3Q}{FQ}\times\frac{P_2Q'}{P_3Q}=\frac{P_2Q'}{FQ}$$

$$\frac{Va}{Vq}=\frac{\frac{Va}{Vq'}}{\frac{Vq}{Vq'}}=\frac{\frac{P_1A}{Q'T'}}{\frac{FQ}{P_2Q'}}=\frac{P_1A}{FQ}\times\frac{P_2Q'}{Q'T'}$$

But

$$\frac{P_2Q'}{Q'T'}=\frac{P_2K}{MK}=\frac{FQ}{QT}$$

Therefore,

$$\frac{Va}{Vq}=\frac{P_1A}{FQ}\times\frac{P_2Q'}{Q'T'}=\frac{P_1A}{FQ}\times\frac{FQ}{QT}=\frac{P_1A}{QT}$$

and

$$\frac{Va}{Vr}=\frac{P_1A}{ST}$$

In the construction for determining the line ST the line P_2F may be omitted. It is only necessary to locate the points K', T', M, K, T and S.

VELOCITY-RATIO DIAGRAMS

The same results may be obtained by means of the velocity-ratio diagrams as by the application of the method of instantaneous centers. One of the advantages of the velocity-ratio diagram is that it shows the relative motions of the various points, such as the slip of the block in the slot, which is not shown in the other analysis.

The principle of the velocity-ratio diagram is very similar to that of an ordinary force diagram, the lines being drawn parallel to the directions of motions instead of forces. In Fig. 11 the line pa is laid off in magnitude and direction equal to the linear velocity of A with respect to P_1, Fig. 10, which indicates that the crank P_1A is rotating counter-clockwise. It is made equal to twice the length of P_1A in order to secure the greater degree of accuracy due to the increased scale. The point A is on the crank AP_1, and the point A' is an imaginary point in P_2Q that is directly in front or behind the point A. Since these two points rotate around different centers, they move with respect to each other; and their relative motion is along the slot. The line aa', Fig. 11, is drawn through a parallel to the slot, and $pa'q$ is drawn perpendicular to the line $P_2A'Q$. The line aa' gives the relative motion of A with respect to A', or the velocity of the block in the slot, and pa' is the velocity of A' about P_2. The point q is located by making $pq = pa' \times \frac{P_2Q}{P_2A'}$, which is determined graphically by drawing similar triangles. The line pr is drawn parallel to the motion of R; and since the relative motion of Q with respect to R is perpendicular to QR, the line qr is drawn perpendicular to QR, thus locating the point r and establishing the length of pr, which is the velocity of the ram when pa is the velocity of the crankpin. In the diagram, pr is equal to twice ST, because pa was made equal to twice P_1A.

It is possible to draw the velocity-ratio diagram for such cases as Fig. 16 without using the instantaneous center P_2, but in some cases its use facilitates and simplifies the construction.

In order to determine the scale of a velocity diagram when the scale of the drawing for the mechanism and the revolutions per minute of the crank are known, let s equal scale of drawing, as s inches (say 3 in.) is equal to 1 ft. Then the actual length of the crank, represented by the line P_1A on the drawing, is $\frac{P_1A}{s}$ feet when P_1A is measured in inches. The linear velocity of A is $\frac{P_1A}{s} \times 2\pi N$ feet per minute, when N equals revolutions per minute of the crank P_1A. The linear velocity of the crankpin A is represented in the diagram by the length of the line P_1A measured in inches. Hence, the scale of the velocity diagram is

$$s'=\frac{1}{2\pi N}\times\frac{P_1A}{\frac{P_1A}{s}}=\frac{s}{2\pi N}\,in. = 1\,ft.\ per\ min.$$

If the scale of the drawing is 3 in. = 1 ft., and N = 30 r.p.m. of the crank, then the scale of the velocity diagram is

$$s'=\frac{s}{2\pi N}=\frac{3}{2\times 3.1416\times 30}=0.0157\,in. = 1\,ft.\ per\ min.$$

or 1 in. = 62.8 ft. per min. If the scale of the drawing is ¾ in. = 1 in., or three-quarters size, and N = 30, the scale of the velocity diagram is

$$s'=\frac{12s}{2\pi N}=\frac{12\times\frac{3}{4}}{2\times 3.1416\times 30}=\frac{1}{20.94}\,in. = 1\,ft.\ per\ min.$$

or 1 in. = 20.94 ft. per minute.

We Never Have an Accident

By ENTROPY

Compared with the submarine-chasing industry and the steel business, the average machine-tool shop is pretty safe for men to work in. Compared with perfect safety, it is not.

It does not make a particle of difference to a man's widow whether he was the only man killed in a certain kind of shop last year or whether he was one of a thousand. He stays dead just as long. It does not make a particle of difference to a man who has his finger pulled off in a miller whether he was one and the only one, or whether he was surrounded with fellow sufferers.

When we ride on a railway train and are told that out of so many million passengers carried last year so many are dead, we do not pat the railways on the back and say to them: "That's fine, you are doing good work. If I am killed, I will leave word for my wife not to sue you for damages." We most certainly do not.

THE SHOP QUESTION

In other words, nothing short of absolute safety in the shop is permissible if we want to do the right thing. Figures which show that it is safer to work in such a shop than in some other will induce a few people to work for us who would otherwise go elsewhere, but there are always some others who prefer to work in still safer industries. This is not cowardice. It is merely an expression of a desire to be efficient;

and no mutilated man is as efficient as he might have been, even though the mutilation consists only of a finger tip nipped off in a pair of gears.

Suppose we do persuade a superintendent that safety as a fact is worth while. What then? He usually tells someone to get after the job of rigging up guards—and forgets about it until something happens. Guards are merely the elemental part of the job. They are merely something that the maker of the machinery ought to have put on anyway. They are as essential a part of his equipment as is a railing on the stairs. The hardest thing to get into the superintendent's head is that guards are merely an evidence that the management wants safety practiced. They are a guarantee of good faith.

At least three-quarters of safety is personal. Every man who takes a chance when nothing can be gained by it is a menace to the other men and to himself. All the kinds of accidents that can happen in a shop have probably happened so often that it is easy to predict what accidents will happen in a large group of shops next month. When it can be predicted with certainty that a given number of men will have castings drop on their toes next month or that so many will get scratches that will become poisoned or infected, such occurrences cease to be accidents, but are preventable and unnecessary parts of the month's routine.

A shop which maintains a hospital and nurses advertises to the newcomer that he is entering an industry that has a known factor of lost time due to accidents. He knows that he is expected, in the course of a given period, to lose a certain amount of time and suffer a predetermined amount of pain and financial loss, which it is cheaper for the company to treat in a hospital than to prevent.

THE GREATEST ACCIDENT CAUSE

On the other hand, the company knows to its sorrow that the greatest hindrance to preventing these so-called accidents, which it knows will happen, is the unwillingness of its employees so to carry themselves as to avoid visible dangers. The man who will not report to the hospital with slight injuries makes much more work for it than the man who does. The man who bunglingly tries to put on a belt that he has not been taught how to handle, costs more money than it would take to get the right man to put it on, and he adds to the cost of the hospital. And so one might go on and cite instance after instance where men take a chance, and too often with the foreman's connivance.

If there is anything that a foreman hates, it is to see a machine standing idle when it might be running. It seems absurd to him to have a man spend half an hour getting a scratch fixed up that he could wrap in a little cotton waste. It seems absurd to call another man away from his work to put on a belt. Anyone can do that, and anyone does; and we have to have hospitals, for the men are careless because their foreman does not take the bother to find out what safe practices are and how to teach the men to be careful.

Figures prepared by one large shop show that the total lost time from attending to every little scratch, every case that did not result in the employee having to go home, amounted to a total of one-twentieth of 1 per cent. of the total time of men working in the shop. More time than that was lost hunting for cuspidors, because the rules about spitting appeal to that superintendent.

Many of the things which ordinarily cause trivial accidents are just as capable of causing bad ones. Castings or round steel may slide or roll off a truck and fall on a man's toes. Of course, they may fall where they do no harm, but they hit something human often enough to make it a paying thing to block them so that they cannot fall.

The very foreman who claims never to have accidents can, if he will, sit down and name over a great number of things that have happened that should not have occurred. And often he has a list of near-accidents, which might have been and very likely will be real accidents next month or next year, that would make one's hair stand on end.

Stenographers and Typewriters Wanted by the Government

The United States Government is in urgent need of thousands of typewriter operators and stenographers and typewriters. All who pass examinations for the departments and offices at Washington, D. C., are assured of certification for appointment. It is the manifest duty of citizens with this special knowledge to use it at this time where it will be of most value to the Government. Women especally are urged to undertake this office work. Those who have not the required training are encouraged to undergo instruction at once.

Examinations for the Departmental Service, for both men and women, are held every Tuesday, in 450 of the principal cities of the United States, and applications may be filed with the Commission at Washington, D. C., at any time.

The entrance salary ranges from $1000 to $1200 a year. Advancement of capable employees to higher salaries is reasonably rapid.

Applicants must have reached their eighteenth birthday on the date of the examination.

For full information in regard to the scope and character of the examination and for application blanks address the U. S. Civil Service Commission, Washington, D. C., or the Secretary of the U. S. Civil Service Board of Examiners at Boston, Mass.; New York, N. Y.; Philadelphia, Penn.; Atlanta, Ga.; Cincinnati, Ohio; Chicago, Ill.; St. Paul, Minn.; St. Louis, Mo.; New Orleans, La.; Seattle, Wash.; San Francisco, Calif.; Honolulu, Hawaii; or San Juan, Porto Rico.

Breaking Up Car Wheels

By W. T. Winslow

A large number of 24-in. car wheels were broken up as follows: A piece of nickel steel 2 ft. long was turned tapering ¾ in. per ft., 3 in. and 4½ in. at the ends. The bore of the wheels was 3¼ to 4¼ in. The wheels were placed in a 9-in. hydraulic wheel press, the tire side next to the ram, and the taper mandrel forced into the bore.

It required from 30 to 50 tons to split the wheels into pieces of suitable size for a small foundry to handle. The time required was about 5 min. per wheel.

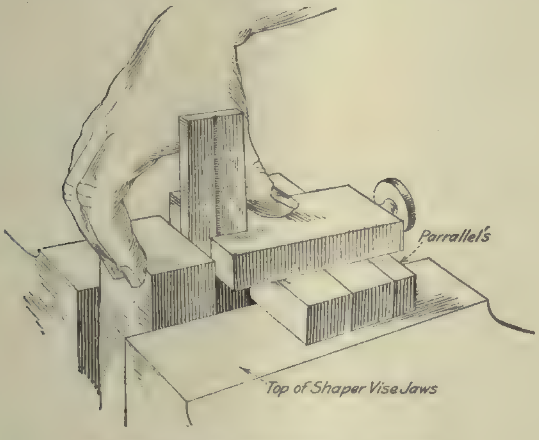
IDEAS FROM PRACTICAL MEN

Squaring the Ends of Small Rectangular Pieces

By Gustave A. Remacle

When squaring the ends of small rectangular pieces in the shaper or miller, the piece may easily be set vertically in the vise or chuck by the following method:

By laying a small pair of parallels across the vise jaws and a square upon the parallels, as shown in the sketch, the thumb of the right hand may be utilized for holding the square firmly upon the parallels, while the index finger of the same hand will hold the piece firmly against the square. The left hand is then free to close the vise jaws upon the piece. This scheme is much better than the plan generally pursued, which is to allow the square to rest upon the bed of the vise, the operator tapping the piece until it is set in the desired position. Owing to the absence of light between the vise jaws, the latter method is not a sure one, and in addition too much time is consumed if the piece being machined is small.



METHOD OF SETTING A PIECE

Making Piercing Punches

By S. W. Palmer

The method of making punches and the jig here illustrated may be of interest. In Fig. 1 is shown a finished piercing punch. In making these punches, a piece of steel of the required length is cut from the bar, heated on one end only, and then placed in the opening *A* between the jaws *B* and *C* of the jig shown in Fig. 2. Jaw *B* is stationary and jaw *C* is moved about the pin *D* by the eccentric pin and handle *E*. This movement is very slight, being only enough to allow the punch to be easily dropped into place and clamped so as to hold it firmly while the hot end is headed over.

The jaws *B* and *C* are lined with the steel blocks *G*, *H* and *J*. These blocks may be replaced when worn, or others of a different inside diameter may be inserted so that punches of different sizes may be made in the same jig. After being headed, the punch is chucked and the top of the head turned square with the body of the punch. It is then chucked a second time and filed for clearance at *X*, Fig. 1, after which it is hardened and tempered for use. This jig has been found very satisfactory for this work and has paid for itself many times over.

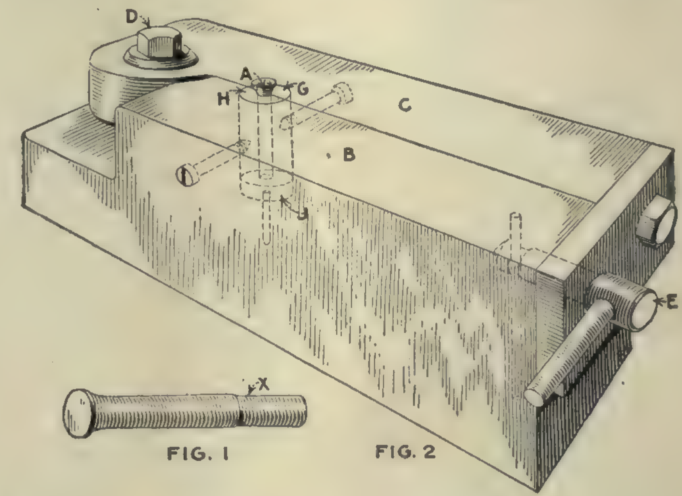


FIG. 1 FIG. 2

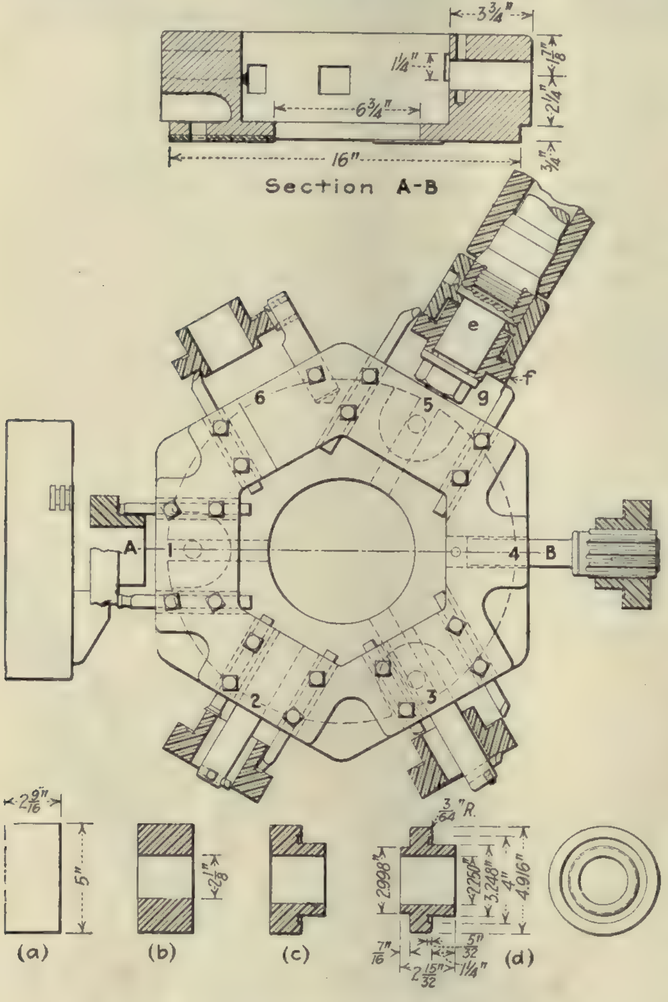
THE PUNCH AND HEADING JIG

Toolholders for Flat Turret Lathe

By J. B. Highland

Handicapped in maintaining production in the turret lathe department due to frequent delays in receiving material in sufficient quantities, and the consequent necessity of frequent changes in set-ups, it was necessary to devise some method whereby the time consumed in making these changes could be reduced to a minimum.

To those familiar with the toolholders furnished with the flat turret lathe it is apparent that in order to get tools in the proper position for most efficient work, especially on the combination tool plate with clamp blocks, it is necessary to use numerous V-blocks and shims of various thicknesses to block tools to the proper height and to secure them to the tool plate. In making changes from one job to another, it is in most cases impossible to remove this tool plate from the machine without dismantling; and if, after so doing, these accessories are not carefully stowed away, the probabilities are that when they are wanted again the shims will have been appropriated by some fellow workman, the V-blocks will be doing service in the drilling department, and some of the special tools will have been ground to suit some other job.



FLAT TURRET LATHE SET-UP

To alleviate this situation, a plan was devised of combining set-ups into complete units, consisting of a plate with the various toolholders cast integral with cored slots, for holding all tools in the proper positions, and grouping such tools to eliminate as much as possible any excess travel of the sliding head, also bringing as many tools in operation as was consistent with the capacity of the machine.

The illustration shows a layout for machining a gear blank that previously required two machines for the demanded production, at a cost of $48.60 per hundred, whereas with the present tooling the time and cost was reduced 46 per cent., or at a present cost of $26.10—and one machine takes care of all requirements.

Referring to the illustration, at *a* is shown the blank, which is sawed from 5-in. round 3½ per cent. nickel steel, and at *b* the blank after piercing on a high-duty driller. These are then chucked in a three-jaw universal chuck with serrated jaws on a 2 x 24 flat turret lathe and the stock reduced as shown in position 1, the cut being divided equally between the front and back tools, which practically balances the cutting pressure. The turret is indexed to position 2, where the blank is bored, a finishing cut taken on the hub, the rim undercut and the end of the hub roughed. Indexed to position 3, and with feed to the cross-slide, finishing cuts are taken at the end of the hub, the edge of the rim and back-faced to over-all length, which also facilitates clamping on the arbor for the second operation. The head or cross-slide is returned to the center, die turret indexed to position 4 and the hub reamed, finishing the blank as shown at *c*.

After a lot of 500 are machined in this way, the chuck is removed from the machine spindle and the special arbor is inserted as shown at *e*. The blanks are held on the arbor by forcing the finished edge of the rim against the face of the sleeve at *f* (the sleeve being a shrink fit on the arbor) and clamped with washer and nut as shown at *g*. The turret is indexed to position 1 and the hub roughed out the same as in the first operation, then indexed to position 5, where the outside of the rim is turned, the cross-feed then thrown in and a finishing cut taken off the side of the rim. Indexed to position 6, a cut is taken over the hub and with a slight cross movement of the head both corners of the rim are simultaneously rounded. This finishes the blank to dimensions, as shown at *d*.

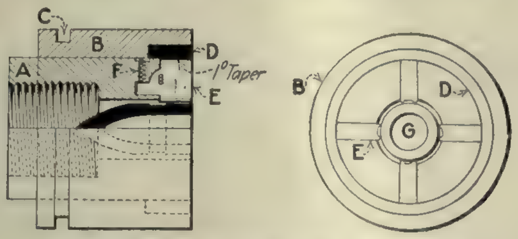
This tool block, or unit, is clamped to the turret by the same method as the standard tool blocks for chucking work furnished with the machine, cored openings being provided as shown in sectional view and the dotted lines on the plan view under positions 1, 3 and 5. At these points are also tongues inserted into the plate and projecting about ⅛ in., which locate the tool block in position on the turret face.

With a number of these units for work that is a standard product, the costly delays of changing from one job to another are practically eliminated, as it is plainly evident that the only time of any consequence involved is in the changing of chucking devices and the setting of the turret stops.

Chuck for One-Pound Shells

By E. W. Burchell

The illustration shows an automatic chuck designed and used to advantage while tapping 1-lb. shells. The cylinder *A* is threaded to fit the spindle of the lathe, and four slots are cut in it for the jaws *E*. These jaws have an elongated hole in them so they will locate themselves on various diameters. A spring *F* pushing against the ends of the jaws causes them to open. A 1-deg. taper is made on top of the jaws. The cylinder *B* is bored out for a sliding fit over *A* and is counterbored for the steel ring *D*. A 1-deg. taper is bored in the ring *D* which, when pulled up over the jaws *E*, holds the work *G* by its own friction. Shoes were made to fit in the groove *C* and attached to a lever fulcrumed from the rear of the lathe. Production was increased 100 per cent. with this device, and two thousand 1-lb. shells were tapped a day. This device could be used on other work besides munitions where it is desired to handle a large number of cylindrical parts for rapid and accurate production.



CHUCK FOR ONE-POUND SHELLS

Record Number System for Drawing Changes

By F. A. Dew

Where anyone and everyone make changes on drawings as they see fit, no record of such changes can be kept; and the concern that allows such shiftless methods deserves all the trouble that surely comes. But where changes are made only on a written order from the chief, it is possible to keep complete records of such changes, with the reasons for making them, and to notify all interested parties of such changes when made. As such changes are often the result of a good deal of correspondence with customers and agents, the full reasons for making them cannot be placed on a crowded drawing, so a record number is used, and this record number is the key to such changes. The date is changed whenever the drawing is changed, and the latest date is always used in connection with the name and number, to identify the drawing. The new date is placed directly under the old one and separated from it by a horizontal line.

Slight changes on drawings made on verbal orders which do not in any way prevent the part being used for its original purpose need not be recorded, and the date need not be changed. All other changes should be recorded as follows:

All orders for new drawings and orders for changes and corrections on existing drawings which can be reduced to writing are given a consecutive number with the prefix R, as R125. This number is placed on the drawing immediately above the date and is the record number of such drawing or any changes that may have been made.

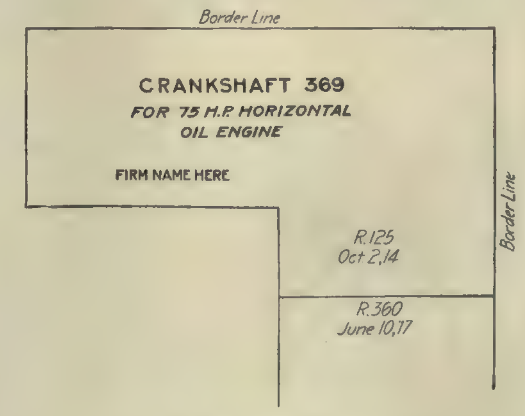
All orders, sketches, prints and papers relating to the same drawing or change are given the same record number, are filed in consecutive order in indexed files and form the record of work done and authority for doing it.

Suppose the management decides to build a new size or type of engine. A written order to that effect is given to the chief, together with some correspondence from agents or customers. The head salesman insists on a certain feature that will make the engine easy to sell, and the boss erector on an idea that will make it easy to erect. The shop wants certain parts made to suit existing tools and jigs. Such modifications as are adopted, are put into writing and signed by the party making them. All these data are given a record number and filed together. This record number is placed on the drawings above the date and tells who is responsible for certain features that are used in the design of the mechanism.

After the engine has been on the market for some time, changes in design or construction become necessary. A written order is made for each change and given a record number. A line is drawn under the original date, the record number placed below the line and a new date below the record number.

Changes on drawings in active use may require a good deal of work outside of the drawing itself. All dependent tracings must be changed and index books and cards corrected; file and factory prints must be changed or destroyed, corrected prints issued on orders in progress and department heads notified; outside prints must be recalled and new prints sent where necessary; engineering lists, shipping lists and material records must be changed; perhaps patterns, tools and dies will also have to be changed. All such items can be taken care of on a change sheet which is signed by each man as he completes the work assigned to him. When finished and checked the change sheet is filed with other data under the record number.

The filing of data and records can be done in any standard letter file. All printed forms and orders should be 8½ x 11. Record prints can be folded to this size for filing. A numerical index book is kept for the record numbers, and the method of indexing can be as simple or as elaborate as desired.



THE CHANGED PRINT

The latest date is considered a part of the drawing title and is given when issuing prints with orders, thus: Make 5 crankshafts 369 of June 10, '17. Suppose that crankshaft 369 of Oct. 2, '14 has been made for years. The shop foreman may have a print of that date hid away for his own use, but the order calls for a print of later date and there can be no excuse for using an obsolete print. The changed print would look like that shown in the illustration.

Data filed under R125 are those used when the engine was designed; R360 is that relating to the change in the crankshaft.

The advantage of using a record number instead of placing the reasons for a change on the drawing is that the record number takes up but little room, whereas the reasons, orders, change sheet and record prints may fill a large envelope or folder. A number of changes can thus be recorded on a crowded drawing. Record prints are folded and filed with the written and printed matter, entirely away from the up-to-date stock prints. Anything on paper, large or small, relating to new design or changes can be filed where it is readily accessible to all who have any business to use it. Men will often hesitate to insist on a change when they have to sign for it, and draftsmen and clerks making changes know that a mistake or omission can be traced back to them at any time.

This kind of work cannot be well done by boys or girls. The mere alteration of a drawing is simple, but to follow up a radical change and sign for it complete is a man's job.

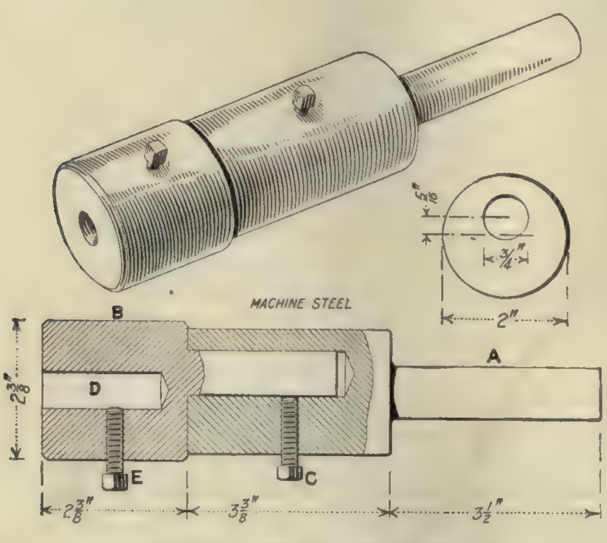
The foregoing system is old and well tried, and the writer has found it to work as well in a small office as in a large one, saving a considerable amount of the trouble generally involved by changes.

Adjustable Boring-Tool Holder for the Milling Machine

By William Forray

The accompanying sketch shows an adjustable toolholder which has the merit of being efficient and at the same time inexpensive.

It consists of the machine-steel shank *A* bored eccentrically to receive the tool holder *B*, which can be clamped in any position by the setscrew *C*. The boring tool or drill is carried in the hole *D* and fastened by the setscrew *E*.



ADJUSTABLE BORING-TOOL HOLDER

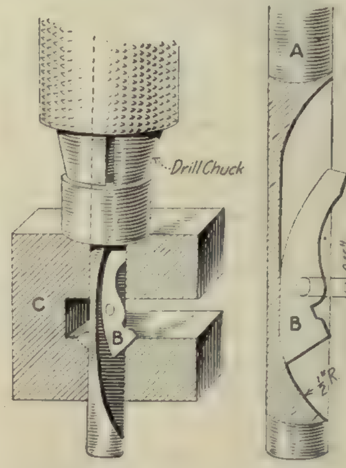
In practice the shank is gripped in the chuck usually provided with a miller. Of course, the shank might be turned some standard taper to fit a standard arbor, if desired.

For light cuts on jig and fixture work, this tool has been found very useful; and it is certainly an inexpensive one to make. It will well repay the cost of material and labor, spent in its construction, where work of the character mentioned above is encountered.

Special Countersinking Tool

By Robert N. Oerter

The device illustrated herewith has been used successfully to countersink a hole where it breaks through into a slot, as designated at *C*. According to the dimensions given, of course, the tool is adaptable only to this particular job. However, it may suggest a principle that could be applied to similar conditions. *A* is a piece of $\frac{3}{16}$-in. drill rod slotted to take the pivoted cutter *B*, which is kept in the position indicated at *B* by centrifugal force. On entering the hole in *C*, the extending end is shoved back, which brings the lower end out into the slot in position to cut. A hardened collar serves as a stop to regulate the cut and prevents the cutter from digging into the work.

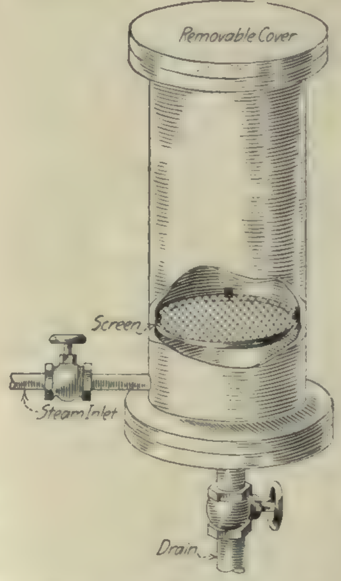


SPECIAL COUNTERSINKING TOOL

Method of Reclaiming Waste

By W. A. Lailer

The high cost of waste and rags used throughout the machine shop made it necessary to cast about for means to reduce our charges for this material, so we devised a washing arrangement, which was made up by our engineer out of some old pipe fittings. As shown by the accompanying sketch, a piece of 12-in. pipe was arranged with companion flanges on each end, a steam inlet in the side, and a drain at the bottom. A screen was then placed in the pipe about 4 in. above the steam inlet. The oily waste was placed in the washer above the screen by removing the companion flange, and then the whole mass was boiled by turning in the live steam, the condensation dripping down through the waste and carrying the oil and dirt off through the blow-off valve. While this crude washing did not turn out perfectly clean waste, it nevertheless took out such a large percentage of the oil, grit and dirt that the waste could be used for practically all purposes. The expenditure for new waste was thereby cut down between one-half and one-third each month.



APPARATUS FOR RECLAIMING WASTE

Editorials

The Failure To Exempt Men for Industry

THE earnest endeavor of those in charge of the draft to avoid all semblance of favoritism, is causing us to follow in the mistaken footsteps of both France and England. The "selective" feature which was so widely heralded, has been confined for the most part to the selection of the numbers from the boxes in which they were kept. And the result of this attitude if continued is bound to delay the winning of our part of the war.

From all over the country comes instances where men who cannot possibly be of as great value in the army as in the industry to which they belong, are refused exemptions. In some cases these men were engaged on work either directly or indirectly connected with the war, but appeals to the highest authorities have been in vain. A continuance of this policy is sure to have a disastrous effect on the industries and re-act directly on our preparation and our supplies for the troops.

We do not question the sincerity of those men who are responsible for the rigid enforcement of the draft and the refusal to make exemptions in the industries, but we cannot agree with their judgment in the matter. We have no desire to secure wholesale exemptions for any special trade or industry, but it must be evident that the skill acquired in long years of experience is of more value to the country at this time than anything else the man can do.

Nor would it be so bad if the men were enlisted and then assigned back to the work he could do best. He would still be at the call of the Government for any service that needed him most. And in many cases the employer would be glad to pay him the difference between his army pay and his former salary or more, to retain his services and so add to the output of the plant and in helping to shorten the war.

Furthermore, it is often a great injustice to the men. In many cases men, who have had naval or military experience, who could have secured commissions in their respective branches have refrained from enlisting because they honestly belived that they could be of more service in their industry. But when drafted and refused exemption, they are not only taken from their industries but must serve as privates when they are better fitted and could be of more value in the other arms of the service. This is the blindest kind of justice, so blind that it lacks even ordinary intelligence, and is by no means in keeping with many of the splendid things which are being accomplished in some lines.

There are several departments in Washington which need designers and draftsmen very badly. Hundreds of these men have been called to the colors and refused exemption. Nor are they allowed to be transferred to this other work for which they are so well fitted in spite of requests of army and navy officers who need them and who are handicapped without them. As a result various kinds of army supplies are being delayed, directly affecting the date of our full and active participation in the war. It reduces itself to the absurd proposition of retaining men in the army that cannot be supplied with ammunition because these very men are not available for the work they can do best, and in which they are most valuable to the country.

We appreciate the spirit that seeks to avoid anything looking toward favoritism, and commend the intention to prevent all suspicions of undue exemptions. But rational exemption is to the interest of increased production in all necessary lines, in the interest of conserving the skill which it requires years to acquire, and which means an investment and an asset of the country in years to come.

We urge that an earnest and immediate consideration be given to a rational plan of exemptions in industry or an assignment of skilled enlisted men to the fields in which they can best serve the country in the present crisis. It may even be necessary to conscript labor to secure an adequate supply in some lines. There is no more vital question before us or one that requires to be acted on more promptly. Every day's delay in this or other work, means unnecessary loss of life on the battlefields.

The New Child Labor Law

WHILE the new child-labor law (which went into effect on Sept. 1, 1917) will not affect many machine shops, it is better to have a thorough understanding of the law than to run afoul of it unintentionally. This law provides that the product of any shop in which children under fourteen years of age are employed, or where children between fourteen and sixteen are employed over eight hours in any one day, or more than six consecutive days, or before 6 a.m. or after 7 p.m., cannot be shipped outside of the state in which it was manufactured. This same restriction as to age applies to both office and shop, and it makes no difference whether the child has worked on the actual goods shipped or not.

The purchaser of goods manufactured in another state is equally liable with the manufacturer if the law has been violated, and in order to protect himself he must demand a guarantee from the manufacturer to the effect that the law has been fully complied with. This makes it perfectly justifiable for a purchaser of goods made in another state to refuse payment until such a guarantee has been given, as only in this way can he be sure of exemption from liability.

The United States Department of Labor suggests the following form of guarantee for the manufacturing establishment and does not approve of any modification or condensed form, although decisions as to this may perhaps be rendered later. The form recommended is:

(I or We), the undersigned, do hereby guarantee that (1) the articles or commodities listed herein (or specify the same) were produced or manufactured by (me or us) in a mill, cannery, workshop, factory, or manufacturing establishment in which within 30 days prior to the removal of such product therefrom no children under the age of 14 years were employed or permitted to work, nor children between the ages of 14 years and 16 years were employed or permitted to work more than eight hours in any day or more than six days in any week, or after the hour of 7 o'clock p. m. or before the hour of 6 o'clock a. m., or (2) were purchased by (me or us) under a guaranty that they were produced or manufactured in a mill, cannery, workshop, factory, or manufacturing establishment in which within 30 days prior to the removal of such product therefrom no children under the age of 14 years were employed or permitted to work, nor children between the ages of 14 years and 16 years were employed or permitted to work more than eight hours in any day or more than six days in any week, or after the hour of 7 o'clock p. m. or before the hour of 6 o'clock a. m.

(Name and place of business of producer or manufacturer or dealer.)

It is also necessary for dealers to give a similar guarantee, the form suggested for this being as follows:

(I or We), the undersigned, do hereby guarantee that the articles or commodities listed herein (or specify the same) were purchased by (me or us) under a guaranty by the manufacturer or producer that they were produced or manufactured in a (mill, cannery, workshop, factory, or manufacturing establishment) in which within 30 days prior to the removal of such product therefrom no children under the age of 14 years were employed or permitted to work, nor children between the ages of 14 years and 16 years were employed or permitted to work more than eight hours in any day or more than six days in any week, or after the hour of 7 o'clock p. m. or before the hour of 6 o'clock a. m.

(Name and place of business of dealer.)

While this new law conflicts with the laws of a number of the states, the state laws only apply to business done within their own borders, whereas this new law applies to all commerce between one state and another which comes under Federal jurisdiction. As will be seen, this expressly prohibits, so far as children under sixteen are concerned, the plan in use in many shops of working a half-hour or an hour extra for the first five days of the week, in order to secure the Saturday half-holiday. If the Saturday half-holiday is granted, the working week for the child under sixteen must be less than forty-eight hours.

The number of children under sixteen years of age working in our machine shops is comparatively small, fortunately, so that very little readjustment will be necessary to comply with this new law. As the future of the race depends on the conservation of its youth, the enforcement of this law will work for the ultimate good of the country. In any case, it is necessary to be familiar with its requirements, so as to avoid annoying misunderstandings with customers and give opportuity for withholding payments on machinery shipped from one state to another. Whatever readjustments may be necessary can easily be made when we know what the law requires, and the sooner these readjustments are made the less disturbing they will be.

Rational Inspection

THE question of inspection, whether it be of munitions or of peaceful products, is one that demands much careful attention, particularly at this time. It is very difficult to make a man, who is not thoroughly familiar with the product he is inspecting, understand, that it is almost impossible to write specifications that shall cover every requirement, and at the same time permit the acceptance of a product that is good enough.

A recent instance had to do with the inspection of lathes for repair work on the other side, and as the inspector knew almost nothing about modern lathe practice, he made a number of inquiries as to the accuracy which was considered sufficient in high-grade machines. He made his inquiry, fortunately, of a practical man who pointed out that his first duty was to approve as many lathes as possible, after being satisfied that they would do the work demanded of them, instead of assuming the attitude of too many inspectors, who seemed to consider the highest possible number of rejections as a mark of their efficiency.

The exact alignment of the lathe, the absolute truth of the spindle, the precise squareness of the cross-slide with the lathe bed, and the pitch of the lead screw are far less important on ordinary repair work, than that the lathe shall be substantial enough for the work to be done, that it shall be handy of manipulation, and that it shall not easily get out of order.

Where only short threads are chased an extremely accurate lead screw is an unnecessary refinement and expense and it is probably safe to say that the average lathe made in this country today is sufficiently accurate in this respect for all practical requirements of the average repair shop. It is much more essential to see that the lathe is so designed as to have sufficient bearing surfaces, that the material is well adapted for the work, that the ways are of a close-grained iron, that there is sufficient belt power, and enough changes of speeds to handle the large variety of work which it will be called upon to do.

If it can be impressed upon all inspectors that their main duty is to secure as much usable material as possible it will greatly assist the supplying of the necessary products and be of the greatest service to the country at this time.

Standard Tools for the Navy

THE mechanical department of the Navy Yards have been endeavoring to standardize tools and appliances for some time, and have run against some snags which were entirely unexpected. In order to reduce the play between the pneumatic tool shank and its holder, the shanks were ordered 0.001 in. plus or minus, this being decided upon as a reasonable tolerance, especially as the shank was round and short.

Strange to say, the makers of the tools objected and failed to keep the shanks within this limit, although this was a perfectly plain job of grinding. The opposition took the form of an offer of a substantial cash rebate if the tolerance was doubled, the price offered being several times the total cost of grinding the whole shank. The only explanation seems to be that the firm in question was not well equipped for this work, as the tolerance is not so close as to be difficult of attainment in ordinarily good work.

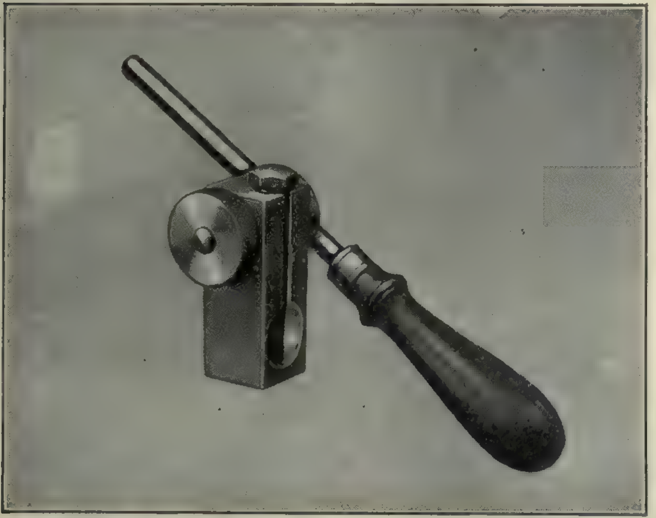
This work of standardization is of great importance as it reduces the amount of stores and spare parts carried, simplifies the ordering of supplies and is a real source of economy from every point of view. And as long as the specifications are no more severe than in this case, the department should have the hearty cooperation of manufacturers in every line to which they apply.

SHOP EQUIPMENT NEWS

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

"Hartford" Diamond-Tool Holder

The illustration shows the "Hartford" diamond-tool holder, which is now being marketed by the National Machine Co., 111-135 Sheldon St., Hartford, Conn., being used for truing the wheel of a surface grinder. The device holds the diamond-tool at any angle and it is claimed that, as it is very firm, a truer cutting surface is obtained than when the tool is held by hand. A binder nut is supplied to fit any size of table slot or with blank nuts for special fittings. All adjustments may be made with one turn of the wrench. The overall size is 4⅜ × 3 × 1¾ in., and the diameter of the tools may be from $\frac{5}{16}$ to $\frac{7}{32}$ in.



HARTFORD DIAMOND-TOOL HOLDER

Master Lathes

The illustrations show two lathes which have recently been placed on the market by the Master Machine Tool Co., 110-112 West 40th St., New York City. Fig. 1 shows the 12-in. cone pulley precision lathe, which is intended for either tool room or accurate manufacturing work. The bed has two wide-spread Vs and two flat bearing surfaces, and the splined lead screw is set immediately beneath the guides. The headstock is of the back-geared three-step cone-pulley type. Special carbon steel is used for the spindle, which is ground to size and machined with a hole through its entire length for the accommodation of draw-in collets. Phosphor bronze bearings are used. The spindle nose is threaded to receive chucks or faceplates and end thrust is taken up on a steel to bronze bearing. A detachable back plate is used on the apron allowing the removal of all parts for repair or inspection. The lead screw is splined for driving the worm which operates the longitudinal and cross feeds through a friction clutch. A four-change feed box is provided. Taper turning is accomplished by a side adjustment of the tailstock. The regular equipment includes double friction countershaft, large and small faceplates, follow and fixed steadyrests, change gears and wrenches. Taper attachment, draw-in attachment, collets, etc., can be furnished as extras.

Fig. 2 shows an all-geared 13-in. lathe adapted to precision and manufacturing work. The gears provide six changes of spindle speeds ranging from 28 to 418 r.p.m., a positive clutch being used. The spindle is of special carbon steel, having a 1$\frac{1}{16}$-in. hole through its entire length to allow for the use of draw-in attachments and collets. Phosphor bronze bearings are used for the

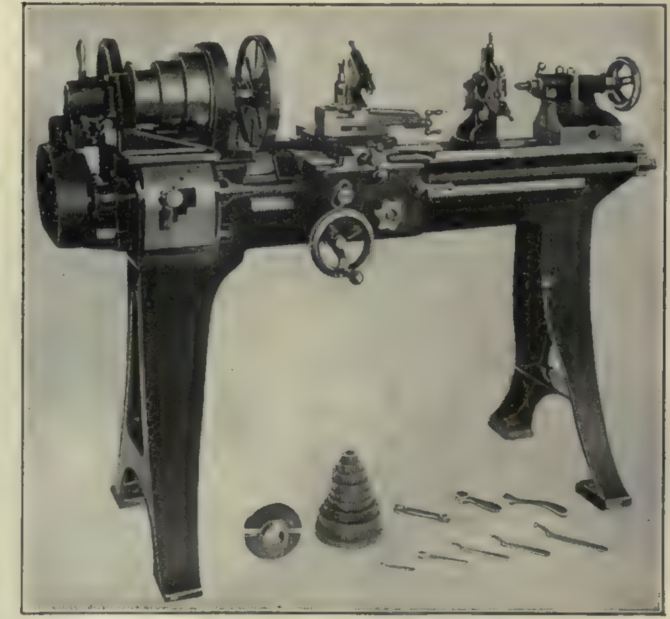


FIG. 1. CONE-PULLEY LATHE

Swing over bed, 12 in.; swing over carriage, 7½ in.; length of bed, 4 ft. 8⅜ in.; distance between centers, 28 in.; hole through spindle, $\frac{13}{16}$ in.; spindle nose threaded, 1⅝ x 8 U. S. S.; front spindle bearing, 1⅝ x 2⅜ in.; rear spindle bearing, 1¼ x 2$\frac{3}{16}$ in.; diameter of tail spindle, 1¼ in.; threads cut, 1¼ to 80 per in.; net weight, 767 lb.

spindle while the end thrust at the front end is carried on a ball bearing. Four feed changes may be obtained by means of the feed box gears. The tailstock is provided with side adjustment for taper turning and the tail center is self-ejecting. If desired the machine may be furnished with motor drive with a positive reverse mechanism in the head, or with a specially designed electric reverse, which eliminates the necessity of a controller. These features are claimed to be especially desirable when cutting threads. The regular equipment includes countershaft, faceplates, follow and fixed steadyrests, change gears and wrenches, etc.

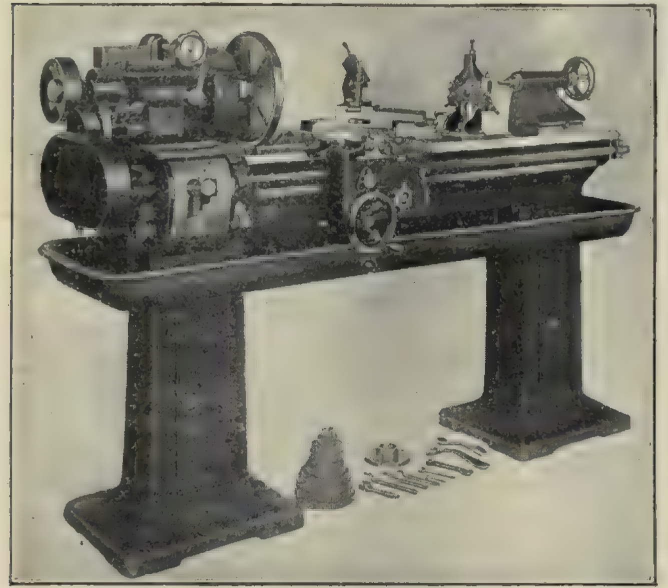


FIG. 2. ALL-GEARED 13-IN. LATHE

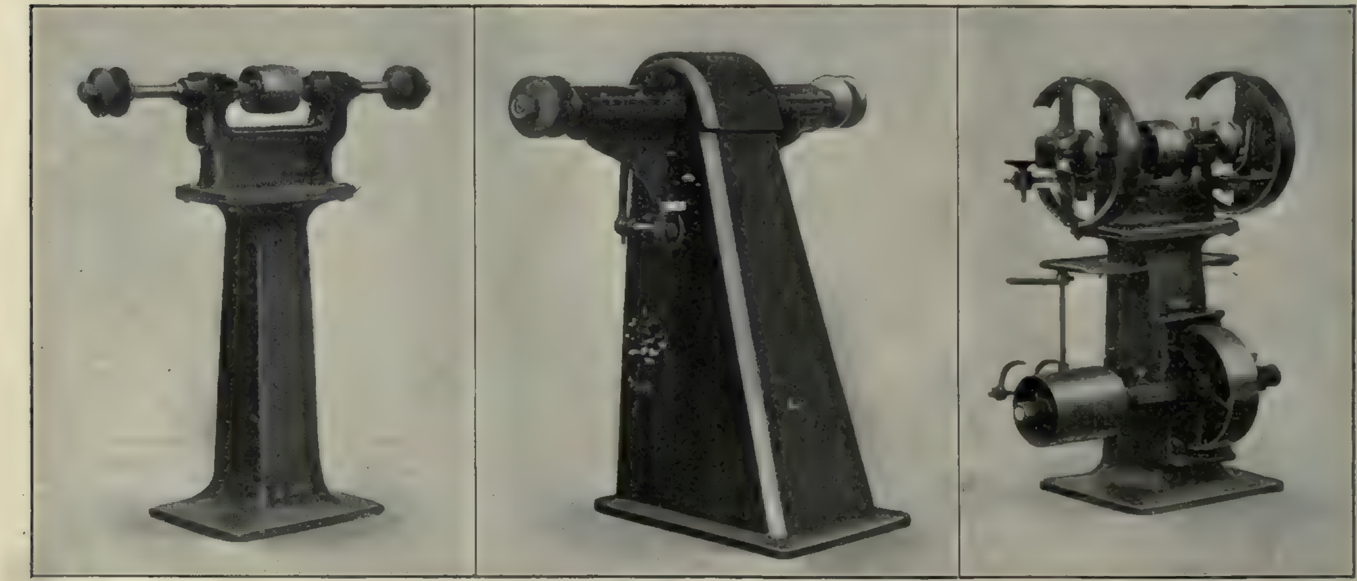
Swing over bed, 13½ in.; swing over carriage, 8 in.; length of bed, 5 ft. 8½ in.; distance between centers, 38 in.; hole through spindle, $1\frac{1}{16}$ in.; spindle nose threaded, 1⅞ x 8 U. S. S.; diameter of spindle bearings, front, 1⅞ in.; rear, 1⅝ in.; taper of centers, Morse No. 3; diameter of tail spindle, 1⅝ in.; cuts threads, 1¼ to 80 per in.; speeds of head spindle, six, 28, 46, 85, 135, 225, 418 r.p.m.; width of belt, 1⅝ in.; speed of pulley on headstock, 300 r.p.m.; net weight, 1110 lb.

St. Louis Grinding and Polishing Stand

The illustrations show several of the grinding and polishing stands now being manufactured by the St. Louis Machine Tool Co., St. Louis, Mo.

Fig. 1 shows a type of grinding and polishing stand made in several sizes, and the specifications given are for their No. 5 size. Fig. 2 shows the rear view of an underdrive grinding stand in several sizes. The specifications are for their No. 7 size. The belt and spindle pulley are entirely covered, and the bearings dustproof and of unusual length. The belt shift is operated from the front by means of a rack and pinion slide.

Fig. 3 shows a self-contained grinding machine made in a number of sizes, the specifications given being for the No. 6 machine. Arbors are of 0.40 point carbon steel, thread two pitch coarser than standard, and boxes are dustproof, lined with high-grade anti-friction metal, provided with oil cellars and self-oiling. On order; bearings can be lined with Randall Graphite, or with removable cast iron or bronze shell bearings. Bodies and caps are milled so all side strain is taken off screws, and liners are eliminated. Rests are of improved design, requiring shorter bracket than the straight type. Back rests are furnished for receiving wheel guard or other fixtures. The pan is five inches below base of machine, giving more room than usual and eliminating the danger of material wedging between wheels and pan. The self-contained countershaft affords several advantages over the detached type, where it is convenient to place the machine near the line shaft. One of the most apparent is the avoidance of the necessity of attaching the counter to the ceiling and lining it up. Another is that the belt is out of the way, often a convenience in handling large work. The most important advantage claimed is the smooth running of the wheels. The belt strain being down against the body of the machine gives the wheels a smooth running motion, which



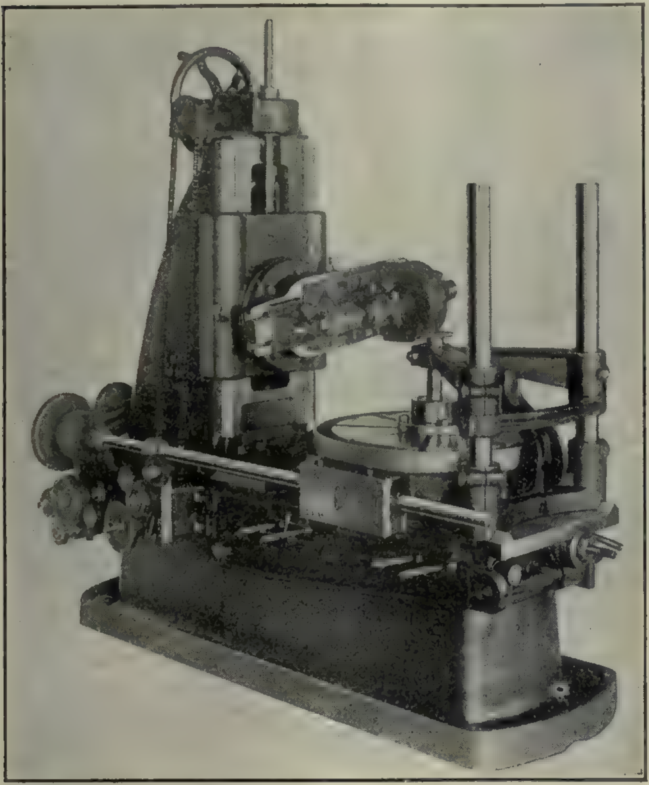
FIGS. 1 TO 3. ST. LOUIS GRINDING AND POLISHING STANDS

Fig. 1—No. 5 grinding and polishing stand. Diameter of arbor in collars, 1 in.; diameter of arbor in bearings, $1\frac{5}{16}$ in.; length of arbor, 42 in.; distance between wheels, 32 in.; length of bearings, 5¼ in.; height to center of arbor, 41 in.; size of base, 15 x 20 in.; weight, 415 lb. Fig. 2—Underdrive grinding stand, No. 7. Diameter of arbor in collars, 1⅞ in.; diameter of arbor in bearings, 1⅝ in.; length of arbor, 56 in.; distance between wheels, 45½ in.; length of bearings, 14 in.; height to center of arbor, 38 in.; size of base, 23 x 24 in.; size of spindle pulley, 5½ x 5½ in.; weight, 700 lb. Fig. 3—No. 6 self-contained grinding machine. Diameter of arbor in collars, 1¾ in.; diameter of arbor in bearings, 1½ in.; length of arbor, 48 in.; distance between wheels, 38 in.; length of bearings, 6 in.; height from top of column casting to center of arbor, 11 in.; height to center of arbor, 41½ in.; size of base of head, 10 x 19½ in.; size of base of column, 18 x 25 in.; spindle pulley, 5 x 5 in.; weight, 550 lb.

is claimed to be impossible with this class of machine belted up. The belt tightening device is very simple and will keep belt at proper tension till worn out without cutting. It consists of the countershaft frame attached to column by accurately milled square gibs and adjusted by screw. Bright parts are polished; while painted parts are filled, rubbed down to a flat surface and painted with oil-proof paint.

Goss Automatic Gear-Hobbing Machine

The Goss Printing Press Co., Chicago, Ill., is now marketing the automatic gear-hobbing machine shown in the illustration. The machine was originally constructed for cutting the gears used in the printing presses manufactured by this company, but in answer to a demand has been placed on the open market. It is made in one size only.

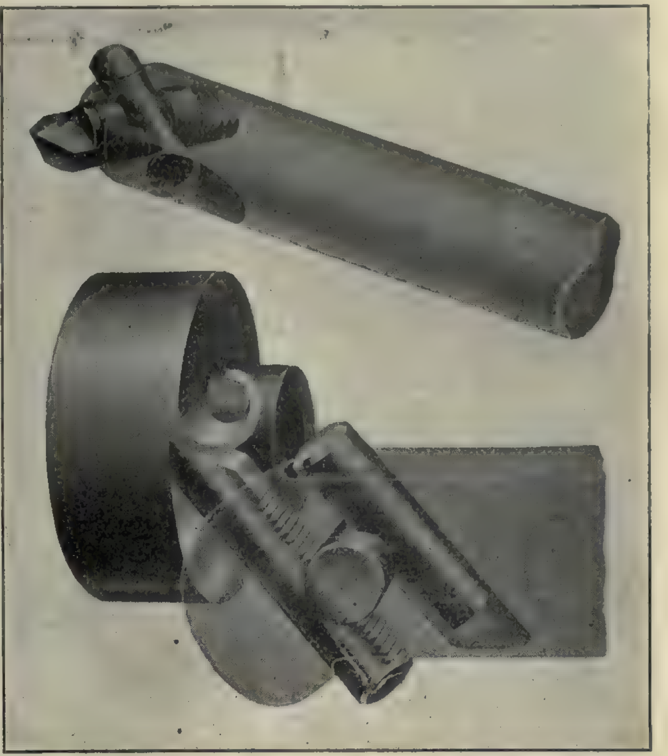


AUTOMATIC GEAR-HOBBING MACHINE

Rated diametral pitch capacity in cast iron or steel, 2½; maximum pitch diameter without supports, 36 in.; with supports, 28 in.; maximum width of face, 12 in.; diameter of cutter arbor, 1$\frac{1}{16}$ in.; diameter of work arbor, 2 in.; minimum distance between centers of work and cutter arbors, 2 in.; cone pulley speeds, 4; floor space, 48 x 72 in.; height 71 in.; net weight, 4420 lb.

Lovejoy Inserted-Cutter Tools

In order to provide a cutting tool that would not slip in the holder under a heavy cut, the Lovejoy Tool Co., Inc., Springfield, Vt., has placed on the market a line of lathe and boring tools as shown in the illustration. As may be seen the cutter is in the form of a cylinder with one side flattened and toothed in a manner somewhat similar to a rack. When the tool has been adjusted to the proper position, a second toothed part is slipped into the tool-holder engaging the teeth in the tool itself. A flat-sided taper pin is then driven into the holder serving to secure the second toothed part, and consequently the tool itself in place. As will be noticed, as long as the second toothed part is in place it is impossible for the tool to slip endwise. It is claimed that as the cutting stress is approximately an end thrust on the tool, the life of the tool is considerably greater than where the cutting pressure takes the form of a cross bending stress. This feature of course does not apply in the case of boring bars. The tools are made in a variety of styles and sizes. The bits are made of heat-treated high-speed steel.



LOVEJOY INSERTED CUTTER, TURNING AND BORING TOOLS

Rivett Automatic Radial Grinding Machine

The machine shown in Figs. 1 and 2 is a full automatic radial grinding machine, made by the Rivett Lathe & Grinder Co., Brighton, Boston, Mass., and is known as their model No. 208. This machine is intended for all classes of radial grinding, but is especially adapted to internal or external ball races, radial thrust bearings, spherical shapes of large diameter, spherical sockets and other similiar work. Complete ball and socket shapes may be ground if desired as the work head may be set to swing in an arc of 200 deg.

The advantages claimed for this machine are: (1) The oscillating head of the machine has a fixed rate of travel throughout the oscillating stroke. (2) The cross feed of the wheel-carrying head is variable, so that the operator may remove a larger quantity of stock at the beginning of the grinding than toward the end, the change in cross feed being made automatically. (3) A great range of feeds may be obtained between maximum and minimum, and there is an arrangement for any combination of cross feeds, coarse or fine. (4) Provision is made for automatic stopping of the machine

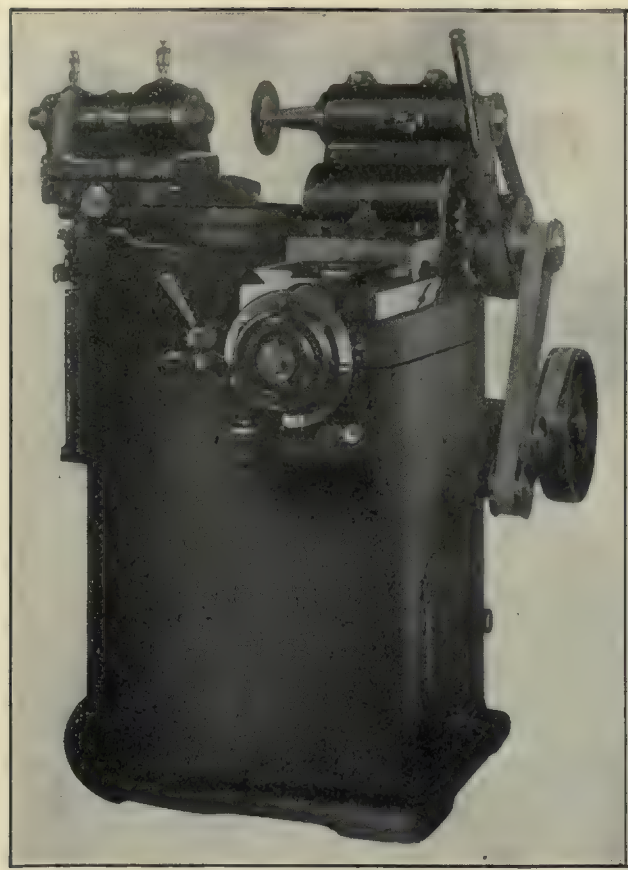
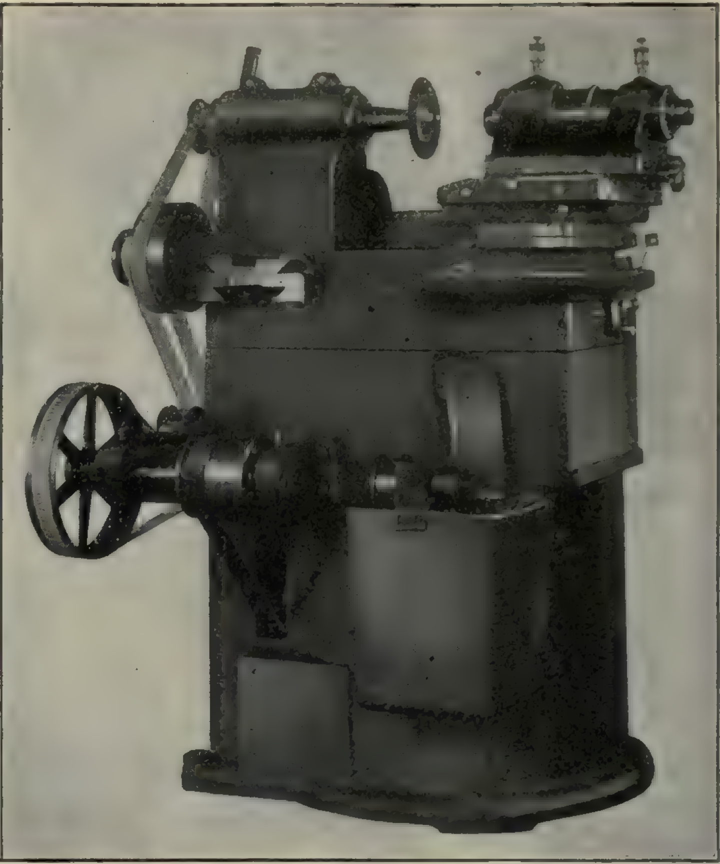


FIG. 1. AUTOMATIC RADIAL GRINDING MACHINE



FG. 2. REAR VIEW OF MACHINE

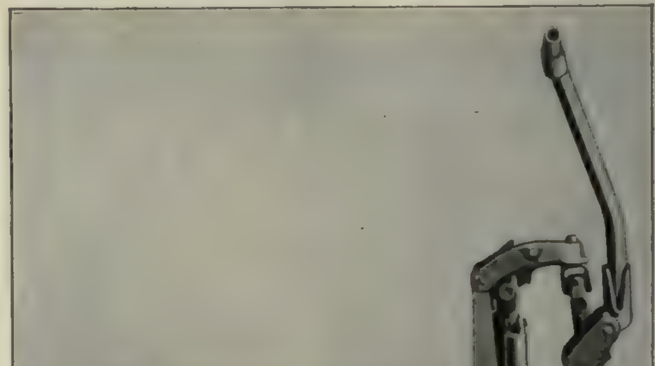
Swing over swivel post, 6½ in.; maximum grinding diameter, 10 in.; cross-slide movement, 4 in.; longitudinal travel of work-carryng head, 5 in.; cross-movement of work-carrying head, 4½ in.; swivel of post each side of center, front 60 deg., rear, 135 deg.; front spindle bearing, 2½ x 3⅝ in.; rear spindle bearing 1⅞ x 3⅝ in.; diameter of hole through spindle, $1\frac{5}{16}$ in.; maximum capacity of split chuck, 1 in.; size of work-carrying-spindle pulley, 4 x 1¾ in.; speeds of oscillating post three, 17, 35 and 70 r.p.m.; distance from floor to center of spindle, 48 in.; movement of grinding wheel bracket, 11 in. forward and 6 in. back of center line; speeds of large grinding wheel spindle, 3500, 6000 and 9000 r.p.m.; speeds of small grinding wheel spindle, 10,000, 14,000 and 18,000 r.p.m.; speeds of work spindle, six, 150, 208, 270, 310, 370, and 500 r.p.m.; spindle nose threaded, 2½ x 8; maximum distance nose of work spindle to end of wheel spindle, 5 in.; length of ways for traverse of spindle head, 9 in.; width of ways, 5 in.; length of head on ways, 10 in.; distance from wheel spindle to top of bed, 6½ in.; floor space, 48 x 48 in.; weight, 4000 lb.; size of motor, 1½ hp.; accessories furnished include large and small grinding spindle with adapter, water attachment, six grinding spindle belts, 3 internal drive belts and oil

as soon as the work has been ground to the predetermined diameter. (5) The work-carrying head always stops with the work facing the operator, in position for gaging. (6) The wheel-carrying spindle is removed from the work, for gaging by a single motion of a hand lever on either internal or external work. (7) The longitudinal slide of the wheel-carrying head has been eliminated, and the cross slide is mounted directly on the upper-base casting of the machine, a feature which increases the rigidity and minimizes wear. (8) The clutch has been eliminated between the oscillating mechanism and oscillating member. (9) The machine is heavily constructed throughout, but especially the oscillating member. (10) An oscillation of 200 deg. is possible, making it feasible to grind all kinds of spherical work without additional attachments.

In regard to construction, all bearings are of the ball type, except that for the oscillating part, which is solid, and the headstock spindle bearings, which are Rivett standard. All parts of the shifting and oscillating mechanism operate in oil baths. The worm and worm wheels of the oscillating mechanisms are of case-hardened machine steel.

"Jacklift" Elevating Truck

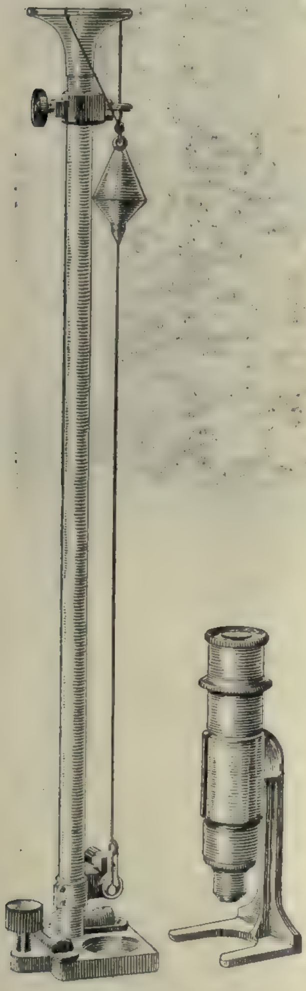
The illustration shows the new type L "Jacklift Master" truck of the Lewis-Shepard Co., 48 Binford St., Boston, Mass. This is a lighter truck than previously manufactured by this company but incorporates the operating features of the heavier trucks such as higher vertical lift and free lifting handle which permits the load to be elevated while the handle of the truck is turned to one side. This feature is claimed to permit operation in narrow aisles or other cramped or congested places. All parts except the wheels are made of



"JACKLIFT" ELEVATING TRUCK

malleable iron or crucible steel. Six models are made, three having 6-in. wheels and three 10-in. wheels. The lifting ratio is 40 to 1, which it is claimed allows the use of the truck by women or boys. The capacity is 2500 pounds.

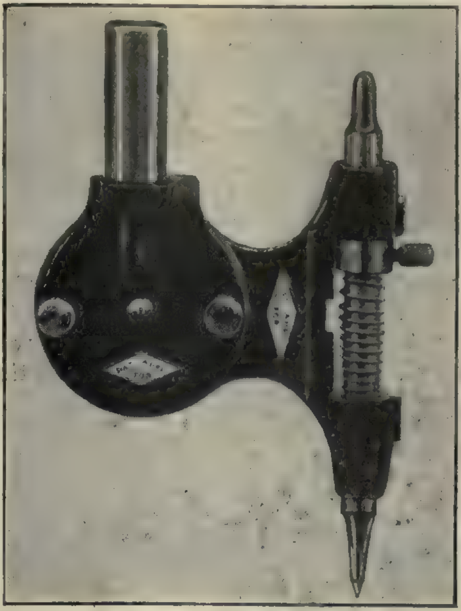
Waldo Hardness Tester


HARDNESS TESTER

With the idea of providing a portable instrument for the inspection of the hardness of metals the Palo Co., 90-94 Maiden Lane, is now marketing the Waldo hardness tester shown in the illustration. This instrument consists essentially of a plummet weighing $\frac{1}{10}$ lb. which is allowed to fall one foot to the material being tested. The plummet is fitted with a conical, renewable, chill-tempered 60-deg. point. It is suspended by a fine silk thread which runs through two slots in the funnel-shaped top piece and down to a small ring which is caught on a trigger near the base. The base rests on three points, two of which are supported by leveling screws, small cross levels serving to indicate when the supporting rod is vertical. After the instrument has been leveled the arm at the top is so adjusted that the plummet is over the hole in the base, the vertical distance of the plummet above the piece to be tested is made one foot and the trigger is released allowing the plummet to drop and make a small indentation in the work. A small portable microscope then replaces the other apparatus and the average diameter of the circular indentation is measured. The microscope is of sufficient magnifying power to measure the indentation with a suitable degree of accuracy, the measuring scale being embodied in the instrument. The object of having the silk cord run over the top support, and down to a releasing mechanism at the base, is to avoid any disturbance in the upper support which might affect the falling of the plummet.

Reliance "Spoticator"

The "Spoticator," which is being manufactured by the Reliance Tool Co., Meriden, Conn., is intended to be attached to a milling machine for use in spotting holes, and in lining operations in connection with jig, die or other like work. When used in this manner the instrument will spot holes on the work as accurately as the table of the milling machine may be moved by the screws. The plunger, or prick punch, is held in its upper position by a spring, but when set in proper position for spotting, it is pushed down against the work by the small knurled handle at the side, and tapped lightly with a hammer.


RELIANCE "SPOTICATOR"

"Smith" Demagnetizer

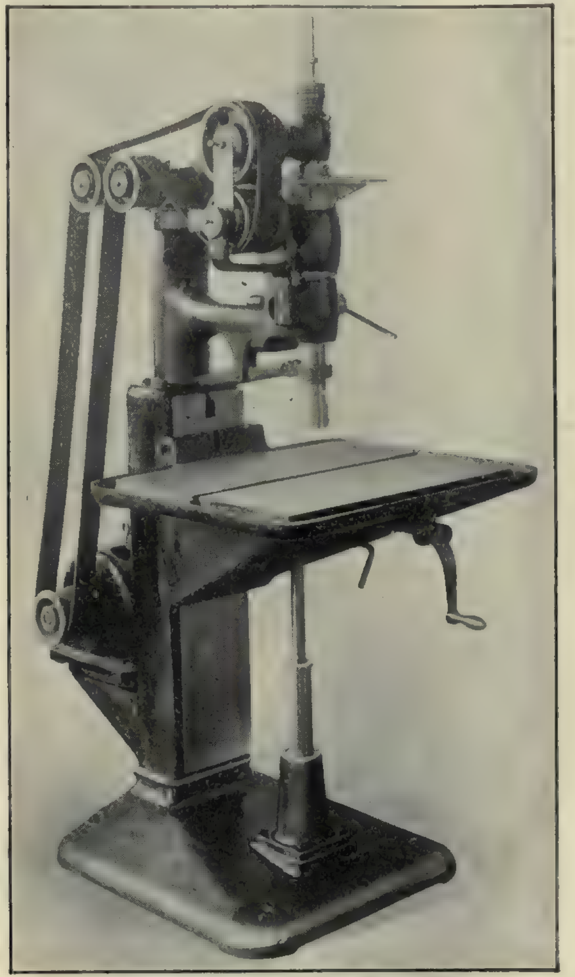
The W. F. Davis Machine Tool Co., 549 West Washington St., Chicago, Ill., is now marketing the "Smith" demagnetizer shown in the illustration. This device is made in various sizes, and claimed to completely demagnetize any metal parts as fast as they can be passed through it. The demagnetizer is intended primarily

"SMITH" DEMAGNETIZER

for use on parts that have been machined on magnetic chucks. This device will do its work much more effectively and cheaply than other types of apparatus now on the market, it is claimed.

Rickert-Shafer Tapping Machine

The vertical tapping machine illustrated is intended for taps from ¼ to ½ in., in steel, and from ¼ to ⅝ in. in cast iron. It is known as the ½-in. model R tapping machine, and is the product of the Rickert-Shafer Co., 613 West 11th St., Erie, Penn. The forward and reverse motions are obtained through a patented friction drive in which, it is claimed, there is practically no lost motion between the driving and reversing of the tap. For heavy tapping work, additional pressure may be obtained by means of an automatic cam action. The head mechanism is such that the spindle may travel a considerable distance to the work, which necessitates fewer movements of the table.



VERTICAL TAPPING MACHINE

Capacity in steel, ¼ to ½ in.; in cast iron, ¼ to ⅝ in.; total height, 70 in.; working surface of table, 20 x 24 in.; maximum distance from table to chuck, 19 in.; distance from spindle to column, 12½ in.; spindle travel, 4½ in.; horsepower required, 1; net weight, 800 lb.

Detroit High-Speed Drilling Machine

The illustrations show a high-speed drilling machine that is being marketed in both the bench and floor types. It is intended especially for manufacturing work, where continuous operation is encountered. The capacity is holes up to ⅜ in. in diameter and the maximum speed is 8000 r.p.m. Two speeds are obtainable by means of two step cone pulleys. Power is transmitted from the pulleys through bevel gears in an oil-tight box, to a vertical shaft from which the drive to the spindle is by means of an open belt, an idler being provided to adjust belt tension. The advantage of this type of drive is that the quarter-turn belt is entirely eliminated. A belt shifter is included. All bearings are of the annular-ball type provided with dust caps and oilers. Twelve of these are used in each machine. All pulleys and revolving parts are ground to size and balanced. The machines are the product of the Detroit Tool Co., 1487 St. Antoine St., Detroit, Mich., and are known as their model L-1.

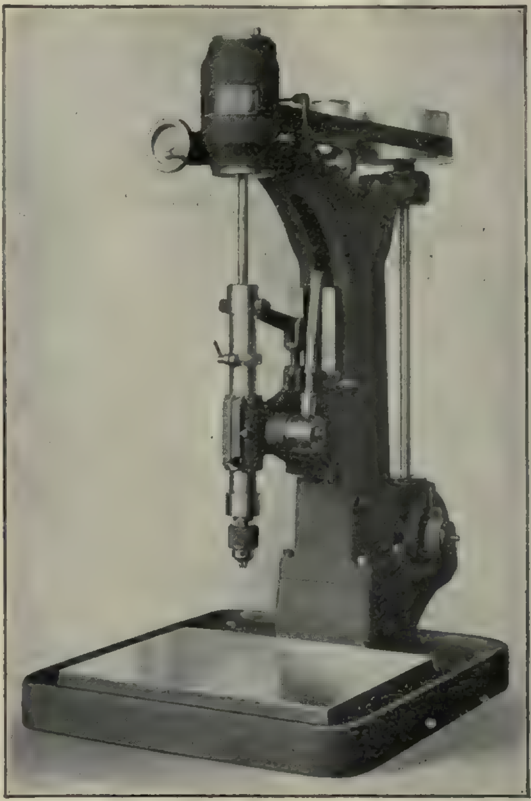


FIG. 1. BENCH TYPE HIGH-SPEED DRILLING MACHINE

Capacity up to ⅜ in.; maximum speed, 8000 r.p.m.; net weight, 156 lb.

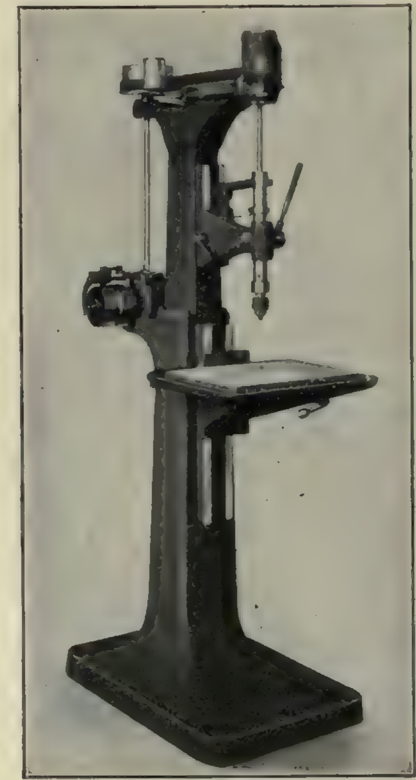


FIG. 2. FLOOR TYPE DRILLING MACHINE

Capacity up to ⅜ in.; net weight, 428 lb.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Oct. 27, 1917—While it is not considered advisable to publish definite information, it can safely be said that things, including rifles, are moving much more smoothly in almost every department than they were a few months or even weeks ago. The expansion of the War Department, from an organization to look after an army totaling about 100,000 men into a body capable of handling men by millions, was a task that even the most experienced army officer had not fully appreciated. The handling of such matters is more than a mere multiplication, as it involves securing material from those who have never before made anything of the kind, and necessitates not only an increased purchasing and inspection department, but almost an organization for teaching manufacturers how some of the supplies are to be made.

It may perhaps be likened to the power required to increase the speed of an automobile, an airplane, or any power propelled vehicle. And just as these are credited with requiring a multiplication of power varying as the square or cube of the speed, so some similar factor has probably been necessary in getting our new military establishments under way.

Real progress is now being made, however; work of various kinds is being centralized and, beginning with the designing and inspection of gages, the whole work is progressing in a hopeful manner.

DELAYS IN MAKING GAGES

One of the things to be avoided, and which is now being carefully looked into, is the awarding of contracts of such size to a single shop as to make prompt deliveries possible. As long as a single shop can deliver the goods at the required rate, it is undoubtedly more economical to have the work concentrated in as few plants as possible. When, however, this plan interferes with securing the needed deliveries it becomes absolutely necessary to split the orders in as small parts as may be necessary and to thus utilize as many plants as possible. This has been found to be necessary in the case of gages for munitions of various kinds, and it is more than probable that contracts for the making of tools and fixtures will have to be divided in a similar manner.

The plan that will probably be adopted for the present is to have the master gages contracted for by the War Department through its various divisions. If, however, as seems probable and also highly desirable, the work of gaging for all departments is brought under one head, this gaging department will order the necessary gages for use in checking the inspection gages used by the Government inspectors in various plants.

All excepting these master gages will probably be contracted for by the various manufacturers, including the gages which are used by Government inspectors in their plants. The checking of these master gages will be done at the Bureau of Standards as was originally planned and if manufacturers desire to have their inspection gages checked by the Bureau of Standards this can be easily arranged for.

This whole question involves a very complete study of tolerances, and these are being considered as rapidly as possible. But even the most careful consideration, which it is possible to give at this time, will not eliminate all inconsistencies, and we must not be too critical in every particular. It is quite probable that where these tolerances are absurdly close, as they are almost sure to be in some cases, that some rational system of inspection may be devised so as to secure a large production of products that will be perfectly acceptable when viewed from a standpoint of useability.

THE AIRPLANE PROGRAM

The airplane program is progressing in all its departments, and while it is not considered advisable to publish the names of the various firms engaged in this new work, it is gratifying to be able to assure our readers that some of the best known firms in the United States are hard at work on actual production and that both Liberty motors and planes are coming along as well as can be expected at this time. And this is not given as any alibi for non-production, because if we could publish the names of the firms engaged in this work it would show at once that they include the finest manufacturing organizations in this country, which stand second to none in this respect, and the best engineering and productive talent is being concentrated to secure results.

One of the pleasing sides of the war situation is the way in which various manufacturers from all over the country have come to the front in rendering assistance in every way possible, even when it involved considerable risk and in some cases actual financial loss. Before Congress finally passed its huge war appropriation, various manufacturers, working in connection with the Ordnance Bureau, actually began manufacturing preparations, such as the erection of new buildings, the purchase of machinery and material, and the employment of mechanics so that the work might be well under way when the appropriation was finally passed. To be sure, there might have been comparatively real risk involved but it seemed inevitable that such appropriations must be passed. But Congress has proved fickle on more than one occasion, and even though it was absolutely certain that the appropriations would be made, this advance preparation meant the tying up of large sums of money for several months and without the definite assurance that the contracts would be let, at least to the parties starting the work.

A Course in Factory Management

The value of any instruction may be said to depend upon the practical knowledge of the instructor and his ability to impart this information to the student. On this basis there can be no doubt as to the value of the course in efficient factory management, which is being taught by the Modern Methods School Co., 5716 Euclid Ave., Cleveland, Ohio, and which has now been in practical operation for about two years.

The idea originated with E. C. Peck, General Superintendent of the Cleveland Twist Drill Co., and came from his knowledge of the great need for thoroughly trained men to fill positions of authority in the industrial and commercial fields. His long experience as a practical and successful factory manager leaves no doubt as to his knowledge of the essential points of such a course and the lessons are based on his experience, in conjunction with that of other successful men in similar capacities. The advisory board contains the names of ten successful superintendents, factory managers, production managers, and cost supervisors.

The course consists of eight textbooks, which cover in a practical way about every phase of factory organization, from the relationship of employer and employee to the handling of the largest problems in the manager's office. The object of this course is to effect a better understanding between workmen and executives and to point out the advantages of coöperation.

The eight textbooks take up the subjects of organization and workmen; the foreman and his duties; the assistant superintendent; the purchasing agent; the engineering department; the power house; factory cost keeping and the factory manager.

This is a field that has a need of a thoroughly practical course of this kind, one that embodies only thoroughly tried and practical ideas and that differs materially from much that is published under the guise of efficiency. Men whose employees have taken this course recommend it highly.

Business Items

The Laughlin-Barney Machinery Co. have moved their offices to 481 Union Arcade, Pittsburgh, Penn.

E. P. Reichhelm & Co., Inc., have recently purchased the six-story structure at 26 John St., New York City.

The M. Mott Engineering Co. announces its removal from Hotel Vanderbilt to 1 Madison Ave., rooms 218-218a.

The Shepard Electric Crane and Hoist Co. will move their New York offices to 30 Church St., at some time in the near future.

The Macleod Company, 2232-2236 Bogan St., Cincinnati, Ohio, will enlarge its plant, and for this purpose has increased its capital stock to $100,000.

The Simplex Tool Co., Woonsocket, R. I., manufacturer of tools, gages, lathe chucks, etc., has just moved to a new factory on Worrall St., and is tripling its capacity.

The Vulcan Steel Products Co. has opened an office in Havana, Cuba, under the management of G. O. Simpson. In connection with this office there will be maintained a permanent exhibition of the machinery, and the steel and iron products in which this company deals.

The Buffalo City Line Realty Co., a subsidiary of J. H. Williams & Co., Brooklyn, N. Y., have sold to the Government a plot of land in Buffalo, N. Y., which will be used as a site for a plant for the building of turbines. The plant will employ between 2000 and 3500 men, and will be operated by the Fore River Shipbuilding Corporation.

The Metropolitan Sewing Machine Co., Nyack, N. Y., has recently been incorporated. It has taken over the buildings, real estate, machinery, patents and business of the former Metropolitan Sewing Machine Co., including the development and manufacture of the Weis automatic design cutting and sewing machine. The capital stock of the new corporation is $1,250,000. The officers are L. N. Littauer, president; F. Bender, vice president and general manager; H. C. Richard, treasurer and secretary, with G. N. Richard as an additional director.

The Davis Bournonville Co., Jersey City, N. J., has taken over the plant and factory of the Davis Acetylene Co., Elkhart, Ind. The plant will hereafter be operated under management from Jersey City, for the manufacture of acetylene pressure generators for the oxyacetylene process, and for special products. The Canadian factory at Niagara Falls, Ont., which was occupied jointly by the two companies, has also been taken over, and will be operated exclusively for the manufacture of oxyacetylene apparatus for the Canadian trade. The company has also purchased the H. G. Kotten Co.'s factory and grounds opposite its Jersey City property. This property will be used for manufacturing electrolytic oxygen apparatus and accessories. An office has recently been established in the Colorado Bldg., Washington, D. C., with Henry R. Swartley, Jr., as resident manager.

Personals

P. J. Karrol has resigned his position as Pittsburgh representative of the International Oxygen Co.

W. H. Bramman is now assistant to the president of the Walter A. Zelnicker Supply Co., St. Louis, Mo.

Robert T. Turner will shortly be located in the New York office of the Shepard Electric Crane and Hoist Co.

Robert S. Alter has been re-elected president of the Foreign Trade Association of the Cincinnati Chamber of Commerce.

W. C. Briggs will succeed W. A. Battey as district manager for the New York office of the Shepard Electric Crane and Hoist Co.

D. R. Marsh, production manager of the Buffalo Forge Co., is now in Washington engaged in work for the Government. He will receive a captain's commission.

Charles O. Rowe is now associated with the sales force of the Hess Steel Corp., Baltimore, Md. Mr. Rowe was formerly associated with the sales department of the Union Drawn Steel Co.

Edmund Bemore, for the past six years demonstrator for the Jones & Lamson Machine Co., Springfield, Vt., has received a commission as first lieutenant in the United States Army, Ordnance Section.

W. B. Sullivan, formerly Eastern representative of the Rich Tool Co., with offices at Philadelphia, has been appointed manager of sales at the general offices in the Railway Exchange, Chicago, Ill.

Edmund Barany, formerly machine designer of the Singer Manufacturing Co., Elizabeth, N. J., is now mechanical engineer and assistant to the general superintendent of the Cleveland Twist Drill Co., Cleveland, Ohio.

W. P. Clark, who has been mechanical superintendent of the Crocker-Wheeler Co., Ampere, N. J., for the past two years, has severed his connections with this concern to accept a position with the Bullard Machine Tool Co., Bridgeport, Conn.

William A. Battey, Eastern sales manager for the Shepard Electric Crane and Hoist Co., will sever his active connection with this concern on Dec. 1, but will retain his interest in the company and continue as a director. He will also devote his attention to the Pennsylvania Crusher Co., of which he is vice president.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

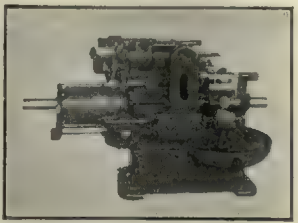
The National Machine Tool Builders Association will hold its sixteenth annual convention at the Hotel Astor, New York City, on Tuesday and Wednesday, Oct. 30 and 31.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Ring-Gear Machine, Automatic

Jones & Lamson Machine Co., Springfield, Vt.

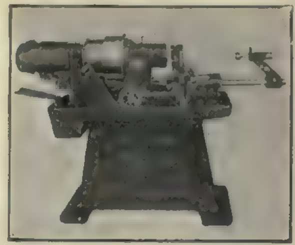


"American Machinist," Sept. 27, 1917

An automatic machine for rough- and finish-turning ring gears, and other similar types of work. The gears are finished on the inside, outside and face of the tooth portion, and rounded off at the back corner; the gears of course having been finished on the inside, front and rear before being placed in position on the machine. Advantages claimed are large production, compactness, simplicity, low capital cost for given output, and low labor cost

Cutting-Off Machine

Etna Machine Co., Toledo, Ohio

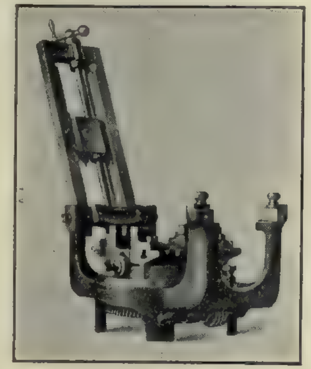


"American Machinist," Oct. 11, 1917

Maximum capacity, 3-in. rounds, 2-in. squares, 2⅜-in. hexagons; hole through push tube, 3¼ in.; hole through spindle, $3\frac{13}{16}$ in.; front bearing, $4\frac{13}{16}$ x 6½ in.; rear bearing, $4\frac{13}{16}$ x 4¾ in.; tools, ⅜ x ⅞ in.: collet opening, ⅛ in.; long adjustment of cross-slide, 8 in.; floor space, 26 x 62 in.; weight, 160 lb.

Jig Drilling (No. 1)

Lapointe Machine Tool Co., Hudson, Mass.

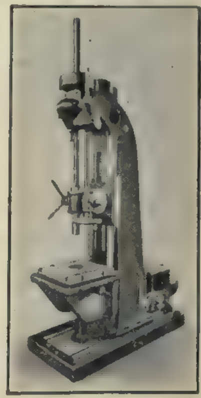


"American Machinist," Oct. 18, 1917

Consists essentially of movable guide bushings that may be moved longitudinally while the work-holding fixture may be moved laterally. The table is fitted to a circular base, which may be rotated through the entire circle by a worm and wheel. Size of work accommodated with table gripping jaws, 5 x 1¾ x 10 in.; size of work accommodated with adjustable straps, 6 x 1¾ x 10 in.; size of circular work accommodated up to 13 in. in diameter; travel of slide, 9 in.; travel of table, 4½ in.; weight, 100 lb.

Drilling Machine (Telsmith)

Smith Engineering Works, 32nd and Locust Sts., Milwaukee, Wis.

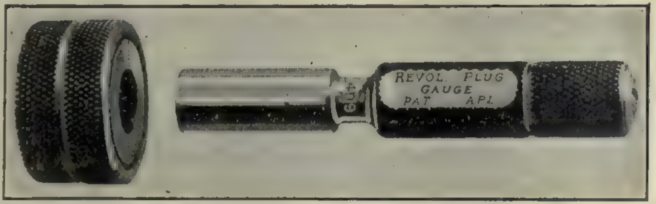


"American Machinist," Oct. 18, 1917

Capacity, work up to 24 in. in diameter; floor space, 6 ft. 1 in. by 2 ft. 4 in.; height, 7 ft. 9⅞ in.; speeds, ten, 30, 40, 54, 74, 101, 132, 178, 238, 335 and 446 r.p.m.; feeds, six, 0.0072, 0.01102, 0.01766, 0.02848, 0.04624 and 0.07081 in. per spindle revolution

Gages, Revolving Grip

Reliable Machine Works, 48 Lafayette St., Ridgewood, L. I.

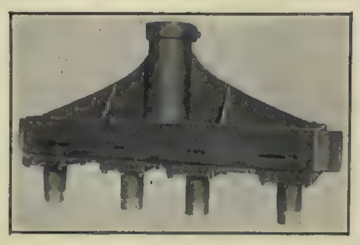


"American Machinist," Oct. 18, 1917

These gages are manufactured in both the plug and ring types, the idea being that with this arrangement the gages may be used for testing the size of the piece being machined without stopping the machine. The revolving portion runs on ball bearings and is held in place on the plug gage by means of a screw while a spring ring serves this purpose on the ring gage. The gages are ground and lapped to size and are furnished in a large number of sizes.

Drilling Head, Adjustable Multiple Spindle

Hoefer Manufacturing Co., Freeport, Ill.

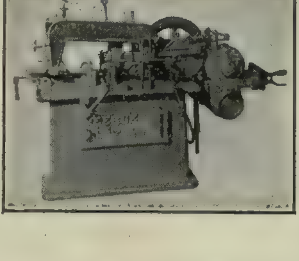


"American Machinist," Oct. 18, 1917.

This head is clamped to the spindle nose, and the drive is from a taper shank toothed driver through hardened helical gears that extend the length of the head in order to allow lateral adjustment of the individual spindles. Will handle drills up to 1 in. in diameter. Ball thrust bearings are used on the individual spindles as well as on the horizontal shaft.

Saw, Metal, High-Speed

Peerless Machine Co., Racine, Wis.

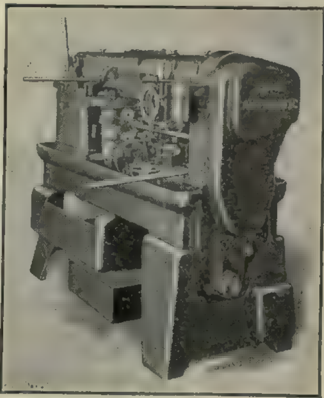


"American Machinist," Oct. 18, 1917

This machine is now made with six speeds ranging from 50 to 150 strokes per minute, obtained by means of gears operating in a gear box attached directly to the machine. If desired the machine can be furnished with a motor drive, the motor in this case being mounted above the machine in order to reduce floor space required. Where motor drive is used the machine is equipped with a set of reducing gears. The capacity of the machine is work up to 6 x 6 in.

Screw Machine, Automatic Four-Spindle

Cone Automatic Machine Co., Windsor, Vt.



"American Machinist," Oct. 25, 1917

Made in three sizes accommodating work 6 in. long and 1, 1¼ and 1⅝ in. in diameter respectively; size of spindle bearings, 1 in. machine, 2¼ x 6⅛ in., 1¼ in. machine, 2½ x 6⅛ in., 1⅝ in. machine, 2⅞ x 6⅛ in.; spindle bearings adjustable; feed changes, 10; spindle speeds, 150 to 900 r.p.m.; motor used, 5 hp., with any voltage or speed desired; speed of driving pulley, 600 r.p.m.; height, 5 ft.; floor space, 30 x 78 in.; weight, 4800 lb.

Patent Applied For

WEEKLY PRICE GUIDE O

IRON AND STEEL

The Government Schedule of steel prices, which went into effect Sept. 24, will have little effect on the general market for some time. Present warehouse stocks—bought at the old mill price—will probably be sold out before the present warehouse prices to ordinary consumers are reduced. The Government prices are: Pig iron, $33 per gross ton; steel bars (Pittsburgh-Chicago), $2.90 per 100 lb.; shapes, $3; plates, $3.25. New Government prices expected within two weeks.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Oct. 26, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	....	$16.00
No. 2 Northern Foundry, Chicago......	33.00	....	22.00
*Bessemer, Pittsburgh	36.30	....	24.95
*Basic, Pittsburgh	33.00	$36.30	20.90
No 2X, Philadelhphia...............	33.75	33.00	21.00
*No. 2, Valley.....................	33.00	....	21.00
No. 2, Southern Cincinnati............	35.90	33.00	18.90
Basic, Eastern Pennsylvania...........	45.00	45.00	21.50

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Oct. 26, 1917	One Month Ago	One Year Ago	Oct. 26, 1917	One Year Ago	Oct. 26, 1917	One Year Ago
Structural shapes ...	$5.25	$5.25	$3.35	$5.00	$3.40	$5.00	$3.25
Soft steel bars......	5.00	5.00	3.40	4.50	3.40	4.50	3.25
Soft steel bar shapes.	5.00	5.00	3.35	4.50	3.40	4.50	3.25
Plates, ¼ to 1 in.thick.	10.00	9.00	....	7.00	....	7.00	....

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Oct. 26, 1917	One Year Ago
Pittsburgh, mill	$5.00	$2.50
Warehouse, New York..................	4.75	3.35
Warehouse, Cleveland	4.45	3.35
Warehouse, Chicago	4.50	3.25

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Oct. 26, 1917	One Month Ago	One Year Ago	Oct. 26, 1917	One Year Ago	Oct 26, 1917	One Year Ago
*No. 28 black.....	7.25	9.50	10.50	3.65	8.50	3.70	9.25	3.90
*No. 26 black.....	7.20	9.40	10.40	3.55	8.40	3.65	9.15	3.80
*No. 22 and 24 black	7.10	9.35	10.35	3.50	8.35	3.60	9.10	3.75
No. 18 and 20 black	7.05	9.30	10.30	4.45	8.70	3.55	9.05	3.70
No. 16 blue annealed	7.95	10.20	10.20	4.45	8.70	3.90	9.70	3.70
No. 14 blue annealed	7.85	10.10	10.10	4.35	8.60	3.80	9.60	3.60
No. 12 blue annealed	7.80	10.05	10.05	4.30	8.55	3.75	9.55	3.55
No. 10 blue annealed	7.75	10.00	10.00	4.25	8.50	3.70	9.50	3.50
*No. 28 galvanized.	9.00	11.00	11.50	5.00	10.00	5.00	10.50	5.25
*No. 26 galvanized.	8.70	10.70	11.20	4.70	9.70	4.70	10.20	4.95
No. 24 galvanized..	8.55	10.55	11.05	4.55	9.40	4.55	10.05	4.80

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Oct. 26, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Oct. 26. 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	15.30	6.30
Chicago	14.00	5.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*	
3/8, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16..	
No. 18	
No. 20	

* Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Oct. 26, 1917	Cleveland Oct. 26, 1917	Chicago Oct. 26, 1917
Tire	5.00	5.00	4.50
Toe calk	5.70	5.50	4.75
Openhearth spring steel...	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	42%	15½%	¾ to 1½.....	33%	17%
½	46%	31½%			
LAP WELD					
2	42%	29½%	2	26%	12%
2½ to 6......	45%	32½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%
BUTT WELD. EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	38%	20½%	¾ to 1½.....	33%	18%
½	43%	30½%			
¾ to 1½......	47%	34½%			
LAP WELD. EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4......	43%	31½%	2¼ to 4......	29%	17%
4½ to [illegible]......	42%	30½%	4½ to 6......	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	37.9%	23.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	41.9%	26.9%

Malleable fittings. Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Oct. 26, 1917	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	29.00
Tin, in 5-ton lots....................	62.00	61.75	42.00
Lead	8.50	8.00	7.00
Spelter	8.50	8.50	11.00

*Government price.

ST. LOUIS

	Oct. 26, 1917	One Month Ago	One Year Ago
Lead	8.00	8.00	7.00
Spelter	8.25	8.25	11.00

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Oct. 26, 1917	One Month Ago	One Year Ago	Oct. 26, 1917	One Year Ago	Oct. 26, 1917	One Year Ago
Copper sheets, base.	35.00–37.00	35.00	37.50	33.00	38.50	34.00	38.00
Copper wire (carload lots)	36.00	38.50	32.00	33.00	33.00	33.50	33.25
Brass pipe, base...	41.00–43.00	43.00	46.50	41.00	46.00	42.00	46.00
Brass sheets	40.00	40.00	44.50	33.25	43.00	35.00	39.00
Solder ½ and ⅓ (case lots)	39.25	39.25	26.62½	37.00	27.00	39.00	25.75

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Oct. 26, 1917	One Year Ago
Mill	$29.00	$42.00
New York	35.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

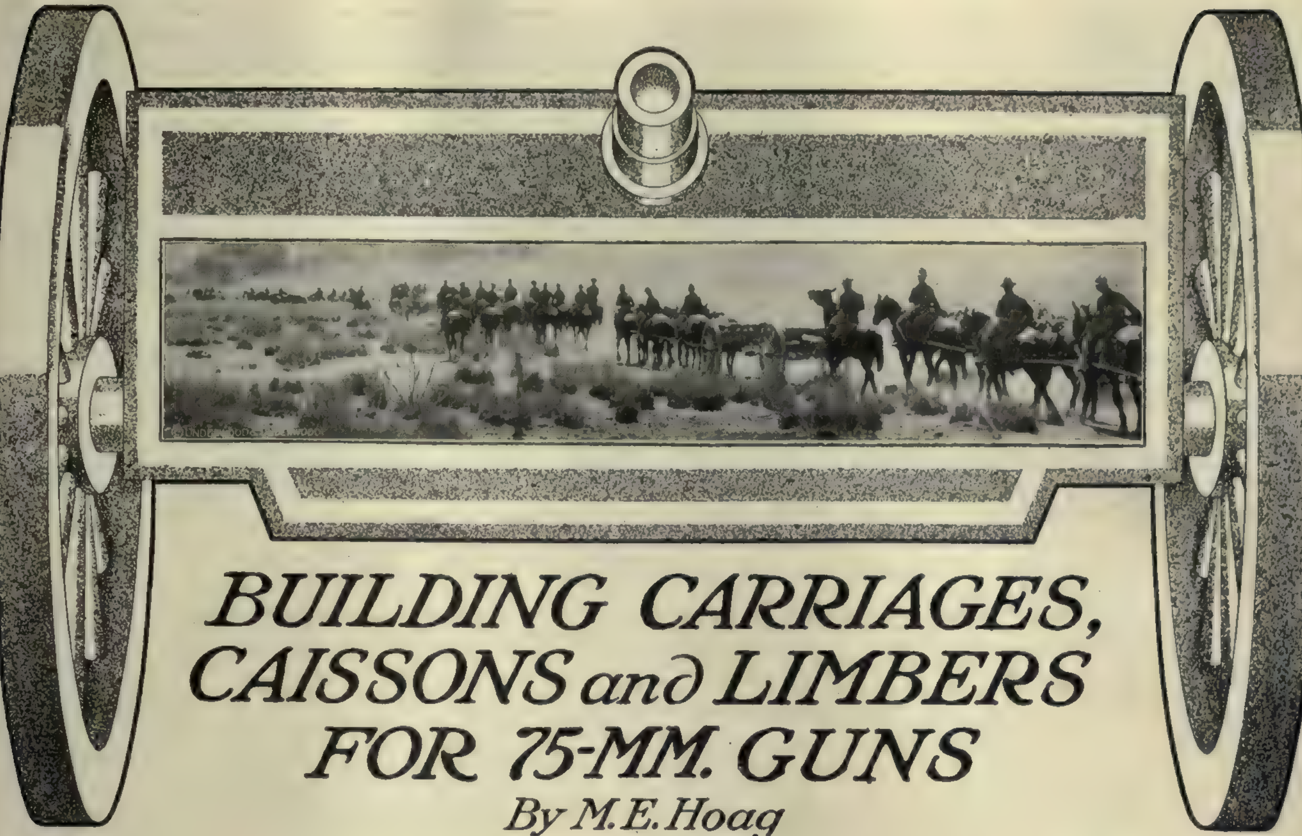
ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.. 19.00

	In Casks		Broken Lots	
	Oct. 26, 1917	One Year Ago	Oct. 26, 1917	One Year Ago
New York	20.00	18.00	20.50	19.00
Cleveland	21.00	16.75	21.25	17.50
Chicago	21.00	17.00	21.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Oct. 26, 1917	One Year Ago
New York	15.00	13.50
Cleveland	16.25	13.00
Chicago	16.00	13.50



BUILDING CARRIAGES, CAISSONS and LIMBERS FOR 75-MM. GUNS

By M. E. Hoag

The information for this article, as well as others to follow, was obtained through the courtesy of the Chief of Ordnance, United States Army, and with the courteous aid of the Commanding Officer of the Rock Island Arsenal and his assistants.

THE work herein described is that performed on one of the latest model guns. As very few of the special jigs, fixtures, etc., required for the work have been completed, some of the methods in use must not be taken as samples of the high state of efficiency that has been developed on regular work. There are some parts, however, which may be considered common property, as they are used on other and older models, and in handling these pieces costs have been reduced to a minimum. Descriptions of the special tools and work on these pieces will give a general idea of the high standard of efficiency that prevails throughout these shops. An idea of the immense amount of work required on special tools will be had when it is taken into consideration that the tool-designing department has made upward of 600 drawings and there still remain about 500 to make.

Owing to the large number of parts that enter into the construction of these pieces of equipment and the several thousand machining operations, it will be impossible to describe each one in detail, as has been done with the Springfield rifle and the munitions. There are many parts and operations that are not difficult and do not require special tooling. But there are also many parts that are of an unusual nature and that

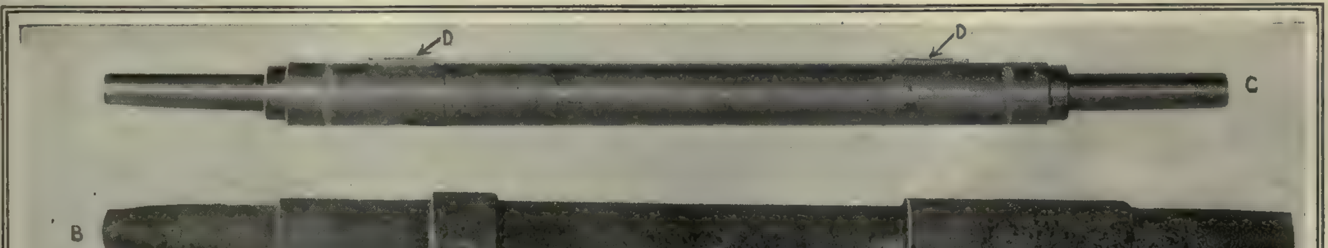


FIG. 1. THE AXLE FORGINGS IN THREE DIFFERENT STAGES OF COMPLETION

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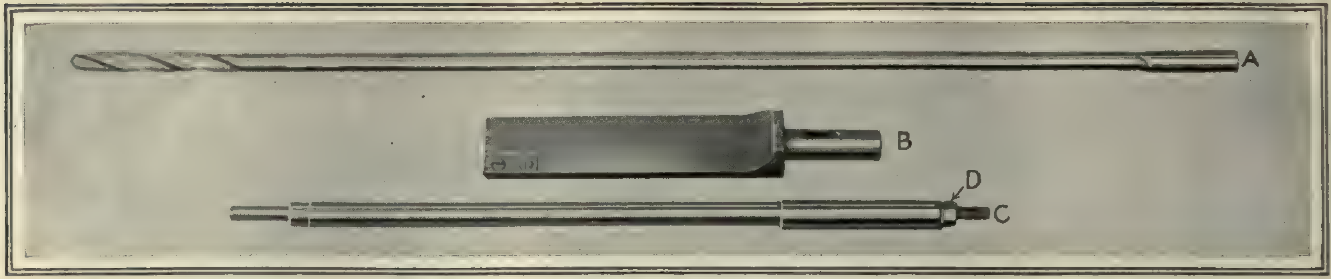


FIG. 3. DRILL FOR HOGNOSING OUT THE AXLE

entail difficult operations and the use of special tools and fixtures. It is these last that will be dealt with in detail.

To those not familiar with artillery, a word of explanation will not be amiss. There are three parts to this equipment—(1) the gun carriage, which consists of the gun, recoil, elevating, sighting and other attachments, all mounted on wheels to facilitate transportation, (2) the caisson and (3) the limber. These last two are very similar in nature and appearance and serve to carry fixed ammunition, tools, etc.

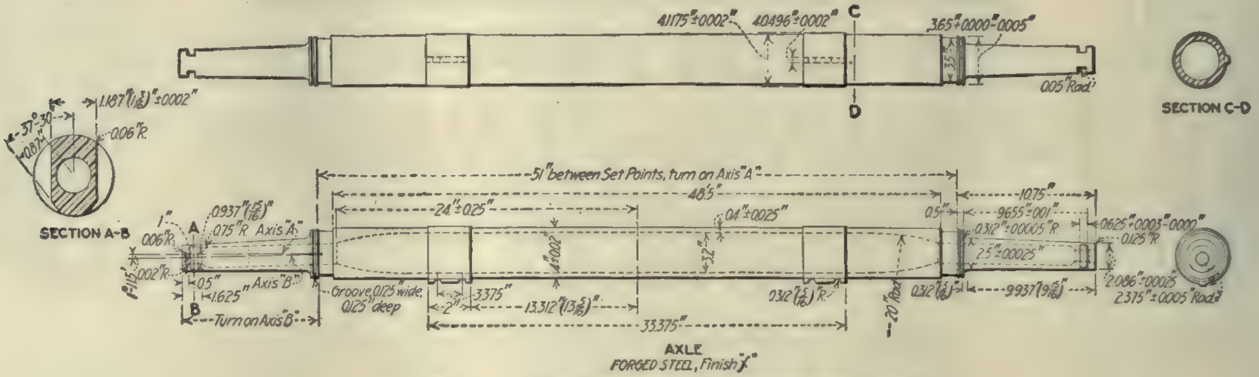


FIG. 4. DETAILS OF THE FINISHED AXLE

The 75-mm. gun limber contains over 160 separate and distinct parts, on which there are over 900 machining operations. The actual total of pieces and operations far exceeds these figures, for a number of the parts are repeated many times, such as rivets, bolts, etc.; and many of the operations, as shown on the "Route Sheets," embody several operations. There are some features that are considered of a secret nature, and it will be impossible to give working drawings or photographs of these completed parts; but in most cases illustrations and descriptions of some of the operations will be given.

Table I gives a list of parts, the number of operations, the material required and in some cases the machining operations.

The axles used on the 75-mm. 1916 model gun-carriage caissons and limbers are identical, with the exception that the axle for the caisson has a keyway milled to take the brake hanger, so a description of the machining operations on one will apply to both.

The axle forgings are received as shown at *A*, Fig. 1, and in the drawing, Fig. 2. The object in having the forgings this shape is to secure the proper internal

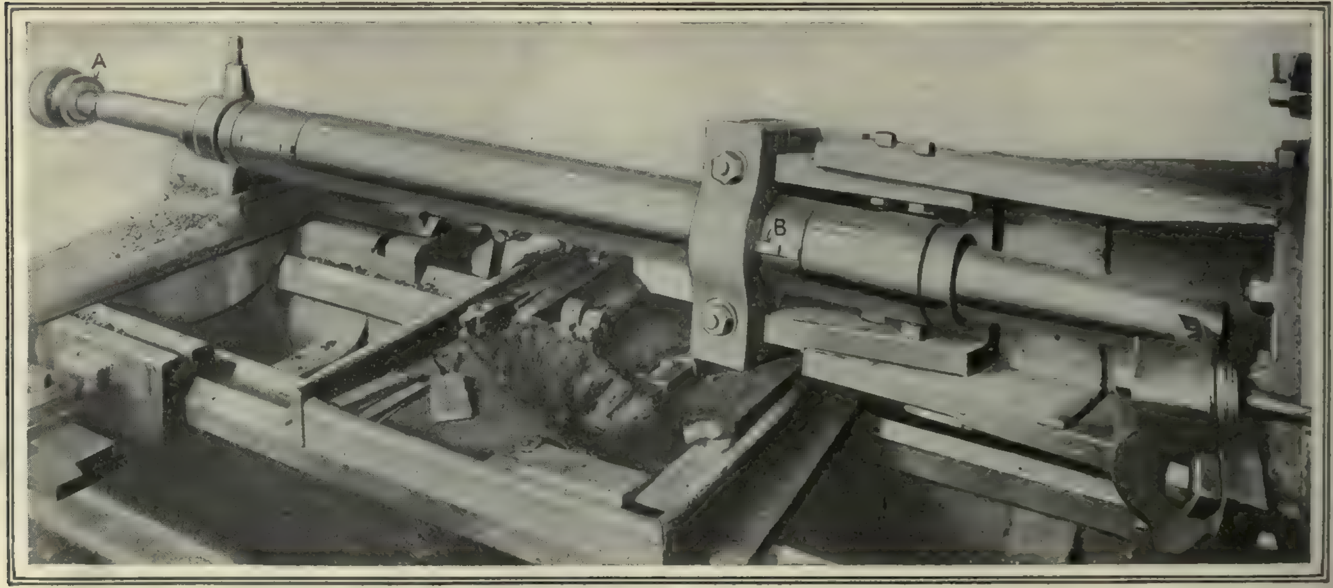


FIG. 5. TURNING OPERATIONS ON THE AXLE IN THE LATHE DEPARTMENT

form after the closing-in operation described later. The first operation is centering and turning for drilling and hognosing. The second operation is drilling through from end to end with the oil drill *A*, Fig. 3. These drills are interesting on account of the method used in making them. Short oil drills are electric welded to the long hollow shanks which have been formed in dies, from seamless steel tubing. Care is exercised to have them fairly straight and enough smaller than the drill so that no finishing is required in order that the shank may clear the hole. After drilling with the oil drills, the axles are hognosed out with the drill *B*, Fig. 3. A simple fixture with bushing serves to guide the hognose tool; otherwise, it would be necessary to bore a spot in each piece in order to start the tool.

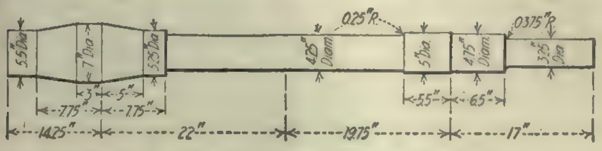


FIG. 2. DETAIL OF AXLE FORGINGS

TABLE I. COMPONENT PARTS, OPERATIONS AND MATERIAL FOR 75 MM., 1916, MODEL LIMBER

Name of Piece	Operations	Material Required
Top-plate rear filler	3	Flange steel, $\frac{1}{8}$x1$\frac{1}{16}$x5$\frac{1}{4}$ in.
Top plate	7	Flange steel, $\frac{1}{16}$x24x92$\frac{1}{2}$ in.
Top-plate front filler	4	Flange steel, $\frac{1}{8}$x1$\frac{11}{16}$x5$\frac{3}{4}$ in.
Front plate	7	Flange steel, $\frac{1}{16}$x15x53 in.
Door-frame angle	3	Angle steel, $\frac{3}{4}$x$\frac{3}{4}$x$\frac{1}{8}$x71$\frac{5}{16}$ in.
Door-frame bar	3	Forged steel, $\frac{3}{16}$x$\frac{7}{8}$x48$\frac{7}{8}$ in.
Door-frame assembly	3	One door-frame angle, 1 door-frame bar, autogenous weld
Door	6	Flange steel, $\frac{1}{16}$x13x51 in.
Front diaphragm	14	Flange steel, $\frac{3}{32}$x14x50$\frac{3}{8}$ in.
Bottom plates, left and right	9	Flange steel, $\frac{1}{16}$x14x23 in.
Rear diaphragm	18	Flange steel, $\frac{3}{32}$x14x50$\frac{3}{8}$ in.
Middle diaphragm	15	Flange steel, $\frac{3}{32}$x14x50$\frac{3}{8}$ in.
Foot rest	13	Flange steel, $\frac{3}{32}$x20x52 in.
Middle transom, right and left	7	Flange steel, $\frac{1}{8}$x8$\frac{3}{16}$x14$\frac{7}{8}$ in.
Front transom, right and left	6	Flange steel, $\frac{1}{8}$x8x14$\frac{9}{16}$ in.
Rear transom, right and left	6	Flange steel, $\frac{1}{8}$x8$\frac{1}{8}$x14$\frac{1}{4}$ in.
Rear transom (inner), right and left	7	Flange steel, $\frac{1}{8}$x8x14$\frac{9}{16}$ in.
Hole reinforce	5	Flange steel, $\frac{3}{16}$x1$\frac{3}{4}$x2 in.
Middle rail, upper half, lower and upper	13	Flange steel, $\frac{5}{32}$x30x60 in.
Middle rail, lower half, lower and upper	14	Flange steel, $\frac{5}{32}$x30x60 in.
Side rail, right and left	9	Flange steel, $\frac{5}{32}$x10x45 in.
Diaphragm reinforce	4	Angle steel, $\frac{1}{8}$x1$\frac{1}{4}$x1$\frac{1}{4}$x3$\frac{5}{8}$ in.
Axle bracket	12	Carbon-steel casting
Bolt, $\frac{5}{8}$x3x$\frac{11}{16}$ in	2	Cold-rolled steel (1$\frac{1}{16}$ in. hex.)
Rear tie-rod, front end	4	Forged steel, $\frac{1}{2}$ in. round by 17 in.
Rear tie-rod, rear end	5	Forged steel, $\frac{5}{8}$x$\frac{1}{2}$x3 in.
Rear tie-rod assembly	4	....
Pins	2	Drill rod, 0.492 x 2 in.
Front tie-rod	4	Forged steel, $\frac{1}{2}$ in. round by 33$\frac{3}{4}$ in.
Pins	2	Drill rod, 0.492x2 in.
Pins	2	Drill rod, 0.492x2$\frac{7}{8}$ in.
Nameplate	1	Bronze casting
Foot-rest plate	6	Flange steel, $\frac{1}{8}$x2$\frac{1}{2}$x5 in.
Bucket-holder transom	7	Flange steel, $\frac{1}{16}$x5$\frac{3}{16}$x15$\frac{7}{16}$ in.
Handle rivet washer	3	Flange steel, $\frac{3}{32}$x1x1$\frac{3}{16}$ in.
Rivet washer	2	Flange steel, $\frac{3}{32}$x1$\frac{3}{16}$x1$\frac{3}{16}$ in.
Rivet washer	2	Flange steel, $\frac{3}{32}$x1$\frac{1}{16}$x1$\frac{1}{16}$ in.
Bucket holder (and assembly)	8	Flange steel, $\frac{1}{16}$x19x52$\frac{1}{2}$ in.
Door handle	2	Forged steel, $\frac{5}{8}$ in. round by 10$\frac{3}{16}$ in.
Door-handle assembly	2	Autogenous weld
Door-handle base	3	Forged steel, $\frac{1}{4}$x1x4.2 in.
Pole clamp	8	Carbon-steel casting
Dowel pin	1	Cold-rolled steel, $\frac{1}{4}$ in. round by $\frac{9}{16}$ in.
Washer	1	Forged steel, 1$\frac{1}{8}$ in. round by $\frac{7}{8}$ in.
Bolt, $\frac{3}{4}$x4$\frac{1}{16}$ in	2	Cold-rolled steel, 1$\frac{1}{4}$ hex. by 5 in.
Pintle	14	Forged steel, 2$\frac{1}{4}$x5x8 in.
Pintle latch, right and left halves	4	Forged steel, $\frac{3}{4}$x3x9$\frac{1}{2}$ in.
Pintle-latch assembly	14	Autogenous weld two halves and machine.
Pin	2	Drill rod, 0.984x3 in.
Pintle bearing	11	Bronze casting
Pintle-bearing guide	16	Forged steel, 4$\frac{1}{2}$x4$\frac{1}{2}$x5$\frac{1}{2}$ in.
Bolt	4	Forged steel, 1$\frac{7}{8}$ in. round by 7$\frac{1}{8}$ in.
Bolt	2	Cold-rolled steel, 1$\frac{1}{4}$ in. round by 5$\frac{7}{8}$ in.
Spring-rod pin	3	Forged steel, 1 in. round by 3$\frac{11}{16}$ in.
Pintle-bearing bolt	1	Cold-rolled steel, 1$\frac{1}{4}$ in. round by 1$\frac{1}{4}$ in.
Sleeve	2	Forged steel, 1$\frac{1}{2}$ in. round by 1$\frac{1}{2}$ in.
Spring rod	9	Forged steel, 1$\frac{3}{4}$x1$\frac{3}{4}$x9$\frac{1}{2}$ in.
Pintle-bearing spring	7	Chrome-vanadium, $\frac{3}{8}$ in. round by 28 in.
Pole-support spring	7	Chrome-vanadium steel, $\frac{5}{8}$ in. round by 96 in.
Pintle nut	4	Forged steel, 2$\frac{1}{2}$ in. round by 1$\frac{1}{4}$ in.
Spring-rod nut	4	Forged steel, 3$\frac{1}{2}$ in. round by 1$\frac{9}{16}$ in.
Trunnion bolt	6	Forged steel, 1$\frac{3}{4}$ in. round by 1$\frac{13}{16}$ in.
$\frac{3}{8}$-in. handle oiler		....
Lock plate	3	Flange steel, $\frac{3}{16}$x1x2$\frac{3}{8}$ in.
Guide bolt	5	Forged steel, 1 in. round by 5$\frac{5}{16}$ in.
$\frac{3}{8}$x$\frac{1}{2}$ fillister-head screw	2	Cold-rolled steel, $\frac{1}{2}$ in. round by $\frac{11}{16}$ in.
Pintle-latch spring	10	Spring steel, $\frac{5}{16}$x1x3$\frac{1}{4}$ in.
Wing-nut pin reinforce	3	Forged steel, $\frac{1}{8}$x2$\frac{1}{2}$x1$\frac{1}{2}$ in.
Double-tree strap	5	Forged steel, $\frac{1}{4}$x3x15$\frac{1}{4}$ in.
Door hinge (male half)	8	Forged steel, $\frac{1}{2}$x1x3$\frac{1}{2}$ in.
Door hinge (female half)	8	Forged steel, $\frac{1}{2}$x1$\frac{1}{4}$x3$\frac{1}{2}$ in.
Door-hinge pin	1	Cold-rolled steel, $\frac{1}{4}$ in. round by 3$\frac{3}{8}$ in.
Lantern bottom bracket	6	Flange steel, $\frac{3}{32}$x8$\frac{3}{16}$x15$\frac{5}{8}$ in.
Lantern bracket body	7	Flange steel, $\frac{3}{32}$x8x19$\frac{1}{16}$ in.
Hatchet-blade bracket body	5	Flange steel, $\frac{3}{32}$x18x7$\frac{3}{4}$ in.
Hatchet-handle rest	2	Flange steel, $\frac{1}{16}$x2$\frac{9}{16}$x$\frac{3}{4}$ in.
Hatchet-handle fastener	5	Flange steel, $\frac{3}{32}$x2x5$\frac{3}{4}$ in.
Pole-prop support	6	Flange steel, $\frac{3}{32}$x4x5 in.
Pole-prop pocket	5	Flange steel, $\frac{3}{32}$x5x6$\frac{5}{16}$ in.
Ax-handle support	5	Flange steel, $\frac{1}{8}$x2$\frac{1}{2}$x3$\frac{1}{2}$ in.
Pick-head fastener	5	Flange steel, $\frac{3}{32}$x1$\frac{1}{2}$x11$\frac{1}{2}$ in.
Pick-handle fastener	5	Flange steel, $\frac{3}{32}$x1x9 in.
Pick, mattock point guard	7	Flange steel, $\frac{1}{8}$x3$\frac{1}{4}$x6 in.
Ax-head fastener	4	Flange steel, $\frac{1}{16}$x3$\frac{13}{16}$x8$\frac{11}{16}$ in.
Pick guard, chisel end	4	Flange steel, $\frac{3}{32}$x3x3$\frac{1}{16}$ in.
Wing nut	5	Bronze casting
Wing-nut pin washer	1	Cold-rolled steel, $\frac{1}{2}$ in. round by $\frac{1}{4}$ in.
Wing-nut pin	5	Bronze casting
Lock-bar ends, right and left	2	Forged steel, $\frac{3}{4}$x1$\frac{1}{2}$x7$\frac{1}{4}$ in.
Lock-bar handle	3	Forged steel, 2$\frac{1}{4}$ in. round by 2$\frac{1}{2}$ in.
Lock-bar assembly	6	....
Lock-bar bearing, right and left	6	Forged steel, $\frac{3}{8}$x1$\frac{1}{2}$x2 in.
Prop foot	3	Bronze casting
Prop eye	4	Forged steel, 1$\frac{3}{4}$ in. round by 2$\frac{1}{2}$ in.
Prop-chain button	1	Forged steel, 1$\frac{1}{8}$ in. round by $\frac{7}{8}$ in.
Prop-chain button rivet	1	Forged steel, 1$\frac{1}{8}$ in. round by 1$\frac{1}{2}$ in.
Limber prop tube	1	Seamless-steel tube, 1$\frac{3}{8}$ in. inside diameter, 1$\frac{3}{4}$ in. outside diameter by 24$\frac{3}{8}$ in.
Prop-chain fastening	5	Flange steel, $\frac{3}{32}$x1x7$\frac{1}{2}$ in.
Prop-chain handle	4	Forged steel, $\frac{3}{16}$x2$\frac{1}{2}$x3$\frac{1}{2}$ in.
Prop-chain complete	3	Steel chain $\frac{3}{16}$x1$\frac{1}{4}$x38$\frac{3}{4}$ in.
Prop bracket	4	Forged steel, $\frac{3}{4}$ in. round by 3 in.
Neck-yoke chafing plate	6	Flange steel, $\frac{1}{8}$x2x6.94 in.
Pole-pin bushing	1	Steel tube, $\frac{11}{16}$ in. inside diameter, 1 in. outside diameter by 4$\frac{5}{8}$ in.
Butt reinforce	2	Extra-heavy steel pipe, 4 in. in diameter by 1$\frac{5}{8}$ in.
Pole body (for 2 poles)	7	Flange steel, $\frac{1}{8}$x21$\frac{3}{4}$x123 in.
Pole-body assembly	18	....
Double-tree body	8	Flange steel, $\frac{1}{8}$x9$\frac{1}{2}$x40$\frac{1}{4}$ in.
Double-tree assembly	7	....
Separator for double-tree	1	Seamless steel tube, 0.406x0.75x1$\frac{1}{8}$ in.
Reinforce piece double-tree body	4	Flange steel $\frac{1}{8}$x9$\frac{5}{16}$x12.17 in.
Double-tree hook, right and left	7	Forged steel, 1$\frac{1}{8}$x1$\frac{3}{8}$x4$\frac{1}{2}$ in.
Nipple	3	Bronze casting
Nipple nut	3	Flange steel, $\frac{5}{16}$x2$\frac{3}{8}$x3 in.
Nipple separator	4	Bronze casting
Round-head steel screws	4	$\frac{3}{8}$x1$\frac{11}{16}$ in.
Pole pin	2	Forged steel, 1$\frac{1}{2}$in. round by 6$\frac{5}{8}$ in.
Pole stop	5	Forged steel, $\frac{3}{4}$x1$\frac{3}{4}$x6 in.
Pole-pin reinforce	5	Flange steel, $\frac{3}{16}$x2$\frac{3}{4}$x4$\frac{1}{2}$ in.
Double-tree bolt	4	Forged steel, 1$\frac{1}{8}$ in. round by 3$\frac{3}{4}$ in.
Neck-yoke stop	8	Forged steel, 1$\frac{1}{2}$ in. round by 6 in.
Neck-yoke counter stop	7	Forged steel, $\frac{3}{4}$x1$\frac{1}{2}$x3.2 in.
Neck-yoke counter-stop spring	1	Music wire, 0.0808x12$\frac{3}{8}$ in.
Neck-yoke counter-stop pin	2	Cold-rolled steel, 0.305x3 in.
Pole plug	2	Bronze casting
Hand rail	5	Seamless steel tube, 0.745 in. inside diameter, $\frac{7}{8}$ in. outside diameter by 35$\frac{1}{4}$ in.
Hand-rail forward bracket, right and left	9	Forged steel, 1x1$\frac{1}{2}$x4$\frac{1}{2}$ in.
Door-chain fastener	3	Flanged steel, $\frac{3}{16}$x1$\frac{1}{2}$x2$\frac{5}{16}$ in.
Hand-rail rear brackets, right and left	8	Forged steel, 1$\frac{3}{4}$ in. round by 8 in. = 2 pieces
Axle	20	Forged steel
Oil-valve spring	2	Music wire, 0.0483x12$\frac{1}{2}$ in.
Oil valve	4	Half-hard brass rod, 1$\frac{1}{8}$x2$\frac{1}{2}$ in.
Oil-valve washer	1	Half-hard seamless tube, $\frac{5}{8}$ in. inside diameter, $\frac{3}{4}$ in. outside diameter by $\frac{3}{16}$ in.
$\frac{1}{8}$-In. bronze rivet	1	Half-hard brass rod, $\frac{3}{16}$x$\frac{1}{2}$ in.
56-In. wheel complete	15	Includes paint, tire, etc.
Hub box complete	9	Forged steel, 3$\frac{1}{2}$ in. round by 18$\frac{1}{4}$ in.
Hub liner	4	Bronze casting
Hub band	9	Forged steel, 2$\frac{1}{2}$ in. round by 2 in.
Hub ring	9	Forged steel, 4$\frac{1}{2}$ in. round by 8$\frac{1}{4}$ in.
Lock washer	5	Spring steel, $\frac{3}{16}$x0.4x11 in.
Wheel fastening	9	Bronze casting
Hub cap	12	Bronze casting
Hub latch	9	Forged steel, $\frac{1}{2}$x$\frac{1}{2}$x2 in.
Hub-latch spring	3	Music wire, 0.048x24 in.
Hub-latch plunger	4	Cold-rolled steel, 0.375x2$\frac{1}{4}$ in.
Wheel-fastening plunger	1	Cold-rolled steel, $\frac{3}{8}$ in. round by 1$\frac{1}{4}$ in.
Wheel-fastening spring	2	Music wire, 0.036x12 in.
Plug	3	Half-hard brass rod, $\frac{7}{8}$ in. round by $\frac{5}{8}$ in.
Dowel	2	Flange steel, $\frac{1}{8}$x1$\frac{3}{4}$x1$\frac{3}{4}$ in.
Nozzle	5	Bronze casting
Head oil can	3	Bronze casting
Bottom (3-in. tubular oil can)	4	Bronze casting
Pole-prop outside reinforce	4	Flange steel, $\frac{1}{16}$x5$\frac{1}{16}$x6$\frac{5}{8}$ in.
Outside leg	4	Flange steel, $\frac{1}{16}$x4$\frac{3}{4}$x33 in.
Pole-prop bolt	3	Forged steel, 1 in. round by 2$\frac{1}{16}$ in.
Inside leg	4	Flange steel, $\frac{1}{16}$x4$\frac{5}{8}$x33 in.
Inside reinforce	4	Flange steel, $\frac{1}{16}$x3$\frac{3}{4}$x6$\frac{1}{4}$ in.
Plug body	8	Forged steel, $\frac{1}{2}$x$\frac{3}{4}$x1$\frac{1}{2}$ in.
Clasp	6	Spring steel, $\frac{5}{8}$ in. round by 2 in.
Plug screw	1	Cold-rolled steel, $\frac{3}{4}$ in. round by 1 in.
End eye sleeve	6	Forged steel, 1$\frac{3}{4}$x2$\frac{1}{4}$x2$\frac{1}{4}$ in.
Eye ring loop	4	Forged steel, 1$\frac{1}{2}$ in. round by 4$\frac{1}{4}$ in.
Loop sleeve	3	Flange steel, $\frac{1}{16}$x1$\frac{3}{4}$x1$\frac{23}{32}$ in.
Martingale staple	4	Forged steel, $\frac{1}{2}$ in. round by 7$\frac{3}{8}$ in.
Neck yoke	1	Seamless steel tubing
Single-tree hook	6	Forged steel, $\frac{3}{8}$x$\frac{7}{8}$x2.6 in.
Single-tree eye	4	Forged steel, $\frac{3}{4}$x3x4 in.
Single-tree body	6	Flange steel, $\frac{3}{32}$x5$\frac{1}{4}$x32 in.
Total	866	

Reference to Fig. 4 shows a radius at the bottom of the hognosed hole. This is secured by the use of the tool *C*, Fig. 3. The operator forces the cutting tools out by turning the nut *D*. After this operation, the three spots *A*, Fig. 1, are turned true with the hognosed hole and serve to locate and hold the axle for the final operations after closing in at the forge. The pieces are next forged, or closed in at both ends until they assume the shape *B*, Fig. 1. Gages are used to get the shape of the inside. After forging, they are measured for length with a gage and the ends cut off. The resulting piece of scrap is stenciled to correspond with the axle from which it was removed, and is heat-treated and given a physical test. If this test piece fails, the axle is given another heat-treatment.

TABLE II. AXLE MACHINING OPERATIONS

Operation
1 Center and turn for drilling and hognosing.
2 Drill and hognose.
3 Turn spots on center and ends true with hognosed hole.
4 Finish radius in hognosed hole and stencil identification number.
5 Forge and bend ends for turning axle arms on axis A.
6 Lay out for cutting ends to length.
7 Saw off ends and stencil test piece.
8 Give heat-treatment.
9 Center ends from spots turned on body.
10 Turn as per drawing No. 201,374-B and stencil T for top, for milling keyways.
11 Mill keyways and tool clearance for turning.
12 Finish turn 4.1175-in. dimensions.
13 Finish file portion that receives axle bracket.
14 Bore, turn and face axle arms on axis A.
15 Mill slots for wheel fastenings.
16 Mill 37-deg., 30-min. angle on wheel-fastening slots.
17 Finish file wheel-fastening slots.
18 Drill radii on keys.
19 Remove burrs and finish for inspection. If test piece does not stand up to physical test, the axle is reheat-treated.

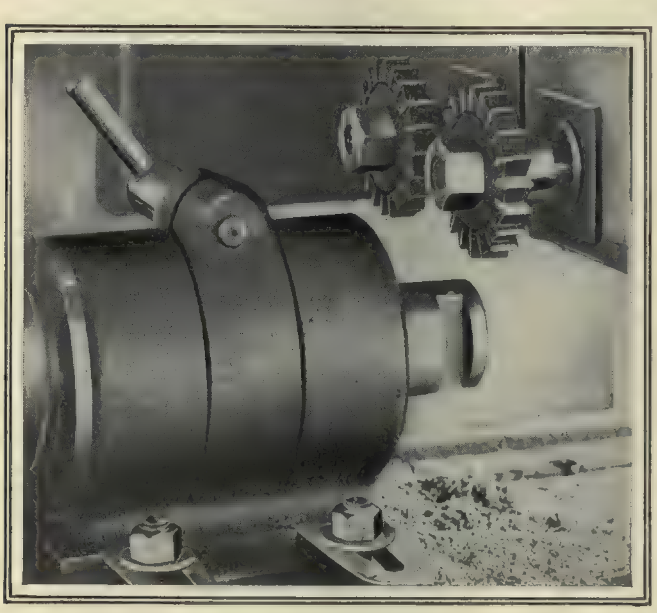


FIG. 6. MILLING THE ARMS

After this forging operation the pieces are again taken to the lathe department and the ends centered for turning. The bushing *A*, Fig. 5, which fits the tailstock quill and is the same diameter as the turned spots on the axle, is used to set and locate the steady-rest for this last operation. The body of the axle is now turned, and stenciled T to indicate the top side of the axle. This is obtained from the bend of the axle arms and is used for locating the keys. The keys are next milled, as shown at *DD*, Fig. 1, to receive the axle bracket. It will be noticed that these keys are an integral part of the axle, and not "set in," as is the general practice in ordinary machine work. In milling these keys a cutter is used wide enough to clear the turning tool used in the next operation. The portion of the axle next to the keys is turned with the use of a backing-off attachment on the lathe, and the rest of the turned portion brought down to size.

They are next placed in the fixture shown in Fig. 5. Locating from the key *B* and the spots already turned, the arms are finish turned and bored on axis *A*, Fig. 4. The arms are finished to a taper gage in this operation and are then milled to take the wheel fastenings, with the double cutter head shown in Fig. 6. Fig. 7 is a view of the back of this fixture with the case removed to show the arrangement of gearing used to drive the cutters. The part of the fixture that holds the axle arm is bored to fit the taper of the arm and is clamped by eccentric rings operated by handles on the opposite side from that shown in the illustration. The other operations on the route sheet do not require description.

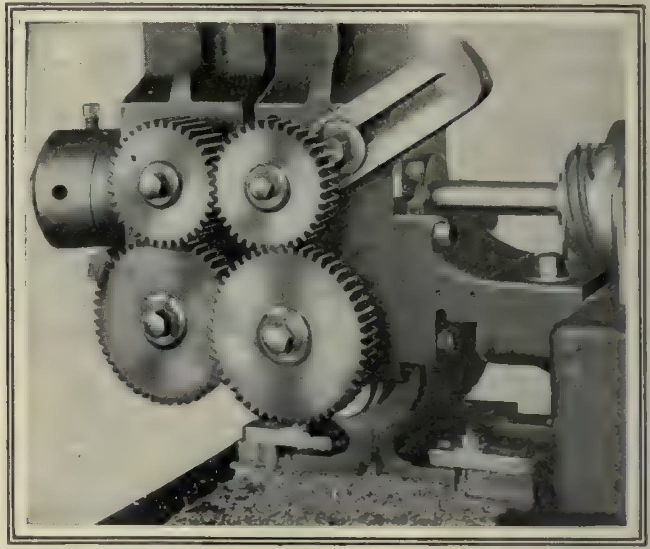
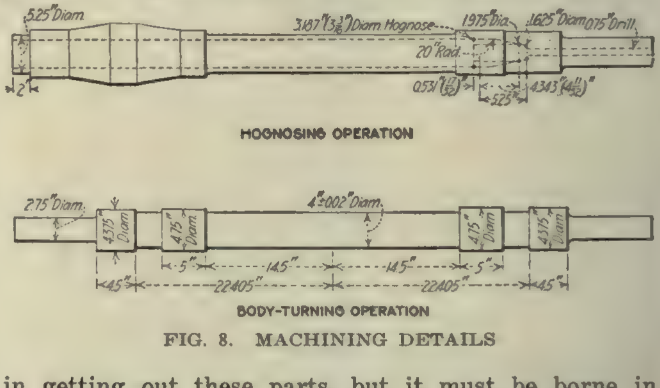


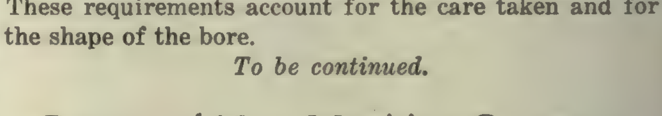
FIG. 7. GEARING OF THE MILLING HEAD

To those not familiar with this line of work, it may seem that a great deal of unnecessary care is expended in getting out these parts, but it must be borne in mind that they will be called upon to stand the most severe usage and that they must be as light as possible. These requirements account for the care taken and for the shape of the bore.

To be continued.



HOGNOSING OPERATION



BODY-TURNING OPERATION

FIG. 8. MACHINING DETAILS

Report of New Munition Contracts

The Imperial Munitions Board at Ottawa recently announced that no more orders for the larger sizes of shells would be given out in Canada. A number of plants engaged in the manufacture of 8-in. and 9.2-in. shells were consequently closed down. It is now announced that large orders will be placed for 6-in. shells.

Series for Executives

The Executive as a Tool Designer vs. The Professional Tool Designer

BY DONALD BAKER

The author of this very interesting article argues in favor of the practical professional tool designer, who makes a specialty of this class of work, and is against the idea of an executive assuming active direction of such work.

AND how often do we see a busy executive acting, or trying to act the double role of executive and tool designer? He may have some natural ability along this line, or he may not, but in either case it may be presumed that it is either through a natural desire to express himself, and to see his ideas carried out, or through a mistaken idea of saving the cost of a more expensive man as head of the drafting department. Whatever the idea, it is costly and expensive.

In a number of instances that have come to the attention of the writer the drafting force has been made up of little more than school boys; one of whom, given the name of chief, may or may not be a little more intelligent than the others, but who has not the practical experience necessary to distinguish between efficient and inefficient practice.

The result is that the executive gets an idea into his head; gives it to the chief in the form of a sketch, or possibly only verbally, the chief turns it over to one of his men to work up; and the design is made, usually with little or no criticism, as it is considered to be an order from the boss. After the drawings are in shape the executive is called upon to look them over. Possibly at a glance everything appears to be satisfactory, and as he has not had the time nor the opportunity that the professional designer would have had to study out the proposition and an absolutely worthless, or at the best a very inefficient design is oftentimes approved and goes through, and after hundreds of dollars have been spent, is scrapped. Sometimes this is done without even having a tryout, as by the time it has reached this stage, someone, probably the mechanic who was called upon to install it, has pointed out what, to a skilled man, is an obvious defect.

In the foregoing lies the crux of the whole situation. The executive, although he may be or has been a very good mechanic, is altogether too busy a man to devote his time to the minute detail required for the proper design of tools. His mind is occupied by many other matters of an altogether different nature, and so the results mentioned are no more than might be expected.

And not only this, but in cases where the drafting force consists of several men the actual cost of the drawings will far exceed the cost of those made where the drawing room is watched over and directed by a competent tool designer. The extra cost, if saved would more than pay for such a man, both through a reduction in the force needed to handle the work, and the added speed in getting out properly supervised and checked drawings.

While I could give from actual experience hundreds of illustrations to bear out the foregoing, the few following are typical instances:

ON A certain operation in which a million pieces were involved the executive designer, while knowing the proper place from which the piece should have been located for the first operation, decided, that because he could not design a chuck which would hold from that particular point that it was an impossibility, and so had a chuck made to hold from a point that made the operation uncertain, and a great many of the pieces did not clean up on the following operations. Another trouble was that on the following operations, it was necessary to use chucks which required that the pieces be screwed on and off by hand, thus making a very slow operation of the job.

A professional tool designer called in later saw the solution at once and designed a chuck, which would hold the pieces properly for the first operation, from which they could be carried along on the following operations by expansion chucks, cutting the chucking time more than half. However, in order to use this chuck it practically meant the scrapping or changing of all tools on the following operations, a matter running into thousands of dollars. Had this been attended to in the first place, the saving in handling time alone would have been enough to pay a competent tool designer's salary for several years, to say nothing of the saving in parts that are now thrown into the scrap pile because they will not finish up.

Another case: A company purchased two expensive special automatic machines for producing a certain small part. These machines were fitted up with the necessary fixtures by the manufacturers and were supposed to be the most up-to-date machines on the market for the work. They were delivered and given a trial but were found to be both slow and inaccurate, it being necessary to hold the work to very close limits. The defects were readily apparent to the designer who was called in later, and both machines were replaced by a little machine designed and built in the factory toolroom at a cost of less than two hundred dollars, thereby scrapping upward of five thousand dollars worth of a class of machine that would be almost impossible to dispose of for much more than its scrap value. The new machine produced better than 99 per cent. perfect parts, and one operator was done away with.

RIGHT in this same shop, ten semi-automatic machines that had been designed for special work and which had cost upward of twenty thousand dollars had never exceeded a production of five hundred parts per day per machine. These were replaced by making changes which converted three of them into simple hand-operated machines and raised production to two thousand parts per day per machine. The balance of the machines in this case were not an entire loss, as they also were converted into machines for another operation which had previously been done on a type of machine which was too weak and inefficient for the job. I may add that the only parts of the machines that were used were the frame and legs, new spindles, cross slides, etc., being added, making them into what was nothing more than powerful hand screw machines which would have been the logical thing to have purchased in the first place and would have cost much less.

In another instance an entire layout of tools worked up between a non-practical chief draftsman and his superintendent, and which were intended to produce five hundred thousand each of the five major parts of a time fuse, were found so little adapted to the work for which they were intended that when a practical man was placed in charge of the designing department, almost the entire small-tool equipment was scrapped, entailing a loss somewhere around fifty thousand dollars, as most of the tools that had been originally intended for the work had either been made or were in the process of construction in outside shops. All, or nearly all, of this loss might have been avoided had an experienced man been put in charge of the designing department in the first place and the superintendent devoted his time to his proper sphere of duties in the organizing and managing of the plant.

THOUGH the salary paid a competent man amounted to as much as ten thousand dollars, for the six or eight months that it might have taken him to get the tools out, he would have been a very cheap investment under these circumstances. As a matter of fact, the loss in money spent for tools that were scrapped was actually the smaller item involved, for these tools not only held up production, but caused the scrapping of thousands of dollars worth of material, which had been made into defective parts. The labor that was spent on this material was also a dead loss. It would be very hard to give an actual figure of the real loss which originated in the drafting room.

As circumstances like these, sometimes smaller and sometimes larger, have so often come up in my experience it seems to me that it should be called to the attention of the men higher up, the men who in the end are held responsible for the success or failure of an organization. Even let it be made common knowledge of the layman, the man who holds stock in the company and fills a seat on the board of directors. With this knowledge they will not be so apt to quibble over the salaries paid to their drafting force, nor will they be so apt to look upon them as non-producers as at present. On the contrary they will learn that upon their designers hinges their whole production system, and well-oiled hinges, while they do not proclaim themselves in the loud voice of their rusty brothers, produce the goods just the same.

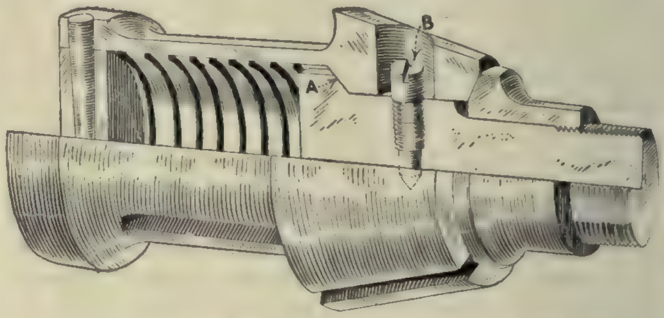
Spring Chuck for Second-Operations

By Raymond Grant

The illustration shows a chuck for holding tapped work for the second operation. I have used this chuck for several years on many jobs. Once the chuck is made, any new job up to its capacity may be handled by making an arbor and collar to suit it.

The chuck bore should be made as large as the machine will allow. This will usually be about $\frac{3}{16}$ to $\frac{1}{4}$ in. smaller than the back, or clearance, bore of the regular chucks on machines from $\frac{3}{4}$- to $1\frac{1}{2}$-in. capacity.

There is a shoulder, as at *A*. This is made 45 deg., and the front end of the chuck is bored to the same angle. The collar on the back of the arbor fits the 45-deg. face inside the chuck, while the slip collar fits the outside, and the other end of the arbor is threaded to suit the work. The screw pin *B* is a loose fit in a slot in the chuck and serves to keep the arbor from being pushed back out of reach when the chuck is open.



SPRING CHUCK FOR SECOND-OPERATION WORK

In use, the chuck (with the arbor and collar in place) is closed as with any chuck, and a piece of work is screwed onto the arbor until it seats against the collar. When the operation is completed and the chuck is released, it will be found that the work is loose and can be unscrewed by reversing the spindle.

It is well when hardening one of these chucks to open it up rather more than the ordinary chuck, for the more spring there is to it radially the more axial movement the arbor will have.

It would seem that such an arrangement would give trouble by slipping inside the nosepiece when unscrewing work, but I have never known this to happen; and the pin *B* prevents the arbor from turning in the chuck.

British Workshops and the War

Extracts from the Report of the Rt. Hon. Christopher Addison, of the British Ministry of Munitions

The author gives an official résumé of the accomplishments of English workshops in connection with war activities has recently been issued by T. Fisher Unwin, Ltd., of London. It is based upon the speech delivered by Mr. Addison in the House of Commons on June 28, 1917. Extracts from this report, which will be of interest to those in the machinery and metalworking trade, are herewith reproduced.

THE great new national factories for shell and fuse production have come into their full bearing during the past year, and we have been able also to reap the fruits of the work of the Boards of Management which were established throughout the country in accordance with the scheme of organization designed in the early days of the Ministry. These boards direct the operations of local coöperative groups as well as of a number of factories which are described as national shell factories, and they superintend the execution of an infinite number of local contracts. They are responsible in fact for about a quarter of our total shell output, and we are indebted to them for many valuable suggestions resulting in improvements and economies in the manufacture of different munitions.

The variety of the productions of gun-ammunition supply is only paralleled by the volume and improving quality of their output. The great national projectile factories for the production of the heavier natures of shell have been in full operation during this year and produced in March exactly one-third of the total output of these heavy natures of shells.

Some impression can be obtained of the diverse processes for which this department is responsible by considering for a moment the manufacture of a single round of ammunition. Apart from the more obvious constituents, it is necessary to obtain and work up emery stone, cryolite, calcium carbide, magnesite, wolfram ore, acetone, carborundum, nickel, bauxite, nitrates, oil, cotton, antimony and many other items from different countries. Forgings and castings must be supplied here and there, brass rod and stampings, an infinity of machining operations must be done, along with the superintendence of equipments, the ordering of the machinery, the manufacture, distribution and supply and use of hundreds of gages, the assembling of ingredients from different works in appropriate centers, the calculation of the raw material, the arrangements for transport, and so forth, making up such a multitude of operations per week that they present collectively manufacturing and other problems of the greatest magnitude, as regards organization, production and direction.

It all runs so smoothly now, the supplies and processes of one department operating with those of another, that the country is scarcely aware that it is going on. It is a result which could only have been secured by the hearty coöperation of carefully picked staffs at headquarters, of engineers, manufacturers, inspectors, transport officers and others in the different districts, assisted by the good will and patriotic and continued devotion of business men and workpeople from one end of the country to the other. Recently we reached such a state of production that we have been able to divert certain of our national factories, in whole or in part, to assisting other sections of the munitions program.

STRUGGLE AND VICTORY

These results have not been easy of attainment. We have had to get ammunition in enormous quantities, working with a new explosive mixture, training gagemakers and other operatives, building factories and making machinery all at the same time. I remember how when first one difficulty cropped up and then another, even the sanguine temper of the Prime Minister sometimes showed signs of wear. There were endless difficulties over obtaining an efficient detonator, difficulties over gages and, above all, over the different types of fuses, with a perpetual struggle against "duds" on the one hand and "prematures" on the other. It seemed sometimes as though we fought our way through one difficulty only in order to discover another. It was like a man climbing a mountain, conquering with joy and expectation the peak in front of him, only to find another and a more difficult one before him. But our work has not been fruitless, and our soldiers on the ridges of Vimy and Messines can now see the plain beyond.

Many of our filling factories, like the shell factories, are worked by voluntary Boards of Management, and, in this way, we are able to make full use of the services of many able men in each district. And here I would like to refer to the ingenuity and boldness of resource shown by Lord Chetwynd in the management of his great filling factory. It is to him that our army in the field owed a great proportion of its earlier supplies of heavy ammunition. The national filling factories, employing about 100,000 persons, now fill about 85 per cent. of the shell ammunition. The cost of filling has been reduced by 40 per cent. as compared with a year ago. As the work has grown, it has necessarily cast an increasing burden upon the Inspection Department. In July, 1915, the staff of the department consisted of 8761 persons. It now consists in this country of nearly 40,000, with an additional staff in the United States of America of more than 8000. We have sought to employ women in every possible way. In March, 1916, they composed 28 per cent. of the staff; they now compose 61 per cent., numbering 29,000, and they are employed on almost all operations except those in which special technical experience or physical strength is required. The work of inspection, I am afraid, is often very tedious and monotonous. When we remember that there are no fewer than 183,000,000 separate gaging operations for every million rounds of 18-pounder shell—which is no great quantity nowadays—we get some glimpse of its monotony.

WOMEN WORKERS IN A BRITISH SHELL FACTORY
Scene in a shell-filling factory in England covering 9½ acres.

Inspection is necessarily very closely associated with design. This, too, has undergone substantial development. During the last 12 months, many of the former prolonged experiments and tedious trials have come to fruition, and the perfection of our present ammunition is due to the increased expertness and careful collaboration of the staffs of the Design, Inspection, Supply and Filling Departments, as well as to the growing expert experience of those concerned with manufacture. During the battle of the Somme, we were constantly receiving reports both from our own side and through prisoners that we were still firing a considerable number of rounds of ammunition—not a high proportion, of course, but still many in the aggregate—which failed to explode, or which burst prematurely. The increase in the quantity of the ammunition supply has happily coincided with the improvement in its quality, and we have lately received enthusiastic reports from Sir Douglas Haig on the accuracy and on the fine detonating quality of the ammunition supplied, whether used for wire cutting, barrage or for any other purpose. About a year ago the premature bursts of shells were at least 10 times as frequent as they have been during the recent offensive, and the damage accordingly to our guns from this cause has become almost negligible.

The Gun Supply Department during the past year has had thrown upon it one of the most difficult tasks assigned to the Ministry. The plant required is so large and so extensive and, in some respects, the degree of skill required is so high that the factors limiting output are specially difficult to overcome. It is well known, also, that guns of British manufacture are to be found both on the Russian and on the Italian fronts. Demands for guns for anti-aircraft purposes and for the arming of merchant ships have placed a particularly heavy strain upon our capacity for producing long-range guns for use in the field. With the increase in the number of guns in the field, also the work involved in making good wear and tear and in providing for repairs has grown in proportion.

Our output of machine guns and rifles has been fully equal to the demands made upon us for these arms. The output at Enfield has increased tenfold, and our capacity for the production of machine guns weekly is more than 20 times greater than it was two years ago. Some months ago, also, our output of small-arms ammunition became so abundant that we ceased to require any assistance whatever from outside this country.

Let me here pay a tribute to our great arsenal at Woolwich, to which we are indebted for almost all kinds of munitions and for the performance of work of the most highly specialized and skilled kind, including the preparation of drawings, specifications and the working out of the details of the new types in which such great advances have been made during the past year. In August, 1914, the staff consisted of 10,866 persons; now it amounts to 73,571. The number of women employed in 1914 was 125; now it is close on 25,000. Many new shops have had to be built and equipped, and 31 canteens have been provided to assist in the provisioning of the workers, many of whom have to come from considerable distances, although we have undertaken extensive housing work in the neighborhood.

THE GREAT PROVIDER

The Machine-Tool Department, under Mr. Herbert and his Advisory Committee, is the servant of all and makes special demands on skilled labor. Every variety of machine, from the smallest tool or lathe to the mightiest crane, is provided by this department. In order somewhat to relieve the pressure upon it, we recently established a machine-tool clearing house under the superintendence of Sir J. Stevenson and Captain Kelly, by which we investigate and examine idle and insufficiently used machinery and try to divert it to a better use. During the past seven months this branch has investigated 22,027 applications and succeeded in releasing 42,638 machines. roughly valued at £3,129,000.

Agricultural-implement supply became one of our duties in the late autumn, and Mr. Edge, who is in charge, has the assistance of a small committee of agricultural-implement makers who responded to our request for assistance with the same readiness that has always been accorded whenever we have asked business men to come to our help. Most of the large agricultural-implement makers had previously become considerable suppliers of munitions, and extensive rearrangements of work have been rendered necessary in order to meet the large program put forward by the Food Production Department.

SCRAP COLLECTING AND SALVAGE

Priority is one method of effecting economy in the use of metals. Further help has been given by the institution of a system of scrap collecting and distribution. This is now getting into working order throughout the country, and it should lead to an extensive cleaning up of the masses of scrap of all kinds which may still be seen in some places and in various munition works.

With a view also to rendering further assistance in this direction, we have established an extensive Salvage Department which works in coöperation with the armies at the front for the salvage, reshipping to this country, reforming and reissue of a large number of parts of munitions. We are now able to reform hundreds of thousands of 18-pounder cartridge cases. When it is remembered that the price of a new case is about 7s., that it can be reformed four times and that we are reforming cases at the cost of 4d. a case, the importance of this branch of work is obvious.

As another contribution toward the saving of metals, an expert committee, working in conjunction with the Designs Department, is now charged with the duty of making recommendation for economizing the use of the more expensive metals. Largely through the efforts of this committee we are securing a reduction in the amount of copper used in copper bands, amounting to a saving of many thousands of tons of copper in a year; and less expensive metals are now being brought into use as constituents of various fuses and other shell components.

Many useful suggestions in the direction of economy and for the utilization of cheaper materials have been received from the Munitions Inventions Department. There is still a steady stream of suggestions, and more than 6000 have been reported on since the beginning of the present year. Many valuable contributions have been made over a wide field, varying from improvements in scientific instruments and modifications in defensive and offensive apparatus to economies in the use and treatment of fuel. In 65 cases special rewards have been made to employees of firms for useful suggestions.

WOMEN'S WORK AND MOBILE LABOR

If we have regard to the upheaval it has involved in industrial methods, we may claim, I think, that the widespread employment of women in munition work has been attended with singularly little difficulty. From 60 per cent. to 80 per cent. of the machine work on shells, fuses and trench warfare supplies is now performed by women. They have been trained in airplane manufacture, in gun work and in almost every other branch of manufacture. It would have been quite impossible to meet the demands by any of the available mobile labor without training others and bringing into operation a large body of labor previously inexperienced. This necessity has cast a large burden upon the training section of the Ministry, which has operated to supplement the training which goes on in the works. More than 60 technical schools and colleges in Great Britain are used in this work. We have trained more than 32,000 workers in these places. There are also five special industrial factories engaged in training. Nearly 8000 people trained in specially difficult processes have been placed in employment this year, and we have contributed 1450 trained mechanics to the Royal Flying Corps.

Three other sections of the Ministry have been in constant operation to supplement that which is done either by dilution or training. There are 38,000 skilled workpeople employed away from their homes as war-munitions volunteers, and I cannot pay too high a tribute to the loyal manner in which they have observed their undertakings and been willing to move as the urgency of one part of the munition program may have acquired priority over that of another. There are also over 40,000 soldiers who have been released from the colors and have similarly placed themselves at the disposal of the Ministry. In addition, more than 30,000 army reserve munitions workers have been placed on work of construction in the steel trade and elsewhere as needed.

From Jack to Bill—Dodging the Draft

Deer Bill—Ever sense I dissided not to inlist Ive bin wurryin sum for feer of thair draftin ov me but now Ive gut it fiksd so I do bleev Ime safe. I thort shure Ide hav to bee rejisterd but you no my bruther well hes thurtyfore so he aint rejisterd none and beside hes in the navey. Well Bill his naim is I. L. and furstoff I thort as no one hear noes mutch abowt me and thayll no less in Misshergun Ile chainj my frunt naim to Nate like whut his frunt naim is Bill but then I sawr how mutch the I on his burth sifficit looks like a J so I maiks it look moar so and it stans for Jack awl OK. and now I aint afrade of beein drafteded for I aint evn rejisterd Bill. And Ime mitey glad I dident inlist for Ive hurd tawk that thair aint to be no penshuns afftur this wawr like aftur the uthers and wy shood I go to Frans and bee shot ded if I cant have no penshun to liv on afterwoods, and how wood I feal ovr in Frans bein shot at with Obus and Boyaux and Poilus and awl them things and no penshun acomin?

I think my bruther must be apreshated in the navey and as Joena sed to the whail you cant keep a good man down, for hes bin maid a kine of offsur. Hes asistent water tendur I dono just whut he has to doo but Ile tel you Bill whut I think. You no wen we sawr that big steemer in N.York and watur porin out of a paip in the side part of her well Bill I think hes one of the men to tel em to start that agoing wen they fines thare isent but only scarse enuf water to flote the ship. Pritty risponserbul job that and I gess he must pul down a good sallery but proberly not no sutch as Ile git in that shop in Misshergun ware they awl gits 5$ dolers a day.

THE WAWR IS HARDIEST ON THE WIMMIN.

It seams to me one of the wurst feechers of this wawr is the exchainjin of priznurs. It mite wurk awl rite in sum caisis but how wood you feal if you was a priznur and thay exchainjd you for sum man wat proberly yure wife she mitent like not one ½ as wel as wat she does you Bill. Its just like the paypur says the wawr is hardist on the wimmin.

Well Bill I gut a tiperiter gurl to rite to Misshergun that Ime reddy to acsept a posishn thare and she dun it to the Qeens taist for 50 sents and I shoed it to the bos and he says your midl naim begins with L. does it Jack? I shood think A. wood be moar aproprit. and he laffed but I doant see no joak in that. You no L. is my new midl naim Bill.

From yure frend

JACK.

PS—Bill I toled the bos Id hav to leev soon and he says keap rite on til you gits sent for you may be a long taim on the watin list does he think Ime going to wurk in a resterrent. But he says weel be glad to let you go without yure wurkin no notis so I gess hes sory to hav a good mecannik leev and tryin to be acomodatin.

Folding Rack for Blueprints

By Robert M. Jones

In shops making a standard line of work, blueprints do not need to be taken to the machine, but must be readily accessible for reference. A convenient method of keeping them is in a folio, bound at the top and hung on the wall out of the way, offering little space for dust and dirt to collect. However, as it is handier to have the prints in a horizontal position when in use, the stand illustrated was made.

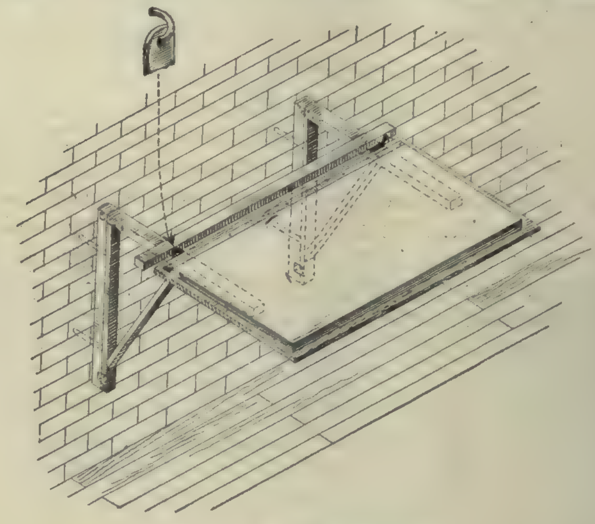


FIG. 1. RACK EXTENDED

It consists of two braces hinged to two pieces fastened to the wall. A tie-bar is loosely bolted to the braces far enough from the wall to provide the necessary room to allow prints to be folded back on the braces. The top of the folio, which has a stiff board back, is hinged to the tie-bar.

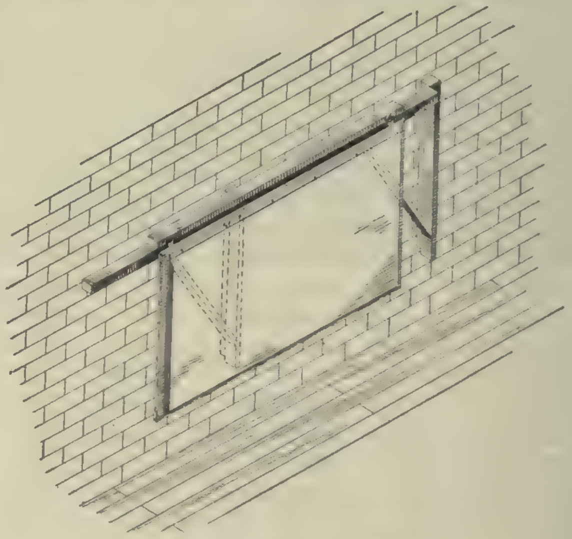
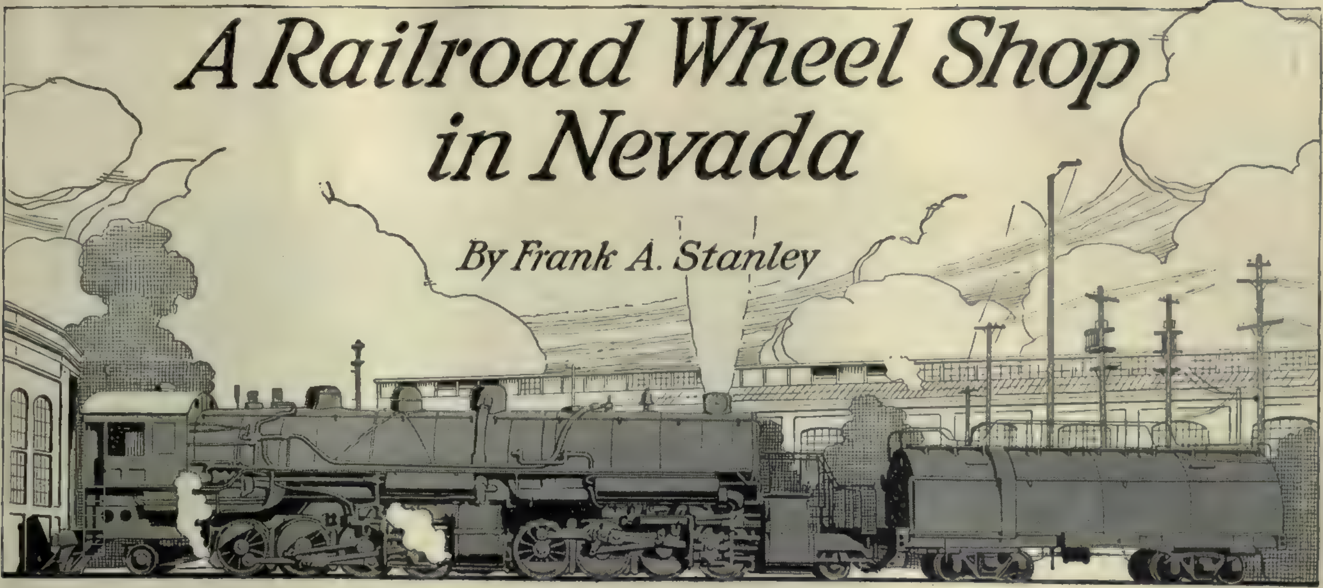


FIG. 2. RACK CLOSED

To extend the folio board, it is lifted to a horizontal position and moved to the right until the supporting braces come underneath it. To close, the folio is moved to the left until the braces come under the tie-bar; then it is allowed to fall. This makes a simple, inexpensive stand easily put in position (it may be worked with one hand); and when not in use, it is out of the way against the wall.

A Railroad Wheel Shop in Nevada

By Frank A. Stanley



Operations including the boring and turning of wheels and the fitting up of axles for locomotives and cars are operations always worth looking into when one visits a railway repair shop. This is quite as true of the wheel department of the Southern Pacific division shops at Sparks, Nev., as of other important plants of similar character.

THE railroad shops at Sparks overhaul and take care of both standard-gage and narrow-gage rolling stock, and the accompanying illustrations illustrate material of both kinds passing through the wheel shop. A number of the work-handling methods are of interest.

One item of interest is the boring of steel wheels in this department. It is customary here in boring such wheels to feed the tool at a rate of 1/16 in. per revolution of work and to take a cut ¼ in. deep. The cutting speed is about 37 ft. per min. The material used for the boring cutters is Mushet self-hardening steel.

Across the room from the wheel borers is the axle-turning equipment, the lathe being fitted with a jib hoist, motor drive, etc. The most interesting feature connected with this operation is the finishing tool, Fig. 1, which instead of being a cutting appliance sizes the journal and gives it a perfectly smooth true surface by means of a burnishing roll carried in the fork at the front end of the toolholder. The roller is about 3 in. in diameter by 1-in. face, and its work is to roll down and burnish about 1/64 in. of material on the over-all diameter in bringing the journal to size and to smooth finish.

The turning operation preceding the application of the roll is conducted at a peripheral velocity of work of 33 ft. per min. The rough-turning cut is taken at a depth in cut of ⅜ in. and a feed of 1/16 in. per revolution. The finish-turning cut is 1/32 in. deep, the feed the same as for the rough cut. Then the burnisher is applied for the removal of the final 1/64 in. to size the journal.

The burnishing tool leaves the journal with a perfectly true, highly polished surface. The surface to be finished is thoroughly oiled before applying the roller, and the work is rotated at about 48 ft. per min. The feed of the roller is approximately ⅛ in. per revolution of work.

It may be of interest at this point to consider briefly some dimensions and weights of the common types of car axles handled at this plant. Referring first to standard-gage work, the three common classes of axles are for 30-ton, 40-ton and 50-ton cars, the lightest of the three being used for freight-cars and tenders both, the intermediate for both passenger cars and freight-cars, and the heaviest for both classes of cars and for tenders. The axle for 30-ton equipment has 4⅛ x 8-in. journals, and its nominal weight in the rough is 504 lb., though according to the specifications the weight may range from 494 to 514 lb. The axle finished weighs 463 lb., so that approximately 40 lb. of metal is removed on an average in the machining process.

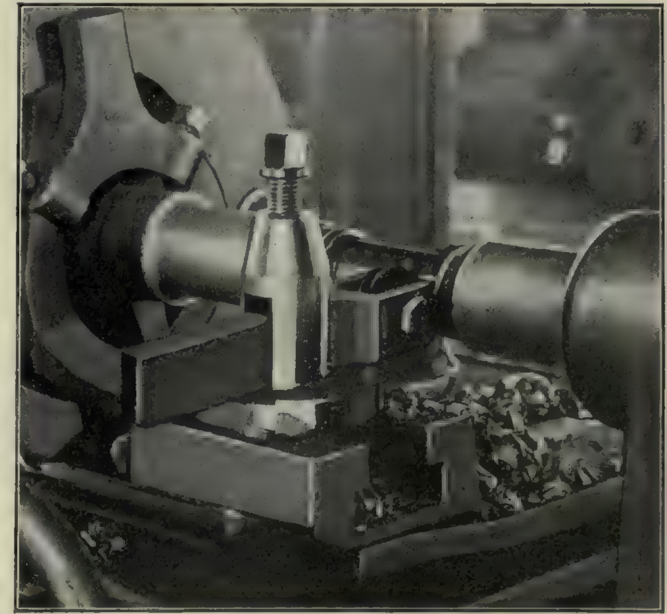


FIG. 1. BURNISHING TOOL USED FOR FINISHING AXLES

The 40-ton axle has journals 5 x 9 in. and weighs finished 657 lb. The nominal weight in the rough is 670 lb., the minimum and maximum figures for allowable weights in the rough being 658 and 682 lb. respectively. The 50-ton car axle has journal dimensions of 5½ x 10 in. and when turned ready for its wheels weighs 775 lb. This axle has a range in weight in the rough from 788 to 820 lb., and the mean of this is of course 804 lb., so that practically the same amount of metal is removed in finishing it as in the case of the 30-ton, or light, axle. The allowance in pressures used in pressing the fits for such work is 10 tons for each inch of diameter, so that for the axles specified the total pressure in mounting the wheels is approximately 50, 60 and 75 tons. The method of driving and turning wheels is shown by Fig. 2, where flange and tread are represented as undergoing the forming cuts that bring them to the templet by which the profile is gaged. In roughing down these steel wheels preparatory to the application of the forming tool, the work is driven at a circumferential speed of about 13 ft. per min., and the tool under a cut ¼ in. deep is fed at the rate of $\frac{3}{16}$ in. per revolution. In finishing the tread and flange with the forming tools the peripheral speed is cut down to about 9 ft. per min. Approximately $\frac{1}{16}$ in. of stock is left by the turning tool for the finishing process under the action of the forming tools. Both turning tools and forming tools are made up from Mushet steel.

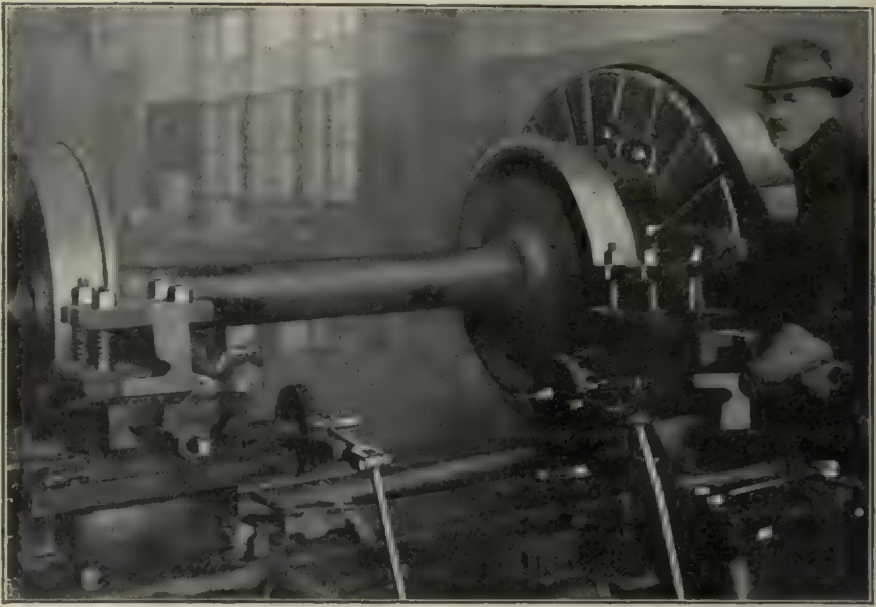


FIG. 2. FORMING THE WHEEL TREAD WITH FORM TOOL AND TEMPLET

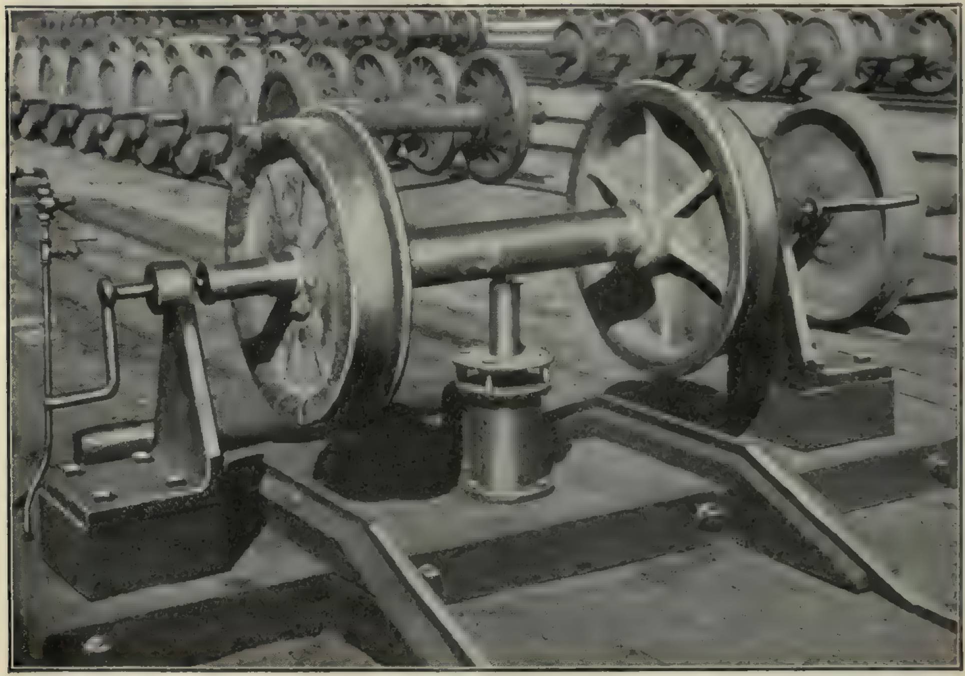


FIG. 3. MACHINE FOR TESTING THE TRUTH OF NARROW-GAGE AXLES

The forming tools are in two shapes: One, with a plain beveled edge to conform to the slightly conical or angular tread face of the wheel; the other, with an additional portion to include the flange and thus cover the entire face of the work. The latter tool is shown removed from its holder and resting in upright position on the cross-slide of the left-hand lathe carriage. The templet for gaging the flange and tread may be seen just to the left of the large forming tool.

This type of forming tool is used for various classes of wheel work, including drivers, steel-tired and steel truck wheels and so on. It is 1½ in. thick and 3 in. deep from cutting edge to back, where it rests against a locating ledge on the toolholder. The toolholder itself is 2 x 3 in. or even larger in section, and the tool proper is secured to it by a pair of ¾-in. screws, the holes for which are plainly visible in the illustration. The surface area along the curved, formed outline of the cutting edge of the tool is enough higher than the remainder of the top surface to permit the tool to be sharpened readily by grinding across the narrow ledge without the entire top face having to be ground off under the wheel. Narrow-gage axles are of course much lighter than those for standard equipment; and while this fact is taken into consideration in handling them and while correspondingly reduced allowances are permitted in making up wheel and axle fits, nevertheless there is a somewhat greater tendency for the narrow-gage axles to be sprung in the wheel-mounting process. This condition has led to the construction of a testing machine for such axles, and the machine, located immediately outside the wheel shop, is shown in the illustration, Fig. 3.

It consists of a pair of centers carried by suitable angle plates mounted on a base that receives a short section of narrow-gage tracks up which the wheels and axle are rolled for placing between centers to test for running truth. At the middle of the apparatus—that is, midway between the centers—is an air cylinder with upright plunger that carries a fork at the top adapted to hold and lift the axle when air is admitted to the cylinder. At the top of the piston stroke the axle is opposite the centers, and the latter are then run forward to hold the axle while the air piston is depressed and cleared from contact with the work to permit the latter to be rotated upon its centers to test its truth. After the test, the axle and wheels are lowered from the centers and rolled out of the machine on the sloping track.

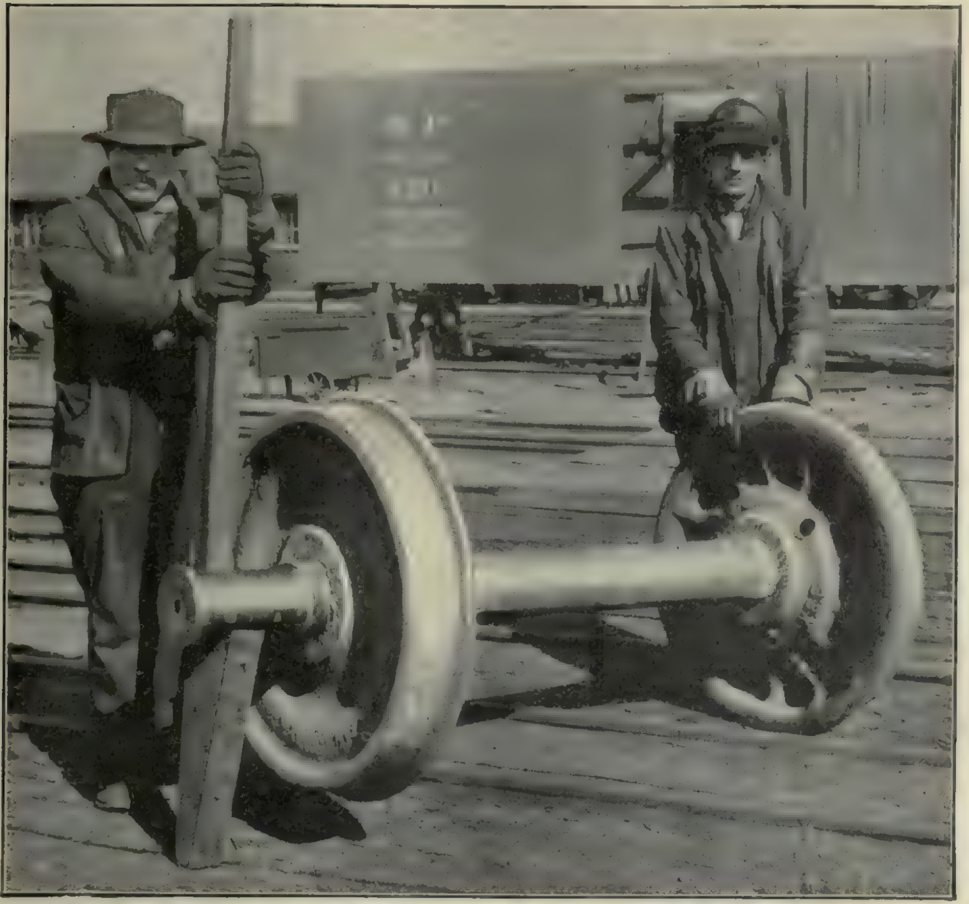


FIG. 4. THE "CANT HOOK" OF THE CAR-SHOP YARDS

Mechanics familiar with the equipment of lumber camps know the usefulness and diversity of purpose of the historic "cant hook." A similarly useful appliance of the same general character is shown in Fig. 4, as adapted to the handling of wheels and axles about the railroad-shop yard. While time-honored in origin and almost universally used about such places, it deserves to be better known in other establishments where work of somewhat the same nature is handled more or less frequently. The step that fits under the axle journal is just high enough to carry the wheel flange clear of the rail, and mounted wheels are thus moved about over tracks and from point to point without difficulty and without the necessity of the workmen waiting for a crane to be available for the handling of each and every pair of wheels that may require moving a short distance. People unfamiliar with the details of repair and replacement of rolling stock have little conception of the enormous number of car wheels that are worn out in service on our various railway systems. To one acquainted with the plants producing new material in the line of wheels, axles, boxes, etc., there is something striking in the mere figures showing the output of new parts of this character which are required; but after all, to the layman whose observations along this line are made in the main from a car window, there is something far more impressive in the occasional scrap heap that comes to his attention, the graveyard of worn-out and used-up material.

The tailpiece illustration of this article is a characteristic view that conveys some idea of what may be seen at the rear of the wheel shop of many a railroad repair plant. Here in this group are something like 17,000 worn-out and discarded wheels, possibly some 4000 tons of metal all told, destined probably for the most part to return eventually to the foundry and to reappear in some form or other for future service.

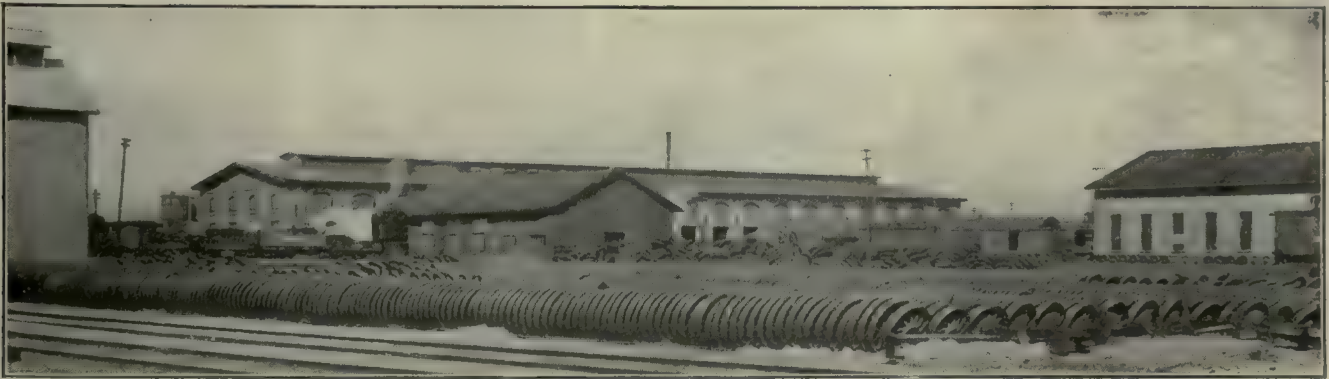
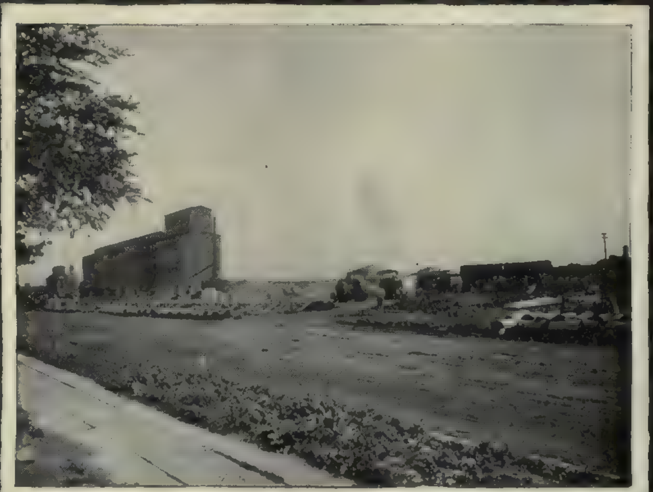


FIG. 5. SEVENTEEN THOUSAND DISCARDED CAR WHEELS

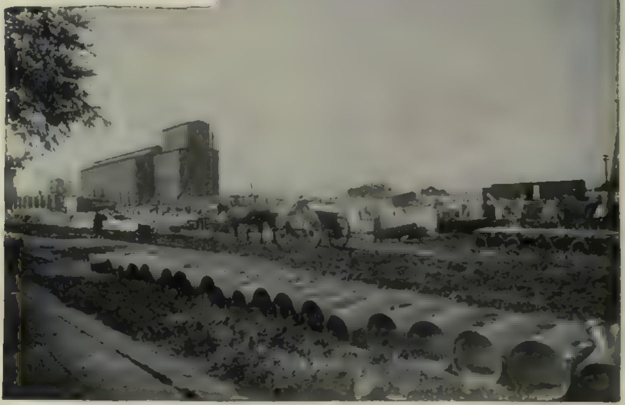
NEW MUNITION SHOP of the Minneapolis,

WORK was started July 25, on the new munition shop of the Minneapolis Steel and Machinery Co., but before much could be done on the building it was necessary to place about 1500 yd. of dirt filling on the site.

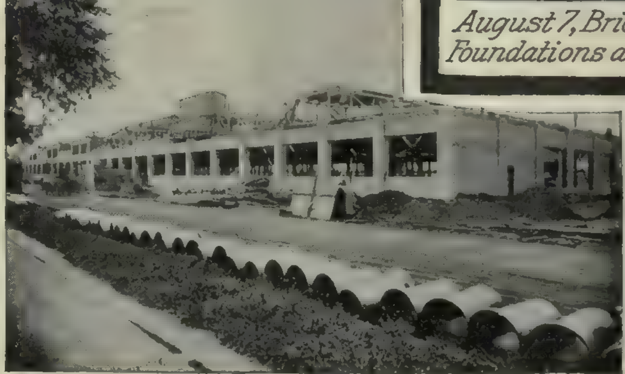
Twenty-eight days from the start of work, placing of the machinery was begun, the floors were in, the walls up and roof on. Forty days from the start, this building was practically completed. The creosote-block paving was laid, and the steel sash were all in and glazed. There were left only the painting



Work Commenced July 25, as the Site Looked July 30



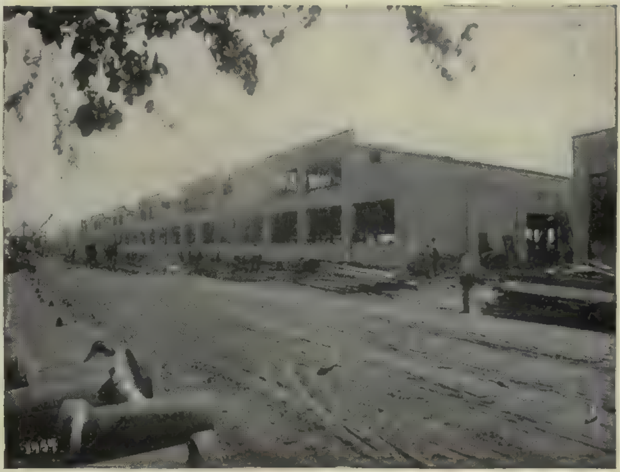
August 7, Bricklayers on the Job, Materials Arriving, Foundations and Floors in Place are not visible—



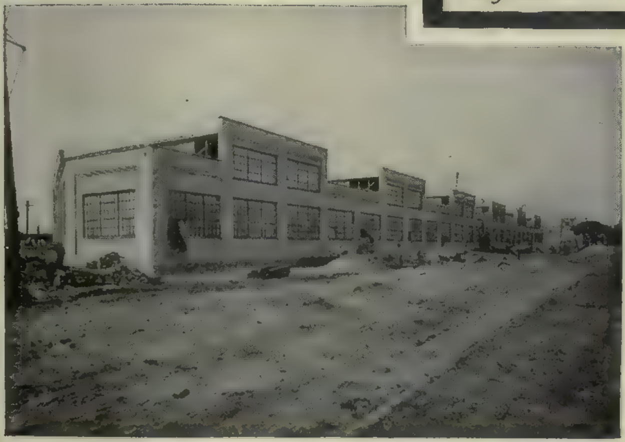
The Walls were Standing August 14

MINNEAPOLIS STEEL & MACHINERY CO.
Minnesota

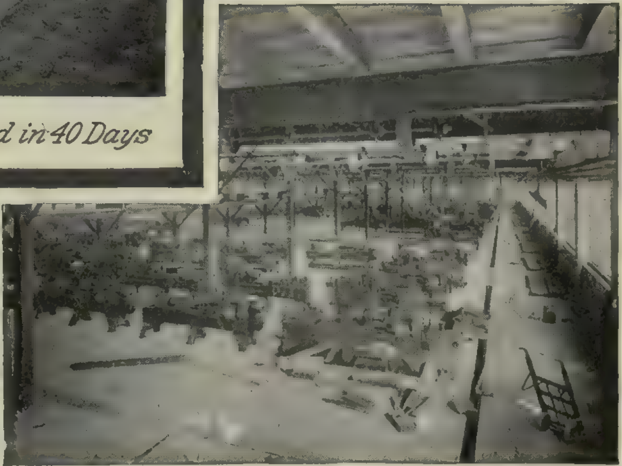
and top layers of the composition roofing. Some of the windows of the clerestory show as missing in the picture, but they are really left out to provide a runway for the roofers and could be set in place in a few minutes. The building, 132 x 432 ft., has concrete foundations, brick walls, steel window sash, steel columns and girders with wooden roof joists and sheeting, covered with built-up felt and asphaltum roofing. About half the floor is 6-in. concrete, and the other half is creosoted-block paving on concrete base.



August 28, Second-Story Bays & Roof completed



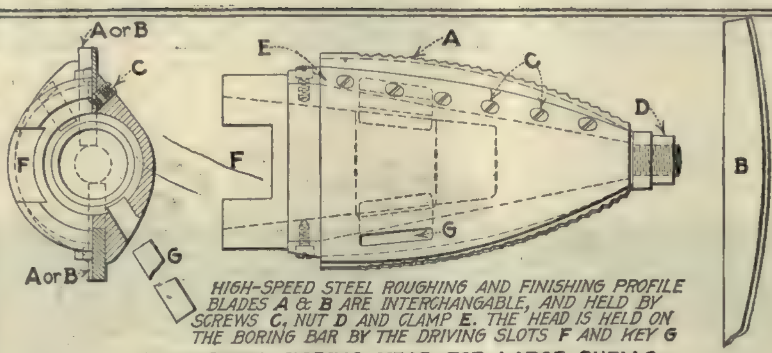
September 4, Building completed in 40 Days



Interior View, September 4

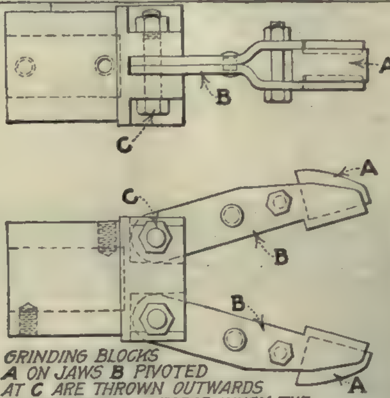
Shell Tools and Fixtures

By M. H. POTTER



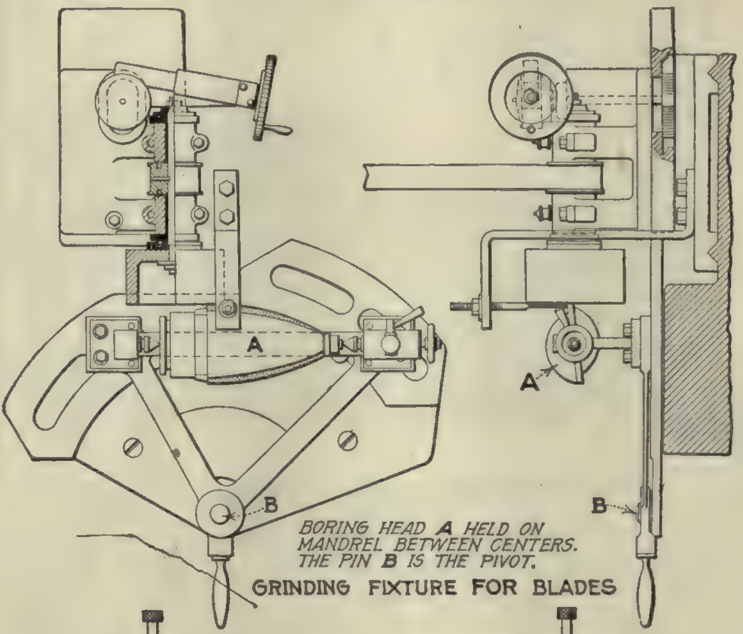
HIGH-SPEED STEEL ROUGHING AND FINISHING PROFILE BLADES **A** & **B** ARE INTERCHANGABLE, AND HELD BY SCREWS **C**, NUT **D** AND CLAMP **E**. THE HEAD IS HELD ON THE BORING BAR BY THE DRIVING SLOTS **F** AND KEY **G**

CAST-STEEL BORING HEAD FOR LARGE SHELLS



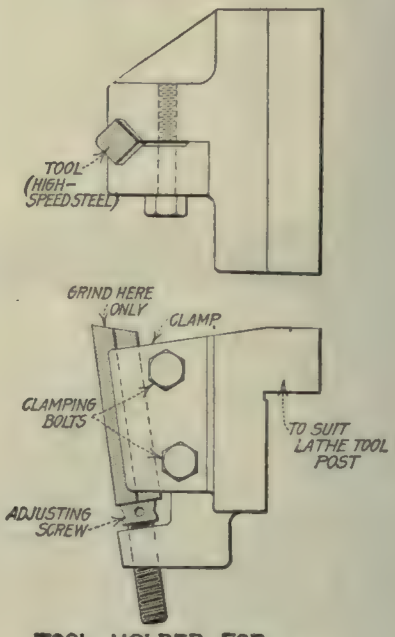
GRINDING BLOCKS **A** ON JAWS **B** PIVOTED AT **C** ARE THROWN OUTWARDS BY CENTRIFUGAL FORCE WHEN THE HEAD IS ROTATED. THE SHELL ON A ROLLER CARRIAGE IS RECIPROCATED WHILE THE HEAD ROTATES.

POLISHING HEAD FOR ROUGH-BORED SHELLS

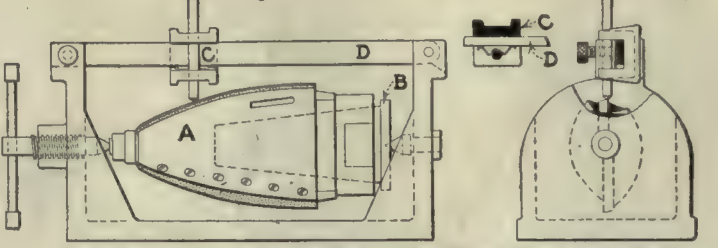


BORING HEAD **A** HELD ON MANDREL BETWEEN CENTERS. THE PIN **B** IS THE PIVOT.

GRINDING FIXTURE FOR BLADES

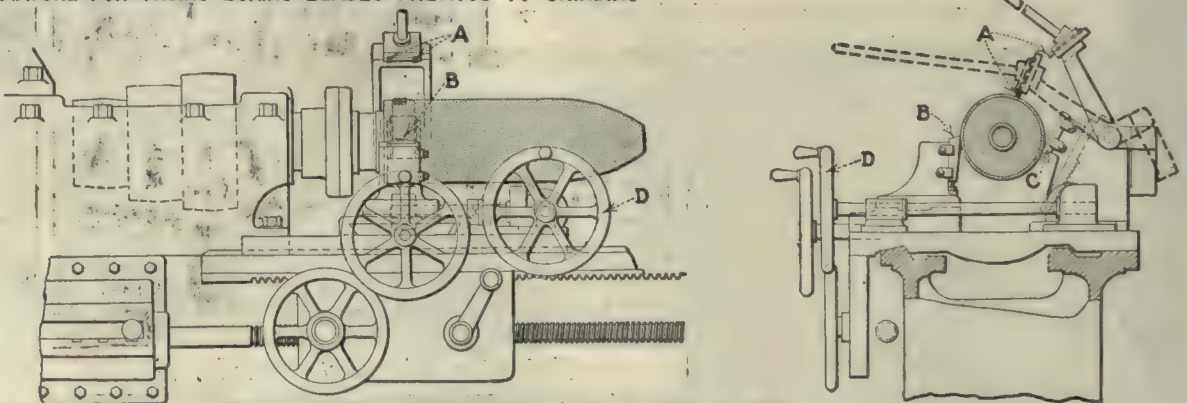


TOOL HOLDER FOR HIGH-SPEED STEEL



THE BORING HEAD **A** WITH BLADES INSERTED IS HELD ON THE MANDREL **B** BETWEEN CENTERS. THE GAGE **C** IS SLID ALONG THE ROD **D**

FIXTURE FOR TRUING BORING BLADES PREVIOUS TO GRINDING



THE TWO SWINGING TRIMMING TOOLS **A** CUT THE BAND TO WIDTH. THE ROUGH FORMING TOOL IS AT **B**. THE SHAVING TOOL **C** IS OPERATED BY THE HAND WHEEL **D**.

DRIVING-BAND TURNING ATTACHMENT FOR SHELLS

Designing and Using Broaches

BY W. G. GROOCOCK

The author takes up the subject of notching teeth and suggests an experiment to prove its value in certain branches of broach practice.

SOME particularly interesting questions in the designing and use of broaches were raised by Charles L. Eaton on page 1019, Vol. 46. Much that he said was in line with my experience, but some of his statements are so distinctly opposed to my knowledge of broaches and broaching that they cannot be accepted unless they are qualified.

The following notes are written not with a desire to criticize, but to emphasize and also to qualify some of Mr. Eaton's statements. He says, for instance, that "nicking the teeth of a broach is a makeshift." This is not so. Nicking the teeth of broaches of any type where the width of cut is over ½ in. is good broach design. In the past the lack of a sufficient number of notches has been the primary cause of poor work.

This applies more particularly to the first and second broach, of large square broaches; also to round broaches of all sizes. Notching as an alternative to the provision of more chip space is not to be recommended, but there have been many cases in my experience where notching has made broaches work better, in spite of the fact, that these broaches had ample chip room. In such case it is not so much chip room as shape of chip thrown off.

Anyone who questions the advisability of notching should try the following experiment: Make a 1½ in. diameter round broach having 36 teeth of ½-in. pitch, and a root diameter of 1 in. This will give a depth for the chips of about ¼ in. Grind the pull end of the broach, and first tooth to enter a 1$\frac{7}{16}$-in. drilled hole and leave the last six teeth parallel and 1½-in. diameter. The remainder of the teeth—30—will each increase about 0.002 in. in diameter, that is, the chip will be 0.001 thick.

Without notching this broach pull it through several pieces of tough steel—drilled out to 1$\frac{7}{16}$ in. and 3 in. through—and note the result. Follow this test by notching the broach teeth with ten notches, each ⅛ in. wide and $\frac{1}{32}$ in. deep, placing the notches on alternate teeth so that they are covered by the preceeding tooth. Leave the last five teeth unnotched. When notching is complete try the broach through pieces of work similar to those first used and note, first the shape of the chips, and second the finish of the hole as compared with those produced by the unnotched broach.

Whoever tries this experiment will never have any further doubts about the advisability of notching round broaches. What is true of round broaches is true in a measure of all broaches where the chip is unduly wide.

Mr. Eaton states that "the contour of the tooth, whether curved or flat, has no appreciable effect on the power required to pull a broach." I do not know what data Mr. Eaton has to support this statement, but my opinion is opposed to such a conclusion, although I have no actual record of pressures to support my opinion. My reason for thinking that a curved surface, say to the teeth of a spline broach, will absorb less power than if such a broach was made with flat tops to the teeth, is based primarily on a fact that is well-known to all lathe men who have had experience with parting tools. If a parting tool is ground with a square end it always exhibits a decided tendency to "hog in," whereas, if the cutting end is rounded it will work without any such tendency at the same speed and with coarser feeds than it would in the square condition.

Now the "hogging in" is caused by a higher pressure which tends to make the tool dip. Higher cutting pressures mean that the machine is absorbing more power. With a broach we have different conditions because the extra pressure would not make the tooth "hog in" as it would be balanced by a similar excess of pressure on the opposite side of the broach. But, undoubtedly, for a given condition of loading and material the broach with flat top teeth would absorb more power than would a similar broach; the teeth of which were ground to a radius.

Mr. Eaton evidently realized this when he mentioned the failure shown by his Fig. 2. It is undoubtedly a disadvantage to the broach user and designer not to be able to record the pressure required to pull broaches through. Makers of broaching machines would do well to cater for this by embodying a pressure-recording device in the pulling head of the machine. This being done the tool designer would be able to note with accuracy the difference, if any, in the pressure required to pull a broach for any change in the shape of the teeth that theory had led him to believe as being desirable. By a combination of theory and practical observation the designer gets results. If the practical observation is based on some exact knowledge gathered from the use of measuring instruments, then the designer is absolutely sure of his data. Hence the need for some reliable means of verifying, by actual measurement, the power required to pull the broaches. I have designed a fixture for this purpose, but unfortunately have not yet had the opportunity of making it, however, I know the value that would accrue from an exact knowledge of the power required under any given set of circumstances.

Observation leads me to believe that a curved tooth takes less power to pull than a flat one—other conditions being the same—and if Mr. Eaton has any data to confirm or refute this he will be conferring a favor on broach users if he will give it to them through these columns.

THE STEEL USED

On the question of material for broaches Mr. Eaton is strongly in favor of "high carbon steel properly hardened." That's just it; "properly hardened" puts it over on us every time. In the main he seems to favor the steels of high carbon content because: "The high temperature necessary to harden low carbon steel renders the broach more liable to distortion."

Is this borne out in practice? Taking low carbon steel as meaning 8 to 9 point carbon and high carbon as being 11 to 12 point carbon, then the hardening temperatures would not vary more than say 200 deg. F., that is, between 1550-1600 deg. and 1350-1400 deg. according to brand of steel. Will this difference in temperature cause much, if any difference, in distortion under proper hardening conditions? I think not. Distortion in hardening is a factor that is influenced more by method than by temperature in the case of broaches and Mr. Eaton evidently realizes this when he says: "I would no more permit the hardening of a broach by an ordinary tool hardener than I would entrust the repair of a high-priced watch to the village blacksmith." In making this statement—without qualifying it—Mr. Eaton is doing an injustice to both the village blacksmith and the tool hardener. The very best watchmaker that I ever knew was a village blacksmith and he was a good smith. A tool hardener should be able to harden any tool and a broach is a tool, nothing more. The fault often lays not with the tool hardener, who does his best, but with his employer, who will not provide the necessary equipment. If an expert is called in, he would refuse to harden broaches with a muffle two sizes too small and with inadequate accommodation for either measuring the temperature or handling the cooling liquid. On the other hand the tool hardener is told to harden them and not make so much fuss over trifles.

EMERGENCY WORK

Should the emergency arise a good surgeon would remove a limb with only a pocket knife and a wood saw, but he would be more certain of his results if he had his proper kit of tools, each of which was designed to perform a function. It is not necessary to go outside your factory to find the expert, and given the proper appliances the average tool hardener will find no more difficulty in hardening broaches than in hardening long reamers or any of the other difficult jobs that a real tool hardener has to tackle. Of course many tool smiths are not tool hardeners, and never will be, because in trying to mystify others as to the importance of a job they understand little of, they mystify themselves. "Giving the devil his due" we must acknowledge that the real tool hardener will have no difficulty in hardening broaches if he has the equipment. He, the real tool hardener, may not be registered on the firm's books as an expert; he may even answer to the name "Bill," but more often than not he can harden some. We are too prone these days to go outside and look for the expert. Personally, I am a bit suspicious of the self-styled experts; they talk too much and do too little. Why not let Bill harden the broaches and give him the necessary tools to do them with.

I side with Mr. Eaton when he says: "It is impossible to rely on the location of a broach hole within certain limits, so for close work the stock is left to finish from the broach hole." When, however, he makes the contradictory statement that "A well-made broach will not drift much" then I think such a statement should be qualified or it will mislead.

Broaches that are symmetric, that is, those whose cutting edges are balanced, do not exhibit much tendency to drift out of line when they are sharp. But if one side happens to get dull then some drifting is certain All broaches are not in balance and on ordnance work in particular one often meets two holes that have a decided tendency to drift over when they are broached. One of these is practically a hexagon hole with one of the flats missing. The idea for using this form is to make it impossible to put the gear wheel or whatever the piece may be on in any but the correct relation to some other part. Broaches for such holes show a decided tendency to drift over to the curved side. Another form that drifts badly, more than any other in my experience, are broaches for D-shaped holes, that is holes to fit a shaft having one flat on it. A little thought will show that the reason for this drifting is due to the fact that the circular part of the broach usually has teeth that are sharp, while the teeth on the flat portion have no relief. The drift is, in such cases, usually over toward the round part of the hole, but if, on the other hand, the broach teeth are relieved all over, that is made to cut on the flat as well as on the round portion, the drift is toward the flat owing to the smaller surface in contact. Broaches for D-shaped holes are about the hardest proposition that I have struck from the viewpoint of drifting out of line and such work should always be finished from the hole. Further, in the preparatory operation on such work plenty of stock should be left on the outside diameter or it may not clean up in the final turning. This is especially true when the work to be broached is brass or bronze. The best results I have had with D-holes were obtained by using three broaches. The first and second broaches had teeth on the diameter and a plain flat without teeth, while the third and finishing broach had a plain diameter but cutting teeth on the flat portion. This system worked well and gave good results when properly arranged.

The principal thing is first to find out how much the first two broaches drift before grinding the flat of the final broach. Having found out by actual experiment how much such broaches drift over on the average, grind sufficient off the first two broaches on the flat to allow for this. Then grind the teeth on the flat side of the final broach taper so that it will clean up what would otherwise be an irregularly shaped flat side. The result from these will be a nice clean hole all over, but it will not be on the original axis of the work, hence the necessity for leaving enough stock on the outside diameter of the work to turn it from the broached hole.

USING A NUMBER OF BROACHES

The last sentence in Mr. Eaton's article is full of "horse sense" and should be read and re-read by all who want to succeed with broaches. He says, "It is better to operate twice or even three times on a piece and have the product satisfactory than to suffer the humiliating expense and delay that usually follow an attempt to remove all the stock in one operation." Why is this excellent advice necessary? I believe there are two factors that largely bias the inexperienced into the error of overlading their broaches. The first is a somewhat natural desire to do the work in as short a time as possible. Only personal experience will cure this and an occasional fall-down will soon correct the tendency to overload. On the other hand it is not sound policy to always play for safety and where many broaches are made it is well to run the risk of falling down occasionally to assure oneself that the loading is as much as the broaches will stand. If such experiments are tried on a full set of broaches they should be closely watched over the first 1000 holes and should be so designed that should they show signs of being overworked then an intermediate broach can be put in to save the set. This should be made when the set is made, and there would be no serious stoppage in case of having to rearrange the set. Probably the best way of testing the loading for a set of broaches is as follows: Suppose a normal set of broaches used for pulling out a splined hole consisted of four broaches and suppose still further that the designer desired to try whether three broaches would do the work. Then, if we make a new number one broach to take out one-third of the stock we can use this with the normal set in place of the original number one broach. This would mean that the number two broach would only do part of the work for which it was designed. If the experimental broach gets through a batch of say 2000 pieces then two other broaches can be made and put in to use with it, thus forming a three-broach set. On the other hand should it show signs of falling down, then we still have our original number one broach and our overloaded experimental broach can then be ground down to form a spare number one for a four-broach set, our normal set. In this way there is no risk of a stoppage in production through falling down, and yet one can try experiments if in doubt. The moral of this is to design your sets of broaches to do what you know they can do. Afterward if you are in doubt as to whether they could do more try an experimental broach with a load to suit.

The second factor that tends toward the overloading of broaches by the inexperienced is due to the fact that a good deal of misleading data have been given in the past about broaching. Fancy times have been claimed for some of the work advertised and the inexperienced have attempted to live up to such times by overloading the broaches.

The point that a broach designer must study is what loading the broaches will stand in the material being used. Never mind what the broach salesman says he has done. You cannot analyze the material he operated on and you did not hold the watch when it was done, consequently do not be foolishly optimistic or afraid of falling down. In broach design, as in other things, it is well to learn to walk before you run.

Special Continuous Painting Machine

By J. P. Brophy

Vice President and General Manager, Cleveland Automatic Machine Co., Cleveland, Ohio

The illustrations show a machine built especially for painting machine castings in our shop. It has a large turntable, into which are set three small tables on which the castings are placed during the spraying process.

The machine is driven by a 2-hp. motor, which is not visible. The operations of the turntable are controlled by the two foot pedals *A* and *B*, Fig. 2. Also, in the large hood covering the machine is a ventilating fan driven by the same motor, which draws away the vapor caused by the paint. Painting is done by means of a compressed-air spraying device, and the nozzle is so constructed that either a spray of paint or an air blast only may be applied to the work

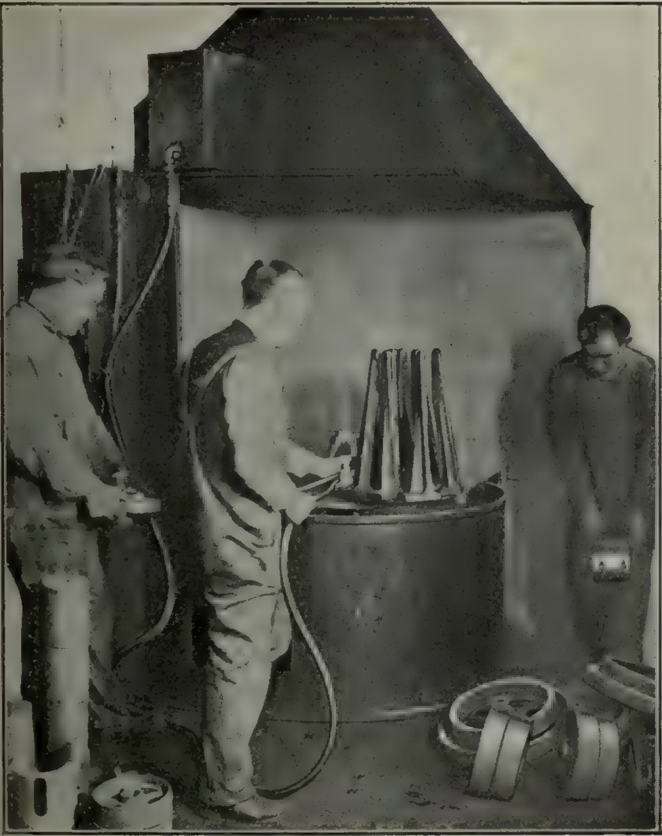


FIG. 1. PAINTING MACHINE IN USE

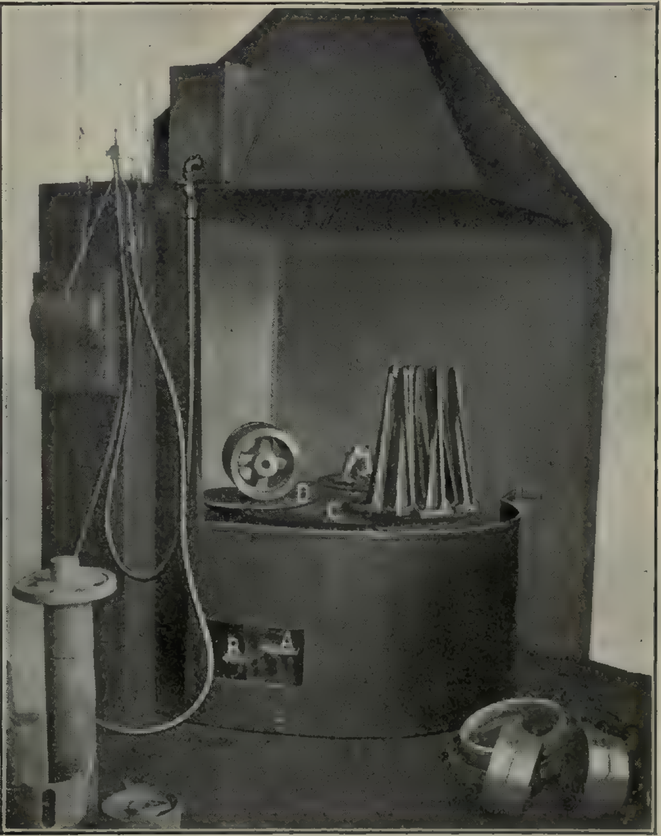


FIG. 2. SOME DETAILS OF THE MACHINE

There are two separate movements in this machine. The main large turntable *C* may be revolved, carrying three smaller turntables, as *D*, which in this case would rotate on their own axes and revolve with a planetary motion around the axis of the main turntable. In this way every side of the castings upon the small turntables is presented to the man who operates the spray nozzle. Another movement is to revolve the small turntables with the large turntable stationary. In this manner the operator can bring directly in front of him the castings that rest upon one of the small turntables, stop the large turntable and then revolve the small turntable, which will allow him to reach every part of the casting in front of him and be sure that it is thoroughly painted inside and out.

In operating this machine, three men are required—one to handle the spray nozzle and to operate the pedals of the machine, bringing the work to any position required, one man to handle the unpainted castings to the machine, and a third to handle the painted castings from the machine to the floor. This operation is so rapid that three men can handle with ease as many castings as 12 men painting with a brush on the bench could possibly take care of, and the paint distribution is ideal.

Referring to Fig. 1, it requires only a matter of a few seconds to cover the group of castings shown in the illustration directly in front of the spray nozzle, while to paint these with a brush by hand would require 15 or 20 min. of a man's time.

The speed at which this machine can be operated depends entirely on how fast it is possible for the men to place castings upon the machine and remove them. Hundreds of variously shaped pieces are finished daily. The foreman of our painting department suggested the machine, and it certainly is a wonderful time saver.

If you, Mr. Reader, should at any time in the future visit our place of business, we would be pleased to show you this machine in operation.

International Aircraft Standards

The following list gives the key numbers for bulletins dealing with the standard specifications adopted by the International Aircraft Standards Board, Washington, D. C., for the guidance of bidders or manufacturers in these lines:

1G1—General specifications for the testing and inspection of metallic materials, 1A1—Methods of chemical analysis, 2S1—Chemical compositions of steels, 2N1—Ingot aluminum, 2N2—Ingot copper, 2N3—Spelter, 3S1—Carbon steel for case-hardening, 3S2—Medium carbon steel bars and billets, 3S3—Alloy steel bars and billets, 100,000 lb. per sq.in. tensile strength, 3S4—Alloy steel bars and billets, 125,000 lb. per sq.in. tensile strength, 3S5—Alloy steel bars and billets, 150,000 lb. per sq.in. tensile strength, 3S6—Alloy steel bars and billets, 175,000 lb. per sq.in. tensile strength, 3S7—Alloy steel bars and billets, 200,000 lb. per sq.in. tensile strength, 3S8—Alloy steel bars and billets, 225,000 lb. per sq.in. tensile strength, 3S9—Alloy steel bars and billets for case-hardening, 170,000 lb. per sq.in. tensile strength, 3S10—Alloy steel bars and billets for case-hardening, 190,000 lb. per sq.in. tensile strength, 3S11—Tolerance on steel bars, 3S12—High-strength steel wire, 3S13—19 nonflexible steel-wire cable, 3S14—7 x 7 nonflexible steel-wire cable, 3S15—7 x 19 extra-flexible steel-wire cable, 3S16—Wire for acetylene welding, 3S17—Wire for electric welding, 3N1—Gunmetal castings, 3N2—Manganese bronze castings, 3N3—Phosphor bronze castings, 3N4—Naval brass or equivalent alloy bars, 3N5—Naval brass or equivalent alloy sheet, 3N6—Sheet brass, 3N7—Brass tubes, 3N8—Sheet copper, 3N9—Phosphor bronze strip, 3N10—Babbitt metal, 3N11—Aluminum alloy castings, 3N12—Sheet aluminum, 4P1—Turnbuckles, 4P2—Ferrules and thimbles.

A "Gas and Flame" Service Regiment for Foreign Service

The commanding officer of the 30th Engineers has requested us to help in mobolizing the personnel of a "Gas and Flame" Service Regiment. This regiment is being recruited now from men volunteering for the service, and will be ready to go "over there" by Thanksgiving. Enlistment offers opportunity to skilled men to be used and recognized as men skilled in their trade, and should appeal to men who have previously felt that they were most needed at home, because of their special training and experience. The regiment will be required in the field of operation to supervise the American offensive in "Gas and Flame" service and will be called upon to instruct men all along the front in this most important work. Consequently it will be in the thick of the greatest activities.

The 30th is the pioneer regiment in the "Gas and Flame" service and men who enlist now will be leaders in the spring offensive. The organization will require a large proportion of men able to assume responsibility, and to act upon their own initiative and individual judgment. There will be opportunities to advance to the higher non-commissioned and commissioned grades. It offers a real chance for red-blooded Americans to get in where their efforts will give definite results. In addition to needing any men who are looking for just this opportunity to help put across this important service, specialists are needed in a number of different lines of work as follows:

Chemists, analytical, research and manufacturing; chemical workers; powdermen; men experienced in gas manufacture; machinists; automobile repair men; men able to operate and repair gas or steam engines; pipe fitters; electricians; designers; interpreters; carpenters; blacksmiths; plumbers; boilermakers and chauffeurs. Men with long experience in their trade are especially desired to fill the master engineer grades. Loyal American citizens between 18 and 40 years of age, who have not actually been called by a local board in the draft, are eligible for enlistment.

Col. A. A. Fries, Engineers, N. A., is to be the commanding officer. He is a regular officer of the Corps of Engineers with many years experience in military and civil engineering. Maj. E. J. Atkisson, Corps of Engineers, is organizing the first battalion at Camp American University, D. C. He is a graduate of West Point and of Cornell University.

Candidates may enlist at the nearest recruiting station or U. S. District Engineering Office, stating fully and clearly their qualifications and that they wish to be enlisted in the 30th Regiment of Engineers, "Gas and Flame." All men must first enlist as privates, the rate of pay being $33 per month and expenses. Men with the necessary experience may be assigned to special duties and given non-commissioned rank at rates of pay ranging from $40.20 to $96 per month and expenses. The latter include, for both privates and non-commissioned officers, food, clothing, medical attendance and transportation. Those who enlist will be eligible immediately for promotion, according to their ability and as openings occur. Men who enlist now will have excellent opportunities for promotion as the service expands.

Government Specifications for Testing and Inspecting Metallic Materials

Adopted by the International Aircraft Standards Board, Washington, D. C.

General—1. These specifications will form part of all individual specifications for metallic materials.

Material—2a. An analysis of each lot of material and of each heat of steel furnished to this specification shall be made by the manufacturer. The chemical composition thus determined shall be reported to the purchaser and the Government inspector, and shall conform to the requirements of the specification.

b. In the case of submission of lots of material of which the heat or identification marks are lacking or doubtful the manufacturer will be required to furnish analyses of a sufficient number of the articles submitted to satisfy the inspector of the uniformity of the lot.

c. An analysis may be made by the purchaser or Government inspector from a tube, sheet, bar, test bar or casting representing each lot of material submitted, and the chemical analysis thus determined shall conform to the requirements specified. If the analysis of any one article does not conform to the requirements specified, analyses of two additional articles of the same lot shall be made, unless otherwise noted, each of which shall conform to the requirements specified.

d. The methods for chemical analysis shall be those of the I. A. S. B.

e. The weight of sample taken for analysis shall be not less than 120 grams, and the sample shall be clean, free from rust, oxide, and extraneous matter, and is to be taken with a slow-speed tool.

f. Drillings for analysis of bars, billets, or other regular shapes shall be taken parallel to the axis at any point midway between the center and surface.

g. Drillings for analysis may be taken from broken tension or bend test specimens when physical requirements are specified.

h. Wire, tubing, sheets, and rods less than 1¼ in. (31.75 mm.) in thickness, shall be sampled through or across the entire section.

i. In case of suspected segregation (steel), a sample may be taken from a point on the axis and analyzed; the percentage of no element may exceed at this point by more than 15 per cent. that specified.

j. In order to obtain evidence of possible unsoundness and piping, sample bars of steel may be nicked and broken for examination of fracture.

k. Drillings or cuttings for the analysis of irregularly shaped pieces (steel), for which no physical requirements are specified, shall be taken from both the thickest and the thinnest sections. Surface drillings shall be discarded.

Manufacture—3a. The materials shall be manufactured according to the best current practice.

b. Steel shall be manufactured or at least finished by the openhearth, electric-furnace, or crucible process unless otherwise noted.

c. A sufficient discard shall be made from each ingot to secure freedom from piping and undue segregation.

d. The billets from which bars or forgings are made are to be rough turned or chipped to remove all surface defects which might produce seams in the finished bar or forging. No undercutting in chipping allowed.

Heat Treatment—e. The manufacturer shall state the heat treatment recommended to give the physical properties specified for all steels which are to be used in the heat-treated condition.

Workmanship and Finish—4a. The articles must be finished in a workmanlike manner and must be free from flaws, surface and other defects to which they are subject.

b. Any article may be rejected because of injurious defects or faults in manufacture at any time, notwithstanding that it has previously passed the physical and chemical tests; it shall be returned to the manufacturer at the latter's expense. This clause shall not be taken to apply to materials fabricated after export.

Physical Properties and Tests—a. Physical tests shall be carried out on testing machines of standard make, which are to be kept in good working condition. The manufacturer must satisfy the inspector that the testing machines are at all times properly calibrated.

Tensile Test—b. To determine whether a specimen has a yield point equal to or greater than that specified the procedure shall be as follows: A line shall be scribed on the test piece with a punch mark as center, and with a radius of about 2 in. (50.8 mm.) when possible; the specified load shall then be applied, removed, and a second line scribed with the same radius and the same center; if two lines are then seen on the test piece, indicating that permanent elongation has occurred, it shall be considered that the specimen has not passed the yield-point test. If the manufacturer desires, the yield point may be determined by an approved autographic or extensometer method.

c. The elastic or the proportional limit, when called for, shall be determined with an extensometer reading to at least 0.002 in. (0.05 mm). It shall be attached to the specimen at the gage marks and not to the shoulders of the specimen nor to any part of the testing machine. The elastic limit is defined as the greatest load per unit of original cross-section which does not produce a permanent set. The proportional limit is the load per unit of original cross-section at which the deformation ceases to be proportional to the load.

Bend Test—d. The specimens shall be bent cold in the bend test.

e. Bars will be bent around a pin of radius equal to the bar diameter or thickness until the sides are parallel; unless otherwise noted the bar must withstand such bending without developing cracks or signs of failure.

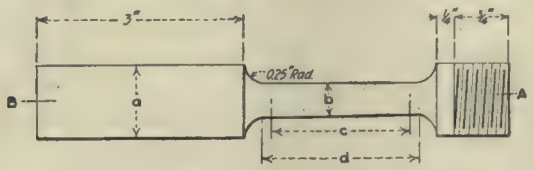
f. On sheets the test comprises two distinct operations, both of which are performed by the use of a press, or, in the absence of this, by using a knife-edge and hammer. First, the strip is placed in position *AB* (Fig. 2a) on block having a V-shaped groove. The knife-edge is placed as shown and pressure is applied by means of either press or hammer until the test specimen assumes the shape *A'B'*. After this block is removed the bending is finished as indicated in Fig. 2b, with or without the interposition of a spacer. The spread of the ends of the test piece varies with the quality and thickness of the sheets. The specimens must be bent as indicated without breaking and after test shall not show hair lines, cracks, or other defects.

Impact Test—g. Impact tests shall be carried out with an impact testing machine of the pendulum type.

Brinell Hardness Test—h. The hardness test shall be made with a 10-mm. diameter ball, using a pressure of 3000 kg. for steel and one of 500 kg. for softer metals. This pressure shall be applied for 30 seconds.

Test Specimens—i. Tension, bend, and impact test specimens shall be taken from the rolled or forged material, except that in the case of irregularly shaped forgings they may be taken from a full-sized prolongation. Specimens shall not be annealed or otherwise treated, except as provided in the individual specifications.

j. Tension, bend, and impact test specimens for rolled material which is to be annealed or otherwise treated before use shall be cut from properly annealed or similarly treated short lengths of the full section of the piece and for forged material from the treated forgings.

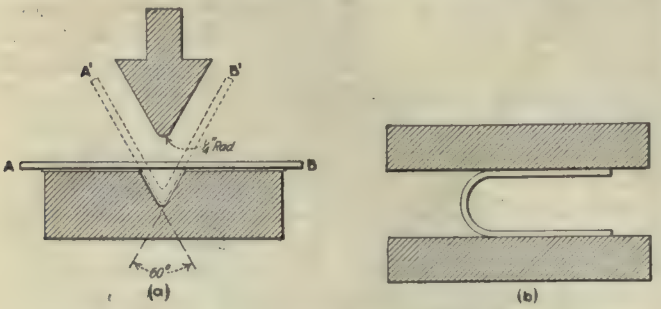


Diameter of Bars	Cross-section Over Gage Length	Dimensions a	b Diameter Over Gage Length	c Gage Length	d
	Sq.In.	In.	In.	In.	In.
Over five-eighths in.......	0.20	Not over 1	0.505	2.90	2.25
One-half to five-eighths in.	0.10	Not over 1	0.358	1.42	1.75
Three-eighths to one-half in.	0.05	Not over 1	0.252	1.01	1.25
One-fourth to three-eighths in....................	0.02	Not over 1	0.159	0.64	1.00
	Sq.Mm.	Mm.	Mm.	Mm.	Mm.
Over 15.88 mm...........	129.0	Not over 25.4	12.83	73.66	57.15
12.70 to 15.88 mm........	64.5	Not over 25.4	9.09	36.07	44.45
9.53 to 12.70 mm.........	32.3	Not over 25.4	6.40	25.65	31.75
6.35 to 9.53 mm..........	12.9	Not over 25.4	4.04	16.26	25.40

Test specimens may be tapered inside gage length (*c*) toward the center to an amount not to exceed 0.003 inch (0.08 mm). Diameter at center (*b*) to conform to dimension called for. This will cause fracture near the center of the gage length. The test specimen will be either threaded (end *A*) or left unthreaded (end *B*), according to method of chucking used.

FIG. 1. I. A. S. B. STANDARD TENSILE TEST SPECIMEN FOR BARS

k. The axis of tension, bend, and impact test specimens for rolled bars and forgings of uniform cross-section over 1½ in. (38.10 mm.) in thickness or diameter and for forgings of irregular section, when practicable, shall be located at a point midway between the center and surface when solid and at any point between the inner and outer surfaces of the wall when bored and shall be parallel to the axis of the piece in the direction in which the metal is drawn.



(a) (b)

FIG. 2. BENDING-TEST OPERATION
The distance X shall conform to value called for in detail specifications for sheets.

l. Tension test for specimens for bars shall conform to the dimensions shown in Fig. 1. The ends shall be of a form to fit the holders of the testing machine in such a way that the load shall be axial; test specimens representing heat-treated or brittle materials shall have threaded ends or ends so made as to permit of testing material, using a ball-and-socket chuck.

m. Tension and bend test specimens for plates, sheets, and shapes shall be of the full thickness of material as rolled. Tensile-test specimens for sheets or plates shall be machined to the form and dimensions shown in Fig. 4. Bend-test specimens for sheets shall have a width of 1.5 in. (38.10 mm.) and a minimum length of 8 in. (203.2 mm.). Test specimens shall not be hammered in order to straighten them, nor may they be tempered, annealed, or otherwise treated unless specifically noted. Impact-test specimens are to be rectangular in section and shall be notched on one side. They are to have the form shown in the sketch, Fig. 3.

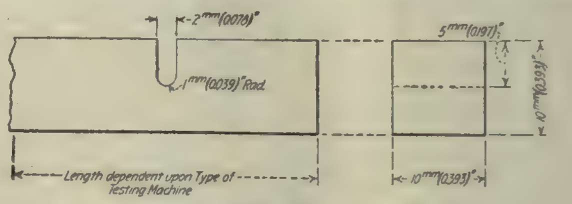


FIG. 3. SPECIMEN FOR IMPACT TEST

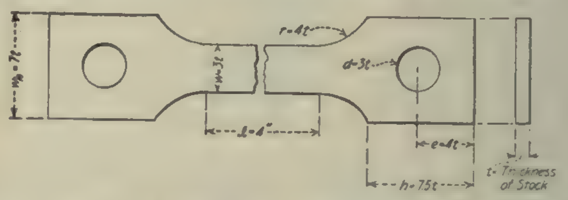


FIG. 4. TENSILE TEST PIECE FOR SHEETS OR PLATES

Selection of Test Specimens—6. A sufficient number of test specimens will be selected by the inspector from each lot of material submitted to satisfy him of the quality of the material. If any test specimen shows defective machining or develops flaws, it may be discarded; in which case the manufacturer and the purchaser or his representative shall agree upon the selection of another specimen in its stead.

Marking and Identification—7a. It shall be the duty of the manufacturer to provide that manufacturing identification marks, such as heat numbers, shall be readily available at the time of inspection of the finished material to the inspector, and further that materials shall be grouped when possible by heat or melt numbers.

b. It shall be the duty of the manufacturer to stamp individual large articles such as billets, forgings, or castings, with the heat or other identification number; smaller articles may similarly be bundled or grouped under the proper identification number or mark.

Inspection and Rejection—8a. The inspector representing the purchaser shall have free entry at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturers' works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. Tests and inspection at the place of manufacture shall be made prior to shipment.

b. The purchaser may make the tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere as a check upon the results obtained by the manufacturer, or in case the latter has not the necessary equipment. Such tests, however, shall be made at the expense of the purchaser.

Rejection—d. Unless otherwise specified, any rejection based on tests made in accordance with paragraph 8b, shall be reported within 10 working days from the receipt of samples.

Rehearing.—e. Samples tested in accordance with paragraph 8b, which represents rejected material, shall be preserved for one month from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

f. All material rejected by the inspector shall bear the letters R A.

Salvage—9a. The manufacturer shall hold at his factory, subject to the decision of the salvage board, for a period of not exceeding 20 days from date of the test report, all rejected material.

b. Material held up and accepted by the salvage board shall be marked and shipped as directed by said board, and in presence of the Government inspector, who shall seal the same with his official seal.

c. The manufacturer shall suffer no reduction in price in consequence of the submission of material to or acceptance of said material by the salvage board. It is clearly understood, however, that inspection and acceptance at the factory by a representative of the purchasing Government, or salvage board, will not relieve the manufacturer from the responsibility of furnishing material of known properties and good workmanship, and if it is found on arrival at destination that such is not the case, the material shall be returned at the expense of the manufacturer and replaced with other material conforming to the specifications in every respect. Such replacement shall not be subject to the action of the salvage board. The recurrence of such a case shall constitute cause for cancellation of unfilled orders and a recommendation against placing further business.

Special Planing Machine Work

BY M. E. HOAG

In the special type of worm-driven machines made by the Moline Tool Co., the driving worms are given support and bearing their full length. This necessitates very accurate machining of the part shown at *A*, Fig. 1. Planing has been found more satisfactory than milling, and with suitable gages and the finishing tool *B* the work is handled accurately and rapidly. The final planing with this tool is really a scraping operation; and as the steel disk is removable, it can be easily ground to size on a cylindrical grinder. As one cutting edge becomes dull, it is turned to bring a new edge into action.

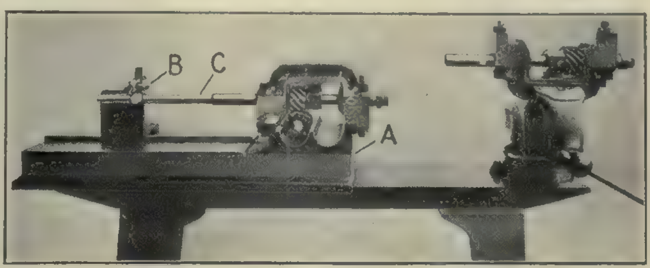


FIG. 3. THE TESTING BENCH AND FIXTURES

In machining these same pieces it is necessary to plane the under side of the overhanging parts shown at *A*, Fig. 2. The average planer hand has probably experienced some trouble on this kind of work. By milling out the bolt slots to a complete circle in the slide, the clapper box may be rotated to any position so as to clear on the return stroke just as readily as it would on ordinary work.

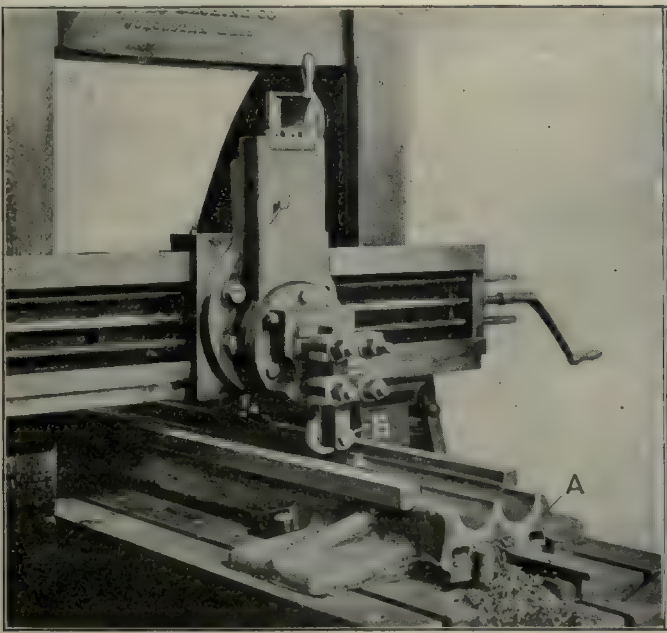


FIG. 1. PLANING OUT DRIVING-WORM SUPPORTS

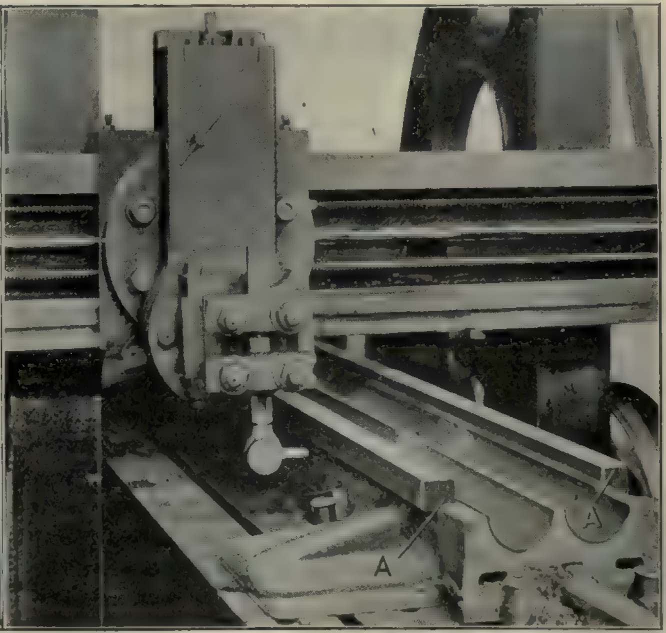


FIG. 2. PLANING THE UNDER SIDE OF PARTS

The heads used on these machines are all made interchangeable by fitting to the standard gage *A*, Fig. 3. Two dial indicators at *B*, together with the hardened and ground test spindle *C*, check up alignment of the head and spindle. The worm and worm gear shown act as a check on position and depth of the bearing recesses already mentioned.

Each of these cast-iron testing benches is fitted with a vise, so if it is necessary to do any fitting or filing, the workman does not have to move the part being tested more than a foot or two, all of which aids in rapid and accurate production.

Machine Guns on Airplanes

By Robert A. Monte

On page 337, R. C. Heinmiller expresses some doubts about the practicability of firing a machine gun between moving propeller blades without hitting them. The problem is, in the main, one of simple arithmetic.

The propeller (as Mr. Heinmiller mentions) rotating at 1300 r.p.m., which is average practice, makes 21.66 revolutions per second. At, for example, 650 shots per minute the consecutive shots are following each other at intervals of $\frac{60}{650}$ sec., are moving at a muzzle velocity of approximately 1800 ft. per sec. and are about 165 ft. apart.

For each two propeller turns one shot is fired. Now if the adjustment is such that each bullet passes approximately 45 deg. past the vertical position of the upper propeller blade, as indicated in the illustration, ample clearance between the bullet and the receding blade is provided. Furthermore, allowing roughly the same ample clearance for the oncoming blade, there is a quarter of a turn left for the bullet to pass. During this one-quarter of a turn of the propeller the bullet travels 20.8 ft. As the width of the propeller, measured in the engine axis, rarely exceeds 12 in., there is some 19 ft. to spare, or very small chance indeed to hit the propeller blades.

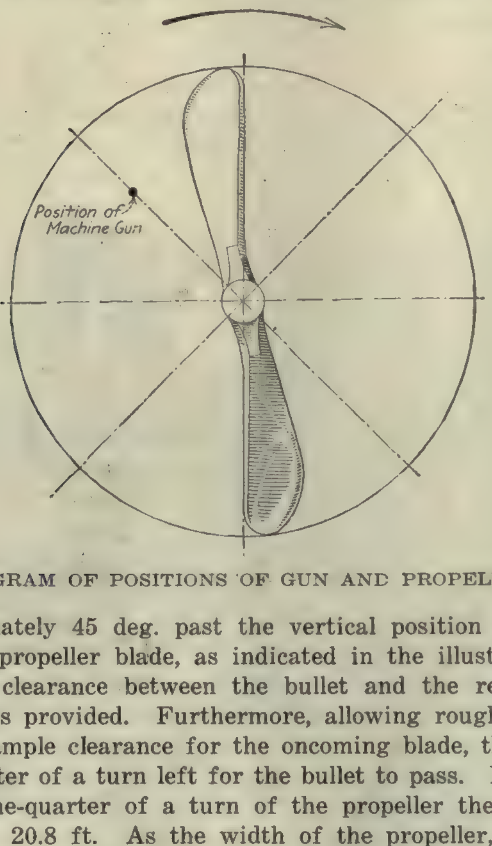


DIAGRAM OF POSITIONS OF GUN AND PROPELLER

Synchronizing the propeller and the machine gun is a relatively simple problem. I do not feel at liberty to describe the system used in the one type of plane and gun I am familiar with; furthermore, the scheme will vary with different types of guns, according to the peculiarity of the recoil mechanism. However, all that is required is to have a 1 to 2 gearing act on the mechanism that determines the speed of the gun, and furthermore this governing device must be positive and not allow the slightest slip whatever. The problem has been solved satisfactorily in all cases, and reports of actual effective continuous use at the fighting fronts have removed all misgivings about the feasibility of the arrangement.

The obvious disadvantage of the scheme is the difficulty of aiming, as the gun necessarily has a fixed position along the hood of the airplane engine and swings only through a very limited angle. The whole airplane has to be swung around to bring the gun to bear on the opponent and to take proper aim. On the now obsolete Fokker plane, the rapid-fire gun was set above the hood, a bit to the right, almost in front of the pilot. It could, however, fire only in the circle described by the propeller. A slanting shot toward the propeller will lengthen the time of passage for the bullet until a point is reached where a collision between blades and bullets is certain and unavoidable.

Another scheme of firing between the propeller blades consists of hindering the striking pin of the machine gun during the passage of the propeller blade in front of the barrel. The motor is connected to the gun by a cam regulated so as to fire the gun with a delay not exceeding $\frac{1}{500}$ sec. As soon as the blade of the propeller is not in the trajectory of the projectile, the system is liberated. When the pilot wishes to fire, he presses on a very small lever, placed in the center of the double handle of the directing lever, which acts by means of a device on the trigger of the gun.

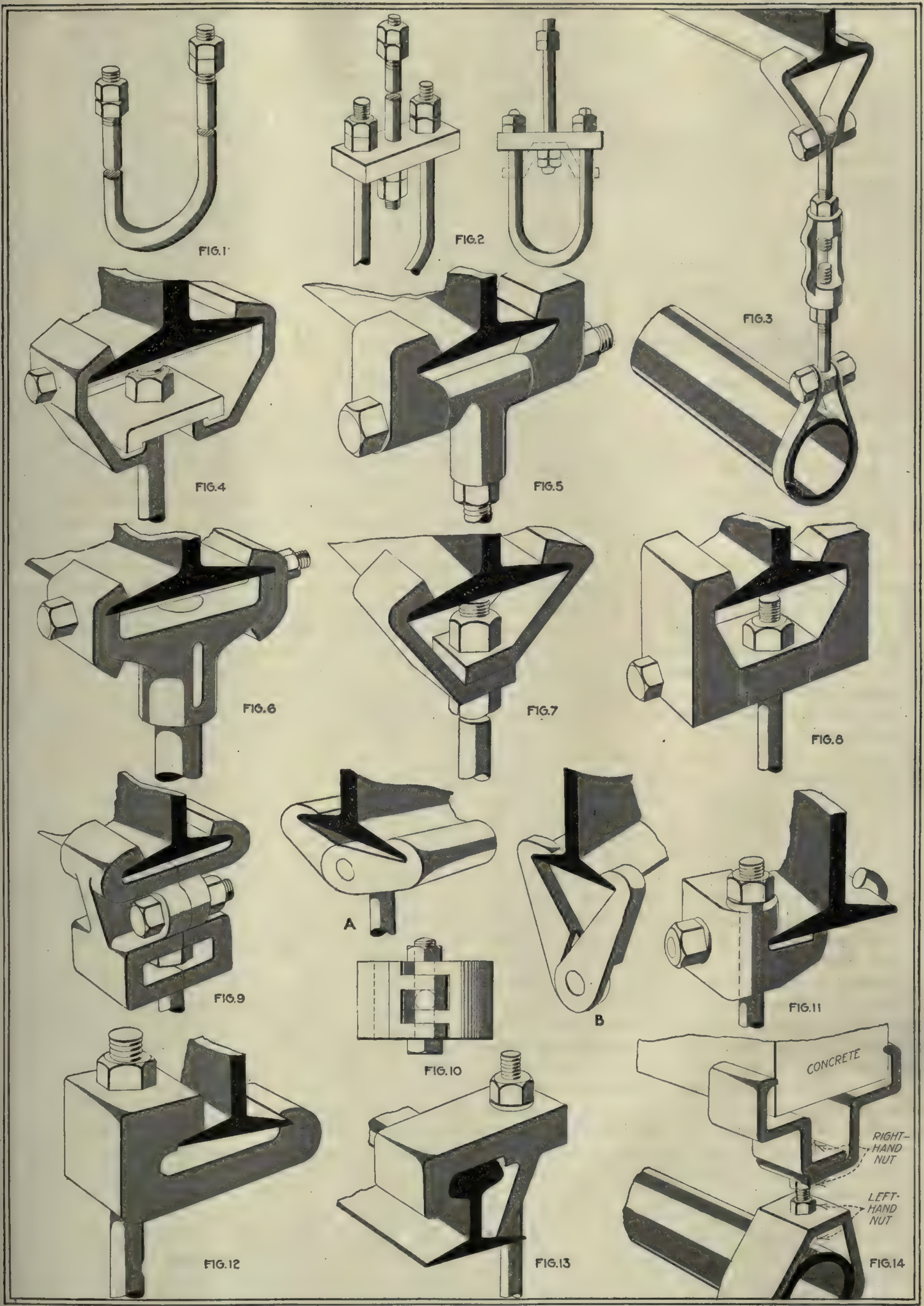
Recent reports from abroad seem to confirm that two and even three machine guns per airplane are quite common; by necessity one of them has to fire between the propeller blades in order to be handy to the observer, whereas the second and third guns are placed near the pilot and defend the rear. Mounted on a revolving base, this latter gun has a wide range of fire.

Various Types of Pipe Hangers

By A. J. Cohen

The common U-bolt, as shown in Fig. 1, forms about the simplest and cheapest pipe hanger when there exists a suitable structure overhead for attaching it. The rod should be threaded for a considerable distance on each end for adjustment, and for pipes subject to vibration, such as steam, exhaust, hydraulic-pressure lines, etc., there should be jam nuts or other form of nut locks. Where the distance to the joint of support is excessive, or the overhead structure favors attachment at a single joint, the pipe hanger in Fig. 2 is suitable. If a flat bar is used for the crossbeam, it should be bent as shown in dotted lines.

Fig. 3 illustrates a complete hanger with clamp suitable for attachment to the lower flange of an I-beam. The strap in which the pipe rests is made from a broad flat bar of wrought iron or steel, varying in thickness from $\frac{1}{8}$ in., or even less for very small pipes, to $\frac{3}{8}$ or $\frac{7}{16}$ in. for large pipes. A turnbuckle with locknuts provides a means for adjusting the length. The rod ends in the turnbuckle are upset to give the same strength at the rest of the thread as in the full section of the rod, and the whole forms a strong, sightly hanger suitable for nearly any location where minimum cost is not considered a matter of first importance.



FIGS. 1 TO 14. A NUMBER OF DIFFERENT TYPES OF PIPE HANGERS

A large percentage of the pipes in use at the present time are suspended from overhead beams, and Figs. 4 to 12 show a variety of clamps intended for this purpose. These are mostly designed to be made of steel castings or forgings. On lines subject to shocks, it is useless to attempt the determination of hanger dimensions by calculations of the dead weight to be carried. Only good judgment qualified by experience is of any use in this case, and about the only rule to be followed is the one that says, "When in doubt, make it stronger."

Fig. 10 is commonly made as shown at *A*. There is less stress upon both the pin and the clamps if made as shown at *B*. Fig. 13 represents a hanger on T-rails used for supporting heavy pipes in a tunnel with smaller pipes hung beneath them. In Fig. 14 a pipe is supported with an adjustable hanger by grooves formed in a concrete beam. The strength of the groove was found by experiment to be far in excess of that of the clamps, which were designed of ample proportions for the service required.

Large vertical pipes are usually supported from the bottom by means of a properly constructed special fitting provided with a base for resting upon a suitable foundation, preferably of masonry. Smaller ones may be suspended from above by rods connecting to a split collar placed beneath a convenient pair of flanges. Sometimes a vertical line is supported about midway of its length by a fitting made of a bracket form and bolted to the wall.

Brass-Shell Drawing and Redrawing

BY GEORGE F. KUHNE

Some manufacturers who have occasion to do, or are doing, shell redrawing have no doubt experienced difficulty with work of this nature. This article describes some of the main causes for defective work and how to avoid them.

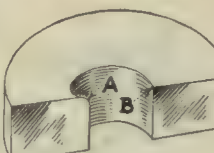
THE quality of drawing material used for brass shells is at times the cause of defective work, but not always. However, from my experience, I know that considerable trouble is met in this direction until the proper material for the desired product is obtained. When it is secured, I retain pieces of the flat stock and complete sets of the successive draws for future reference.

It is an error to draw shells to their finished diameters without a sufficient amount of reduction. Anyone experiencing much difficulty in shell breakage should consider the addition of one or more reductions as the case requires, unless this condition is the result of causes that I will mention farther on in this article.

The first cupping should not be very deep; in fact, I believe that for stock from No. 14 B & S. gage and thicker, a depth equal to one-half the diameter of the shell is a conservative and safe proportion, as the strength and properties of the material can easily be depreciated on a first cupping. While these corrections will assist, they will by no means eliminate all the difficulties, as there are other objectional features that are detrimental to the successful production of this class of work.

First-operation dies—that is, in the blank and form—should have rounded edges, as in Fig. 1. In making a die of this type the radius *A* is very important. Sharp corners as at *B* would cause too much stress to be employed, which might exceed the tensile strength of the material, thereby causing rupture or fracture to the shell. A good rule to use in determining this radius is to make it equal to from six to ten times the stock thickness. However, when it is desirable to secure an even top edge for a shell that is completed in one operation, this radius can be reduced to its minimum. For thin stock, this radius can be quite small; but when thick stock is used it can be increased quite a little without any danger of wrinkling, because heavy stock clings more readily and better to the drawing surface.

When first-operation dies are made, the allowance between the punch diameter and inside diameter of the die should exceed twice the thickness of material. A rule that is satisfactory is to allow from 2.2 to 2.5 times the material thickness. Too close an allowance will result in fractured shells, increased wear upon the die, more power and unsatisfactory production, as the heat generated will prevent the proper lubrication from taking place, and a continual pitting of the die, also scratched work, will result.



Cupping Die
1ST Operation
FIG. 1

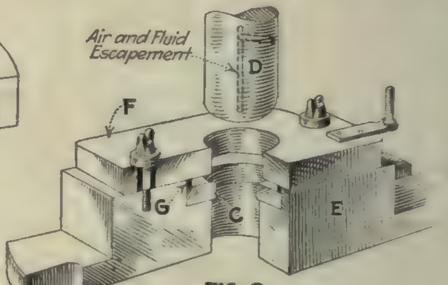


FIG. 2

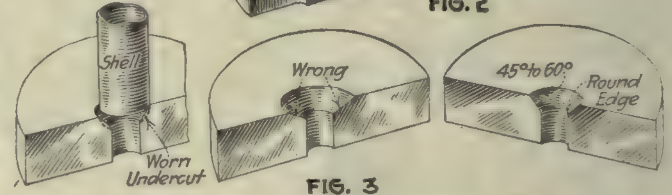


FIG. 3

FIGS. 1 TO 3. SHELL-DRAWING DIES

When a shell of thick stock is to be drawn and the double-acting press or a combination die is not available or practical for the desired product, a safe and efficient method to employ is to blank the piece first and cup it by means of tools, as shown in Fig. 2; *C* is the drawing die, *D* the punch, *E* the bolster and *F* the stripper.

The blank is inserted into the nest *G*, as provided, after which the stripper *F* is screwed down onto the blank, creating pressure much the same as when a double-action press is used, and perfectly satisfactory work is produced.

No drawing die should have sharp edges at the drawing point, nor should a too abrupt angle or lead be made. In order to permit the metal to draw or flow properly, round corners, as in Fig. 3, should be employed, although after the die has been used a length of time it will be noticed that the shell has become shorter, owing to the wearing out or undercutting of this edge.

Dies should not have too long a reducing surface, as the work when passing through the die will become heated excessively, thereby preventing the lubricant from performing its functions properly, causing particles of the work to adhere to the sides of the die, which eventually will attract more metal as the work progresses. Then if the shells are not already breaking, scratches will appear upon them, due to this wrong condition.

Annealing and Pickling

To eliminate the annealing of brass shells preparatory to a reduction is not always advisable, as at times it renders the material too hard and brittle, especially when thin stock is used. It is hard upon the dies, and in redrawing shells of about $\frac{5}{16}$-in. diameter by 4 in. long, 0.010 in. thick, I have noticed that the product was rather crooked or bent when not annealed previously. Another condition that will cause bent shells is having the back of a die broken out, but this of course does not occur when the diameter of the shell is large or of thick stock.

Annealing and pickling are two very important operations for work of this nature, and pitting of the die, scratched work and shell breakage are largely attributed to lack of sufficient precautions in this direction. Too little annealing is just as detrimental as its extreme, and should the annealing be insufficient (1000 to 1100 deg. F. is about correct), the bottom of the shell will very likely punch out; the die pits very easily, and if the stock is heavy, you will be reminded of this by the press doing the "mule stunt." On the other hand, work that has been subjected to too great a temperature decreases the ductility and tensile strength of the material. When this condition prevails, a shell may or may not draw to its full length, although should no breakage occur, the smooth finish that is most desirable is lacking and in its place appears an uneven, scaled-looking product.

Extreme care should be used in annealing. If a pyrometer is not convenient, adjust the furnace until it shows a bright, red glow, allowing the work to remain therein a sufficient time to bring all pieces to a like color, say cherry red.

If the temperature of the furnace is not increased, the work will not become overheated, although the shells are allowed to remain in it longer than the predetermined time. Use sheet-iron pans with covers, to prevent oxidation of the work and incidentally lessen the labor of pickling, but remember that the shells must be free from soap or oil and must be washed thoroughly before the annealing. After the annealing, the work is of course pickled in order to remove all evidence of scale or oxidation, and it is to be remembered that equal caution is required as for the annealing.

Ten parts of water to one part of sulphuric acid give a satisfactory solution for warm pickle; but if cold, seven parts of water to one part of sulphuric acid is a good combination. This, however, can be mixed to suit conditions. In preparing this bath, always put the water in first, the acid last; but if you are curious, do the contrary, but very carefully, and you will profit by the experience and know why the chemical action makes this precaution necessary, but be sure to keep the face well back from the vessel in which the mixing takes place.

After all oxidation is removed, the shells should be immersed and washed thoroughly in hot or boiling water (lukewarm will not suffice). The equipment for this should consist of a wooden tank with provision for an outlet and inlet for a continual supply of clear water. Should this operation be improperly done and the work be exposed to the air, it will be noticed that reddish spots appear upon the surface of the shells, and in some instances a green sediment, or verdigris, which is nothing but the acid, a condition to be particularly avoided. The shells on top may not appear to be as mentioned, but a bit more investigation halfway down or to the bottom will surely result in this finding.

It is needless to state that the acid has quite an affinity for steel; and should work in the condition mentioned be redrawn, not much progress will be made, as the tools will become pitted almost immediately and eventually be ruined.

Then again, suppose the acid spots have not made an appearance. This does not necessarily mean that the work is clean. Shells are improperly cleaned so long as there is any vestige of scale or oxidation upon them, and it is then time either to strengthen the mixture or talk to the cleaner, who perhaps was in too great a hurry or took a chance on the shells passing.

The redrawing of shells that have any oxidation upon them is simply erroneous, impractical and profitless. Forgetting, however, about the wear upon the tools, the man in the plating or finishing department may wonder why he has such a job in bright dipping and plating them, as the case may be. It is for no other reason than that the scale has been ironed into the shell.

A good way to prevent the oxygen from acting upon the shells is to immerse them in a receptacle of some kind filled with water or a soap mixture. Attached to it should be a pipe for heating. If there is any acid upon the shells, it will soon rise to the surface in a curdled state, where it is very readily skimmed off.

Redrawing dies and punches should always be kept in a polished condition, as much as possible, to get good results; but if conditions existing such as I have mentioned, it will be of very little use.

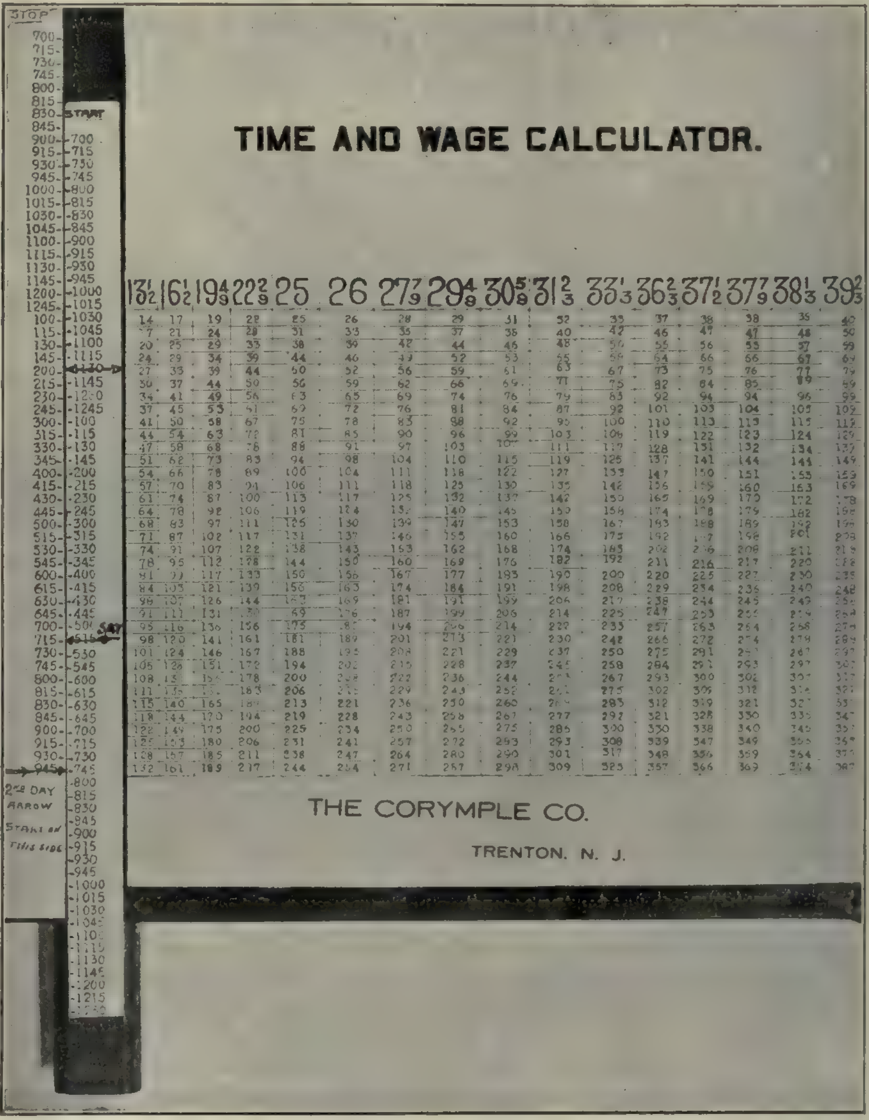
Time and Wage Calculator

By Foster B. Cooley

The accompanying illustration shows a very useful, rapid and accurate device for calculating elapsed time and resultant wages at different rates. It consists of a board with a vertical slide inserted near the left-hand side which carries figures representing the starting time in jumps of 15 min. Work proceeds from 7 a.m. to 12 m. and from 12:30 to 5:15 p.m., making a working day of 9¾ hours.

At the left of the slide, on the board, is a set of figures which are duplicates of the ones on the slide. These figures represent the stopping time. The figures in columns on the board at the right of the slide are the amounts of wages in dollars and cents, at the rate per hour shown at the top of each column. The first line is for 1 hour, the second 1¼ hours, the third 1½ hours, etc., at the rate specified at the top of the columns.

At the position of the slide shown, starting at any time on the slide and stopping directly opposite at the left on the board, the double-headed arrow on the slide points to 2 hours (on the left) and to the amount of money (on the right). By moving the slide, any elapsed time can be figured (between times of the same day) by using the double-headed arrow on the slide. Now if the time is to be figured starting one day and stopping the next, the procedure is just the opposite; that is, start on the board and stop on the slide, then read the answer on the slide opposite the arrow at the bottom of the board marked "2nd Day." For example, starting, say at 3:45 p.m. one day and finishing at 1:45 p.m. the next day, bring 1:45 on the slide opposite 3:45 on the board, and read opposite the second-day arrow, which is 7¾ hours, the actual working time. If there are a number of days between the working times, say from some time on a Monday to some time on a Thursday, figure as above and add two full days of 9¾ hours each. The second-day arrow, of course, does not point to the correct amount of money in the wage table; but after the time is found, 7¾ hours for instance, read opposite the figures 7:45 on the board scale to get the amount of money in wages, which at 13½c. per hour would be $1.05. On Saturday, in a 54-hour shop, the time generally runs from 7 to 12:15 p.m., making a day of 5¼ hours; so in figuring time from Friday to Monday, figure the same as from one day to the next and add 5¼ hours. If the time starts on Saturday and runs to Monday, start on the slide, stop on the board and read opposite the arrow marked "Saturday." For instance, from 9:30 a.m., Saturday, to 11:30 a.m., Monday, is 7¼ hours, as shown in the illustration. The working time and the rates, of course, will vary in different factories, but the rule can be worked out to suit any particular time and rates.



DEVICE FOR CALCULATING TIME AND WAGES

If desired, the time can be put on a narrow rule made of two pieces of wood dovetailed together in a suitable manner so that one piece will slide against the other, and the wage table may be made separate. This device was made to figure costs from workmen's time cards, the workman simply noting his starting and stopping time on the work card.

Lathe Design Suggestion

By Arthur W. Suiter

On page 611, A. H. Halladay speaks of the great advantage it would be to have lathe carriages so geared that one turn of the handle would move the carriage one inch along the lathe bed. It is indeed true that such an arrangement is of considerable value, not only in the cutting of threads to which he makes specific reference, but in a number of other ways as well. Is this contributor unacquainted with the Lodge & Shipley lathes? I have used lathes of this make ranging from 14- to 26-in. swing, and they were all provided with this feature. In some lines of work, such as cutting shoulders, grooves and recesses, especially when this was internally done, this facility proved most useful. An adjustable collar, graduated in thirty-seconds, was provided on the handle, though it always seemed hard to understand why sixty-fourths or hundredths were not used instead, as there was room enough for these finer graduations. It may be that this idea is no longer retained, though I can see no reason why anything so useful should be given up. In these days of efficiency, objections might be made to this idea for lathes with a swing greater than 26 inches.

IDEAS FROM PRACTICAL MEN

Multiple-Roll Chuck and Formulas for Grinding Hole in Gears

By C. H. Eastman

Fig. 1 shows a draw-in collet chuck *AB* with a number of rolls *C* distributed around the circumference of the gear; any number of rolls can be used, according to the number of teeth in the gear. The rolls *C* are mounted on a retaining ring *D*. They should be a loose fit in the retaining ring to allow them to enter freely between the teeth of the gear and also to adjust themselves to any irregularities that may occur in the gear teeth.

The tapered ends make it easy for them to enter between the gear teeth and collet chuck. The method of holding the rolls *C* in the retaining ring *D* should be observed. A small hole is drilled in the end of the roll *C* and the end upset with a center punch enough so that the rolls will not fall out of the ring. The rolls should be made of tool steel, hardened and ground to a diameter that can be found by the formulas given. The retaining ring can be made of machinery steel. The draw-in collet *B* is of tool steel, hardened and spring tempered except where the rolls come in contact with it; this portion should be left quite hard, to assure a good wearing surface for the rolls. The chuck *A* is of cast iron and is ground where the draw-in collet comes in contact with it to assure a good bearing surface.

The first formula, Fig. 2, is for finding the diameter of a roll that will lie directly on the pitch line of the gear and also to find the diameter over the roll from the center line of the gear, which equals one-half the inside diameter of the spring collet for any diameter of gear with any number of teeth. All that is necessary to be known is the pitch diameter of the gear and the number of teeth in the gear for which the chuck is to be adapted.

In a great many cases it is not a good plan to use a roll that will lie directly on the pitch line of the gear.

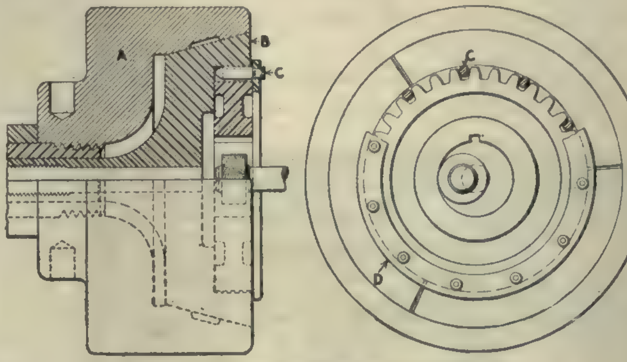
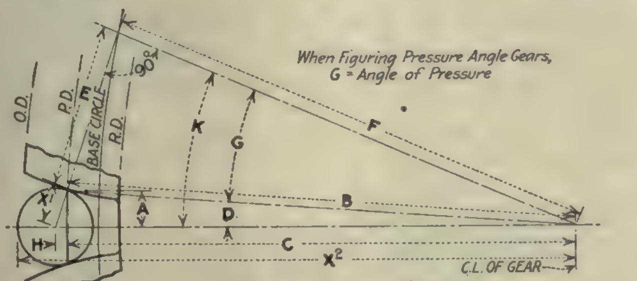


FIG. 1. MULTIPLE-ROLL CHUCK

Owing to the irregularities of the teeth, the draw-in collet is liable to hold on the outside diameter of the gear instead of holding by the rolls. In grinding hardened gears with ground teeth, it is advisable to use rolls that will lie on the pitch line of the gear. In grinding soft gears, always use the diameter roll that will lie slightly above the pitch line of the gear; for such cases I have provided a separate formula, No. 2, as given in Fig. 3.

This formula can be applied by using any standard-diameter roll that will be suitable for the gear that is to be ground. In using the formula it is necessary to know the diameter of the roll, the pitch diameter of the



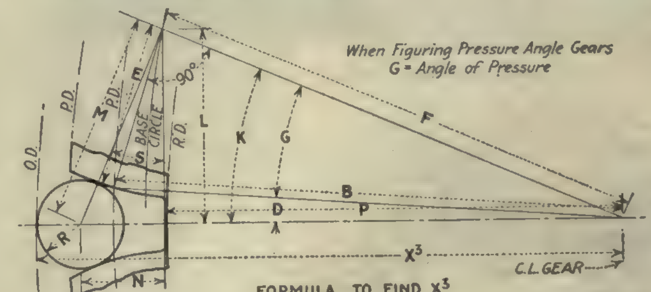
FORMULA TO FIND X^1 AND X^2

O.D. = Outside Diameter of Gear
P.D. = Pitch Diameter of Gear
R.D. = Root Diameter of Gear
A = ½ Chordal Thickness = ¼ Chordal Pitch
B = ½ Pitch Diameter
X^1 = ½ Diameter of Roll
X^2 = ½ Outside Diameter over Roll

$E = \frac{1}{4}B$ F = Base Circle $K = D + G$ $D\text{-}\sin = \frac{A}{B}$ $C = B \times \cos D$ $G\text{-}\sin = \frac{E}{B}$

$F = B \times \cos G$ $X^1 = \frac{A}{\cos K}$ $H = B \times \tan K$ $X^2 = C + H + X^1$

FIG. 2. FORMULA NO. 1



FORMULA TO FIND X^3

O.D. = Outside Diameter of Gear
P.D. = Pitch Diameter of Gear
R.D. = Root Diameter of Gear
A = ½ Chordal Thickness = ¼ Chordal Pitch
B = ½ Pitch Diameter
R = ½ Diameter of Roll
X^3 = ½ Outside Diameter over Roll

$M = E + R$ $E = \frac{1}{4}B$ $G\text{-}\sin = \frac{E}{B}$ $F = B \times \cos G$ $D\text{-}\sin = \frac{A}{B}$ $K = G + D$ $P = F \times \cos K$

$L = F \times \sin K$ $S\text{-}\cos = \frac{L}{M}$ $N = M \times \sin S$ $X^3 = P + N + R$

FIG. 3. FORMULA NO. 2

gear and the number of teeth in the gear. With these, the diameter over the rolls can be found, which equals one-half the diameter of the hole in the draw-in collet.

The foregoing formulas have been found by some of the leading automobile manufacturers to give the most efficient and most accurate method of grinding the hole in transmission gears.

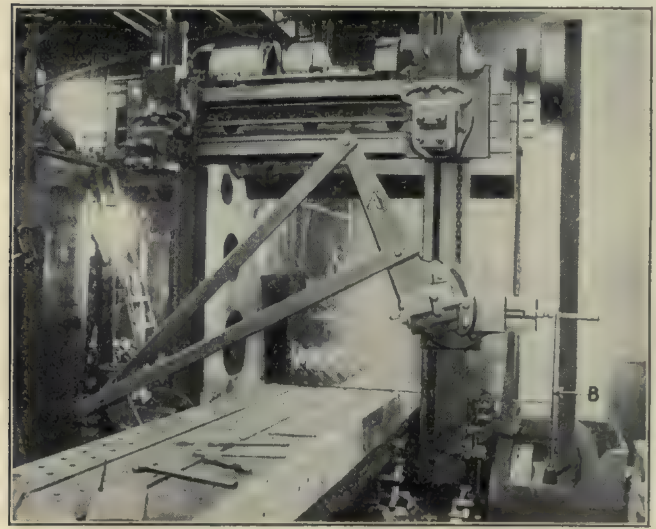
Radius Planing Attachment

By C. Johnson

The object of the device shown is to produce true circular or cylindrical surfaces on an ordinary planer, when for special reasons the work cannot be done on a lathe or boring mill.

As shown, the cutting tool is in this case carried by the side head on the right, while the side head on the left carries a fixed center stud. It will readily be seen that the point of the tool will travel in a true circular arc when the side head is caused to move up or down on the planer housing. For other radii, the two heads on the cross-rail may be used in a similar combination.

The long member *A* reaching upward, to which the two radial arms are bolted, is a cast-iron plate fastened to the back side of the clapper box and left free to swivel with the clapper box about the usual flat-headed screw provided under the clapper.



RADIUS-PLANING ATTACHMENT

The outside thrust collar on the side-head screw is removed to leave the slide free to move to the left. By means of the simple take-up arrangement *B*, which is a small weight and a cord wound about the outside end of a screw, any slack between the slide and the screw, will, at each succeeding feed movement by the side head, be automatically taken up. This relieves the device of any strain due to cutting and places the strain directly where it belongs—on the screw.

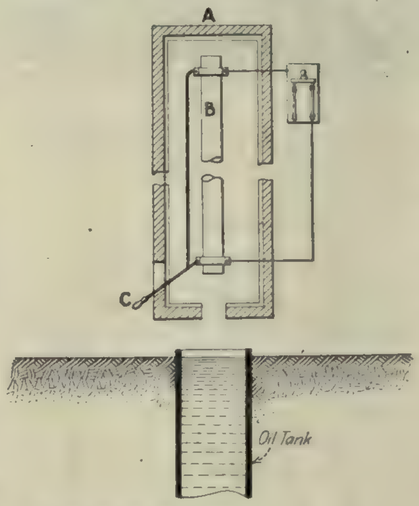
In order to make this take-up work successfully, it is necessary to so arrange the work, the fixed center and the direction of feed that the cutting-tool will, at each succeeding feed movement by the side head, move a small amount to the left.

The rim of a wheel 10 ft. in diameter by 4 ft. 6 in. wide, consisting of 25 segments, was recently machined by means of this device. After assembling, it proved in every way as true as if machined on a boring mill. This attachment was made at the shop of H. W. Caldwell & Son, Chicago, Illinois.

Heating Long Tubes Electrically

By F. T. Schell

The accompanying illustration shows a method we employed to harden steel tubes 15 ft. long. *A* is an asbestos-lined box, and by sending a low-voltage current through the tube *B* it was an easy matter to get the required heat. The lever *C* on the left operated the clamps on top and bottom of the tube. When the required heat was reached the tube was dropped in an oil tank that was sunk in the ground. The only difficulty we had was to keep the oil cold but this could be easily overcome if production warranted. One great advantage of this method was that the tubes were heated uniformly throughout their entire length.



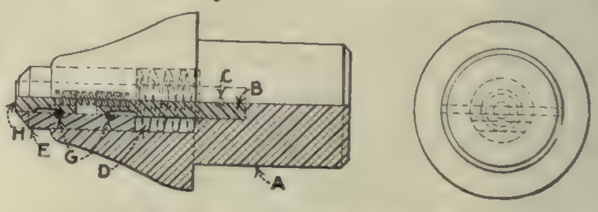
ELECTRIC HEATING FURNACE FOR TUBES

Handy Rivet Set

By S. W. Palmer

The rivet set illustrated is especially handy for holding two pieces of metal together while setting the rivet.

In the illustration *A* is a machine-steel body fitted into the ram of the press. In this body is the stem *B*, which has been forced into place and is held by a small pin *C*. Between this stem and the body is a hardened steel shell *E*, which is free to act against a coil spring *D*. Inside of the lower end of this shell is a hardened steel set *H*, which is free to act against a light coil spring. The parts *H* and *E* are held from falling out by the small pins *G*.



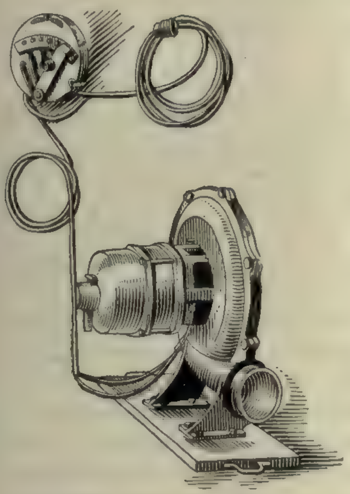
HANDY RIVET SET

After the work has been placed under the set, the press is tripped. As the ram descends, the set *H* moves upward in the shell *E* and the work is forced down and held tightly in place by the shell *E*, which moves up slowly against the action of the spring *D*. This action continues until the set *H* reaches the stem *B*, after which the rivet head is formed by the continued downward action of the press. During this time, the shell *E* continues to hold the work in place and to move upward slightly within the body *A*. This device affords a quick and easy method of holding and riveting sheet-metal parts and might be applied to some other lines of work.

Portable Air Blast

By M. E. Hoag

Shops that are not equipped with compressed-air systems will probably find the following suggestions both practical and convenient: In the shops of Harding Bros., Chicago, they are using small direct-connected electric motors and blowers, mounted on small portable bases, each unit being equipped with cord and plug to fit the lamp sockets. A short length of rubber hose and nozzle carries the air jet to the desired point. These blowers are readily moved from one machine to another and answer all the requirements of more expensive installations for blowing chips, cooling cutters, etc. This system serves for all shop uses with fewer blowers than would be possible were a permanent blower used for each machine in the shop.



PORTABLE AIR BLAST

Two-Stage Modified Geneva Stop

By Albert Constable

The Geneva stop motion is a well-known mechanism, but in its usual design the rotated part is limited to an angular movement of 90 deg.; that is, one revolution of the constantly revolving primary member moves the secondary member one-fourth of a revolution, or 90 deg. The mechanism herein described enables an angular movement of 180 deg. in the secondary member to be obtained for one revolution of the primary member.

Four diagrammatic views of the mechanism are given, one view for each 45-deg. travel of the secondary member. Also, an application of the motion is shown in Fig. 1. At *A* and *B* are fixed centers. The lever *C*, revolving constantly around the center *B*, during a portion of its revolution engages in the slots cut in the plate *D* and imparts an intermittent motion to the plate, moving it through an angle of 180 deg. before disengaging.

In the usual Geneva stop motion the moving pin engages with only one slot at a time to give the required movement. In the mechanism here described, use is made of two slots. In the plate *D*, and positioned as shown, are two bushes *E* at a distance from the axis of the plate *D*. The movement of these bushes about their own centers is controlled by crankpins at their rear ends working in a stationary cam path shown at *F*.

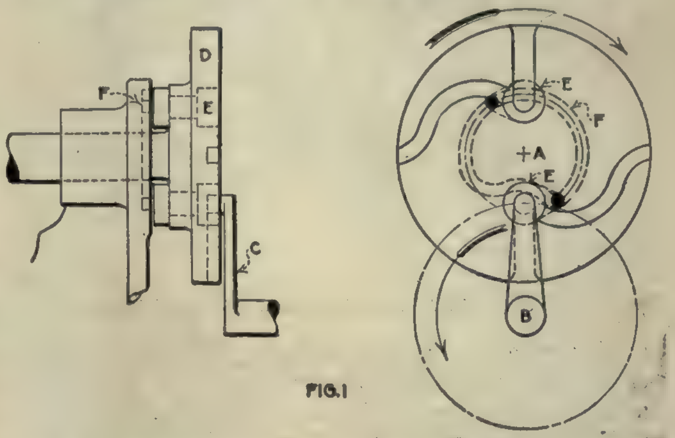
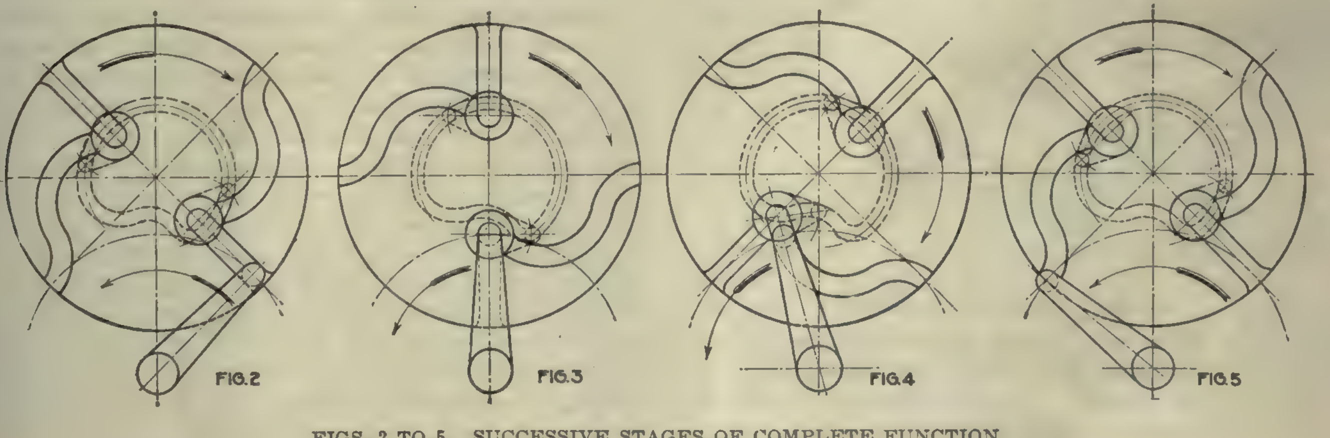


FIG. 1. APPLICATION OF TWO-STAGE GENEVA STOP

In operation, the projecting pin on the primary member *C* engages with the axial slot in the plate *D*. This position is clearly shown in Fig. 2. The plate *D* is thus moved through 45 deg. when the position is as shown in Fig. 3. The actuating pin has now entered the bush *E*, Fig. 1. The object of this bush is to deflect the pin from the axial slot to the curved slot, which it does by reason of the crankpin at its rear end, which is controlled by the stationary cam path. It then assumes the position shown in Fig. 4. The passage of the pin down the curved slot moves the plate *D*, Fig. 1, the remaining 90 deg. Fig. 5 shows the pin disengaging.

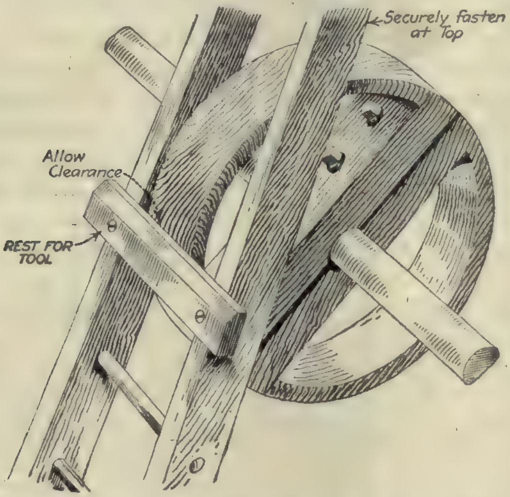


FIGS. 2 TO 5. SUCCESSIVE STAGES OF COMPLETE FUNCTION

Turning a Large Pulley

By M. E. Duggan

On page 165, Dan Kees describes his method of turning a large pulley. For a wood pulley that requires truing up, I would suggest turning the pulley without removing it from its regular position on the shaft. With a ladder securely fastened at bottom and top; a tool rest made of maple wood fastened to the ladder, as shown; a turning tool made of high-speed steel, the end tapering and rounding to about ⅛-in. radius; and a little nerve—the job is easily and quickly done.



TURNING A WOODEN PULLEY IN PLACE

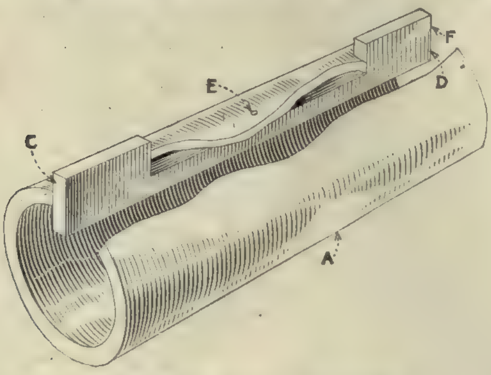
If anyone is afraid to tackle the job, he had better leave his address at the office, in case it might be necessary to remove him from the premises feet first. I have trued up a number of pulleys in this way without experiencing a single accident. A little care and a sharp tool are the only things required.

Keys Through Thin Bushings

By Charles Eisler

In response to the request of H. E. McCray, on page 121, I will describe some bushings that I have been using for a number of years.

In the illustration, *A* is a solid bushing, milled out at each end to fit the key, as shown at *C*. The key is made so that half of the key *D* is fitted into the mandrel keyway, and the part *F* is fitted into the cutter, pulley or whatever the case requires. The key can also be pinned or screwed in the bushing *A*, as shown at *E*.



KEY FOR THIN BUSHING

This way of making keys is cheap and generally works out satisfactorily. The advantage of using such bushings is that they are solid. When a bushing is slit or cut in half it will never retain its proper and accurate diameter.

Measuring and Testing Taps and Screws

By James F. Coyne

The measuring and testing of taps presents a serious problem to the manufacturer who has to produce interchangeable parts in quantities. He must have all the limit possible both in diameter and lead. From practical experience I have found that a tap that is 0.002 in. short in lead can be 0.002 in. large in diameter, and a tap that is 0.002 in. long in lead can be 0.002 in. small in diameter.

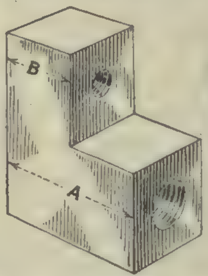


FIG. 1. GAGE FOR SCREWS

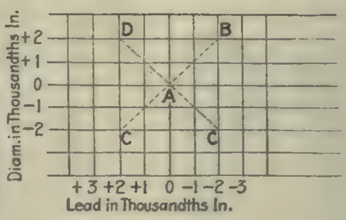


FIG. 2. TOLERANCE CHART FOR SCREWS

The accompanying chart will readily show that a tap 0.002 in. short in lead (line *AB*) can be 0.002 in. large in diameter; and the line *AC*—a tap that is 0.002 in. long in lead—can be 0.002 in. small in diameter. The line *AD* shows a tap 0.002 in. long in lead and 0.002 in. large in diameter. It can be readily seen that the latter tap will cut a large hole.

A successful method that I have used to test the screws during the process of manufacturing is to have test gages made like Fig. 1. The exact depth of the hole the screw is to fit is represented by *A*, and *B* is one-half the depth.

These gages are made of cast iron and will serve to test several thousand pieces at the screw machine. The part *A* checks the lead, and *B* checks the diameter.

Setting the Dividing Head

By C. Ross Lewis

In the dividing head, 40 turns of the handle give one turn of the spindle. To get the fractional number of turns of the handle for any number of divisions, place 40 above the line and the required number of divisions below the line. For example: Suppose the number of divisions required is 72. We have $\frac{40}{72}$ turns of the handle. Reducing this fraction to lowest terms, we get $\frac{5}{9}$. The next step is to select a circle with spaces divisible by the denominator 9, probably 27. Changing $\frac{5}{9}$ to twenty-sevenths gives $\frac{15}{27}$. Therefore, 15 spaces in the 27-space circle is required.

By calling each circle a number of spaces rather than a number of holes, many mistakes are avoided in setting the sectors. There is never a doubt in the amateur's mind as to whether he should count the first hole or not, when using this method.

Who Opposes the Metric System?

By R. C. Heinmiller

If the heads of industries that are to be affected by a change to the metric system were to be consulted before the step is taken there is no question but that it would never be taken in this country. Only a man who is active in manufacturing, like Mr. Brophy, has any idea of the cost and work involved in making a change in the construction of a machine. I believe very few have any idea of the cost and work involved in making the change to the metric system, throughout this country, except the manufacturer who has to bear the burden during the transition period. What assurance has he that he will profit by it? The man who will have to practice the metric system, and not the one who now preaches it, should be allowed to cast the deciding vote as to whether or not this system should be adopted.

The metric system is also being widely discussed in England, according to articles and correspondence in English engineering periodicals. Outbursts among the metric enthusiasts occur frequently there too. The following extract was taken from a correspondence in London *Engineering* in the issue of May 4. It is interesting as well as amusing:

"You drew attention to the number of presidents of U. S. A. engineering firms who oppose the metric system, and infer that their opposition means that of the engineering talent of the United States. But a president in U. S. A. is really the same as chairman of directors here. He is usually an elderly commercial man, who has confidence in his fellow capitalists, but knows very little of engineering. His age makes him opposed to changes, and he fears, with Mr. Halsey, the scrapping of tools and literature, although such a thing never occurred in a metric country."

The absurdity of the argument presented in this English correspondence is apparent to all who are acquainted with the heads of engineering firms in this country, or who have been reading "Who's Who" in the *American Machinist.* Here are a few cases as illustrations:

Ambrose Swasey, president of the Warner & Swasey Co., served his time as a machinist apprentice in a shop in Exeter N. H. He worked for Pratt & Whitney about eleven years. Murray Shipley, formerly president of the Lodge & Shipley Machine Tool Co., is a graduate of the Sheffield Scientific School, Yale University. James H. Drury, president of the Lapointe Machine Tool Co. and of the J. T. Slocomb Co., began work with Brown & Sharpe Mfg. Co. at fourteen and continued in their employ twenty-nine years. Jacob D. Cox, president of the Cleveland Twist Drill Co., worked successively as roll turner, puddler, roller, and machinist. Henry Champion, president of the Newton Machine Tool Works, started in the shop and worked his way up. Benjamin F. Barnes, president of the Barnes Drill Co., learned his trade after attending school till the age of fourteen. William Oesterlein, president and treasurer of the Oesterlein Machine Co., was a mechanic fifty years ago. E. C. Henn, vice president and general superintendent of the National Acme Mfg. Co., spent eighteen years with Pratt & Cady, and a short time with Pratt & Whitney.

These are only a few of the many instances that might be cited, but go to show that presidents of engineering firms in this country are not "elderly commercial men who know very little of engineering," but men of engineering experience who are able to judge the advantages and disadvantages of a change to the metric system. Their decision should bear weight in the settlement of this question.

Bosses, Men and Diplomacy

By Entropy

Often a man will go into business on his own account because, as he puts it, he will be his own boss. He soon finds out that he has exchanged his one boss for a multitude, comprising his customers, his employees and the people from whom he buys, to say nothing of the banks that may chance to finance him.

He does have the privilege, however, of firing any one or as many as he likes of his bosses. Every one that he fires, however, means a loss of the profit that he might have made, so after a time he becomes more solicitous about this multitude of bosses than he ever was over the single one that preceded them.

He also comes to realize the opportunity that every one of his employees has to discharge his bosses. The very office boys can make a visitor so uncomfortable that he will prefer to take his orders and his influence across the street. His order clerks can write for additional information, and his claim agent can turn down a claim in such ways that no self-respecting man will deal further with him.

The worst of these business losers, however, is the man who wreaks personal revenge at the expense of the company for which he works. Every day is bound to bring something that is offensive to some individual. He may be unnecessarily sensitive himself, or he may be so loyal to the firm that an insult to it may be an insult that he feels called on to resent himself. His method of resenting it may easily make not merely an enemy for himself, but for the firm.

This is by no means confined to loss of customers. Oftener, perhaps, it is loss of employees. Sometimes it seems as if every employee ought to be tagged with his inventory valuation, something like this: "This is John Jones; he has been with the company eight years and is considered worth $1600 over and above the current expense of employing him. Anyone caught alienating his thoughts from this company or in any way influencing him to leave us will be docked that sum."

Seriously, every man that is worth keeping at all has some such valuation. It may be expressed in terms of what it cost to find him and break him in, or in terms of the expected cost of finding another man and bringing him to the point of equal efficiency. Possibly, of course, error may be made in the valuation, and possibly it should be a negative quantity; but that is a matter of judgment on the part of the firm which should not be too closely questioned by others who do not know all the circumstances.

If some such valuation were placed on men, there would certainly be some serious thinking before department heads summarily discharged men of long standing with the company.

Machine Tool Builders Convention

SPECIAL CORRESPONDENCE

THE sixteenth annual convention of the National Association of Machine Tool Builders was held in New York at the Hotel Astor on Oct. 30 and 31. The meeting was very largely attended, being opened with a very creditable rendering of "America," which was followed by the usual invocation and the reports of the various officers.

The opening address by President Doane was particularly timely and is reproduced herewith:

"This is the Sixteenth Annual Meeting of your Association, and it is with great pleasure that I have the honor to again address you, to welcome members and guests and to tender most cordial greetings to all.

"We have with us a number of new members; may they find in their hearts a ready response to the spirit of hospitality, of friendship and coöperation here extended, and which has been built up through many meetings of this sympathetic machine tool building family.

"It is a fitting time for instant and complete friendship amongst us; this is a day when we should knit our hearts together in a new and profound loyalty, which begins with our Association and from there goes out to our beloved country. We need each other, and America needs all of us. As President Wilson has said: 'We must coöperate in the whole field of business, the Government with the merchant, the merchant with the employee, and all with each other.'

"I was never more proud of being a member of this Association than in the past six months, during which time it has demonstrated its value to our country, by way of providing the means to quickly collect and distribute information, statistics and various data which were needed by Government officials almost instantly. We all knew it was coming, but yet, when the storm broke, the need was even greater than any man had imagined or could realize in advance.

"Through this Association and its membership, our leaders at Washington have been able to quickly inform themselves of the condition of our plants, and every member, I am sure, has done his utmost to speed up shipments and to satisfy as best he could the governmental requirements.

Value of Time

"Hours are extremely valuable in warfare; even minutes often win battles. Any machine tool builder who does not bend all his mental energy to the solution of the problem of rapid output is a lame soldier in the fighting line. We must literally spend sleepless days and nights, for we are the machines behind the men behind the guns. No machines—no guns!

"Humanity is living in a mechanical age. This is no longer a time when wars are to be decided by personal bravery; victory will perch on the banner of the nation with personal skill. It is time to encourage to the limit mechanical efficiency and personal service throughout our country.

"I have little patience at this time with race-track followers, with pool-room hangers-on, park loungers and others of that class, who take much from a community and give little or nothing in return; they should be put to work and made to do their share in this emergency with which we are grappling. If the Government can conscript a fine young man, your son or brother perhaps, why can it not draft the loafer and make him do his bit as well?

"The machine shops of this country are the real reserves of the army. Napoleon would perhaps have called them his 'Imperial Guard.' We can have a peculiar pride in knowing that upon our shoulders rests such a responsibility, and those of us who cannot go to the firing line can do our part at our shops, because the fighting man is not the only one who must 'go over the top'; we must do the same thing with good tools and plenty of them at top speed.

Attitude of the United States

"This has been a peace-loving nation for many years, during which time our great scientific and mechanical works have directed their entire effort to constructive work, consequently and naturally, we were not ready for war, a devastating work. Our energy was all expended in the work of upbuilding; we have; however, all these fundamental industries, which, by throwing into reverse gear, much as we regret to change their course, can turn their great power with terrific force to the purpose of warlike destruction.

"Now that we have been forced into war, let us show the enemies of our country that while we believe in upbuilding we have at our command the power to tear into atoms the destructive forces which have been let loose upon an unwilling world for purely selfish and autocratic ends; that as creators of freedom, we will turn all our machinery of progress toward the destruction of the enemies of freedom.

"We have been striving to create an 'Industrial and Social Heaven' in America; let us show them that we will fight like Hell to keep it!

"But this war will end some time; no man knows when, and then the business man with a large plant and a large payroll will have some real questions to solve, requiring clear vision and courage. A prophet may indulge in predictions based on natural laws and past experience. Without, however, making any attempt at prophecy, I want to direct the attention of this membership to the fact that during the last three years there has been built about the same number of machine tools as would be built in ten years.

"They are, of course, through a process of long hourly service and a lack of skilled operators, being worn out more rapidly than usual; but even under such conditions, the life of a well-designed and well-built machine tool is quite long. Therefore, I ask you, how long will it require the world market to absorb this oversupply which even now is apparent in some kinds of machine tools? Mind you, I am not predicting, simply calling your attention to a condition, with a view to having each manufacturer answer the question as best he can, but I would also like to add the old warning: 'The good sailor trims his sails for a squall!'

"This country has long been preëminent in the machine-tool building industry because we have cheap raw material, the inventive mind, labor efficiency and business organization. In the future, however, we must add additional qualifications; namely, we must further improve, we must grow more efficient, and we must deal with all nations in the same open-minded, honest, straight-forward way. There must be no scraps of paper' in our business dealings, no 'secret diplomacy,' simply old-fashioned, dyed-in-the-wool, painstaking business transactions, which will permit us to extend our world trade to every country where a machine tool is used. In other words, 'In time of war prepare for peace.'

"Our country needs our service now more than it ever has before. This terrific struggle means more than physical effort; it means strains of every kind; it means heavy taxes; it means personal sacrifices; it means work and lots of it; but I am quite sure that the machine-tool builders of this country are fully equal to their task.

"Let us make this convention memorable in the annals of our craft. Let us dedicate ourselves to a deeper patriotism and give to our country every energy we possess, with the hope and prayer that when victory shall again come to the flag which has never known defeat, it will usher in an everlasting peace."

Following this was an extremely interesting address by Henry Japp, C. B. E., Deputy Director General in the United States for the British Minister of Munitions. This was of such wide-spread interest that it will be reproduced in full in our next issue. Following this was an address by George E. MacIlwaine, of the Babson Statistical Organization. Mr. MacIlwaine showed the trend of business during the past 13 years, by means of the Babson chart, and gave many suggestions as to what might be expected and as to some of the changes which he believed must take place as the result of the war.

CONVENTION PROGRAM

The afternoon session of the first day consisted of addresses by Prof. R. Poliakoff, a member of the Russian Commission; E. G. Todd, of the firm of E. Isberque & Co., of Antwerp, Belgium; Roger F. Redier, representing France; Henry S. Moos, M. E., member of the American Machinery Syndicate of New York and Spain; and G. E. Briggs, of the Buenos Aires branch of the National City Bank of New York. Italy was to be represented by Sebastiano Raimondo, General Director of Gio. Ansaldo & Co., of New York, but he was unable to be present. These addresses were all of extreme interest and of particular value as showing the different viewpoints of the present situation.

The second day was confined entirely to committee and other executive meetings, at one of which George Merryweather, the well-known machinery dealer of Cleveland, who is now connected with the Machine Tool Division of the War Industries Board, addressed the members.

A number of new members were elected, among them being Cleveland Milling Machine Co., Cleveland, Ohio; Hoefer Manufacturing Co., Freeport, Ill.; Ott Grinding Machine Co., Indianapolis, Ind.; the Millholland Co., Indianapolis, Ind.; Platt & Wright Co., Chicago, Ill.; Grand Rapids Grinding Co., Grand Rapids, Mich.; Giddings & Lewis, Fond du Lac, Wis.; U. S. Machine Co., Cincinnati, Ohio, and the Wood Turret Machine Co., Peoria, Ill.

The committee on resolutions reported the death of two members, Paul Kendig, formerly connected with the Seneca Falls Manufacturing Co., and who was a very prominent figure at the various conventions, where his counsel and advice, accompanied by his cherry voice and good humor will be sadly missed.

The death of Albert S. Smith, President of the Smith & Mills Co., Cincinnati, Ohio, was also announced. Mr. Smith was long associated with the machine-tool industry in Cincinnati and was the last surviving member of the original firm. He was well and favorably known among his business associates, his death leaving but few of the old guard in Cincinnati.

Information to Applicants for Enlisted Ordnance Corps

The Enlisted Ordnance Corps, National Army, into which the Ordnance Enlisted Reserve Corps has been merged, is charged with the supply, maintenance and repair of all cannon and artillery vehicles and equipment, machines for the service and maneuver of artillery, small arms, ammunition, harness, motor trucks, motor cycles, tractors and railroad cars; in fact, it is the army behind the army commonly known as "Service of the Rear."

There is a place for practically every man who knows a trade in the Enlisted Ordnance Corps—machinists, mechanics, plumbers, painters, carpenters, canvas workers, auto mechanics, saddlers, blacksmiths and wheelrights are especially needed at this time. Applicants must be between 18 and 40 years, citizens or declarants, and be able to speak, read and write the English language. They should have no absolute dependents, and must be able to pass a physical examination conforming to that prescribed for the regular army.

If accepted for enlistment, men will ordinarily be sent to an arsenal school for a period of instruction, on completion of which they will be assigned to detachments, units or organizations, with ultimate service abroad. Previous military training, while preferable, is not essential, as men will continue the work which they pursue in civil life.

In view of the importance of their work a large number of men will serve as non-commissioned officers. Original enlistment is required as private, but later courses of training or special qualifications quickly lead to higher grades. Pay ranges from $30 to $97.20 a month, depending upon demonstrated ability and place of service. Men enlist for duration of war only. Free quarters, rations, clothing, bedding, medical attendance, etc., are provided.

Men registered under the Selective Service law may voluntarily enlist prior to the posting of their names by their local boards. No man who has been called to appear for physical examination is eligible.

Application blanks may be obtained by writing to Chief of Ordnance, Enlisted Personnel Division, Washington, D. C.

Editorials

The Machine Builders Respond to Uncle Sam's Appeal

IF ANYONE says that the great machine-building industries of this country are not truly patriotic, they know mighty little about the facts of the case. If they even intimate that they are not ready to make sacrifices to help the Government and the country (which mean you, and all of us) in its hour of need, they sadly lack information.

Here is a single instance which is hopeful, helpful and illuminating.

A certain important department needed a large supply of skilled men of a class which is never any too plentiful, and which it is now almost impossible to secure. In fact, most large machine building concerns are constantly trying, by advertising and otherwise, to add to their force.

Yet when the call came, through channels which they knew were working for the best interest of all concerned, the managers of these concerns gave up some of the best men they had, each as many as he could spare, and made up the required quota for the special work in hand.

* * *

And furthermore, they paid the men's transportation to Washington, and in many cases, are paying them the difference between their former salaries and what the Government can pay them. For Congress, in its wisdom, although appropriating money with a lavish hand, has made it impossible to pay these men what they are worth, no matter how badly they may be needed.

Many of these manufacturers have been hard hit by the draft, and are justly disgusted with the lack of discrimination in the exempting of men, and the failure to assign them back to the industry. They might easily have said that if the Government needed men it could take those who had been drafted, but they waived all personal feeling in the matter, and responded to the full extent of their ability in every case.

Their own work will be delayed and with it the profits on the work they are doing. In many cases it will delay important work to some extent. But the need was vital and fundamental, and there was no arguing as to which was the more important. The Government at Washington called, and the machine builders responded heartily, promptly and generously, as we knew they would.

Success of the Second Loan Call

THE success of the Second Liberty Loan not only emphasizes the intense patriotism of all Americans irrespective of their place of nativity, but shows to the entire world the large scale on which enormous undertakings are carried through by the people of this country. It is an object lesson in the successful accomplishment of big doings that does not require extended comment. It will, however, have its moral effect in a large measure on our Allies, and will, undoubtedly, prove an inspiration and stimulus to them for making increased and continued effort in behalf of the freedom of the world from autocracy and militarism. On the other hand it must be a serious blow to the enemy who had hoped for, and confidently predicted the failure of the loan.

* * *

The magnitude of the amount of the subscriptions is beyond human comprehension, but when it is realized that according to reliable and thoroughly conservative estimates, approximately one in every ten of the inhabitants of our country and its possessions has been a bond purchaser, a vague idea is conveyed of just what the loan means, and the universal character of its taking by our citizens, banking institutions, manufacturing establishments, business houses of all descriptions, mechanics, artisans, and laboring men of all classes emphasizes in a marked degree the intense loyalty and patriotism of our people. The spirit of determination and unanimity displayed among our citizens in all parts of the country will as surely comfort every patriotic American, as it will confound our enemies.

All talk of a referendum on the war should be silenced now for all time. The Liberty Loan was in itself the only referendum needed to show that we are in this war, not only to stay, but to win.

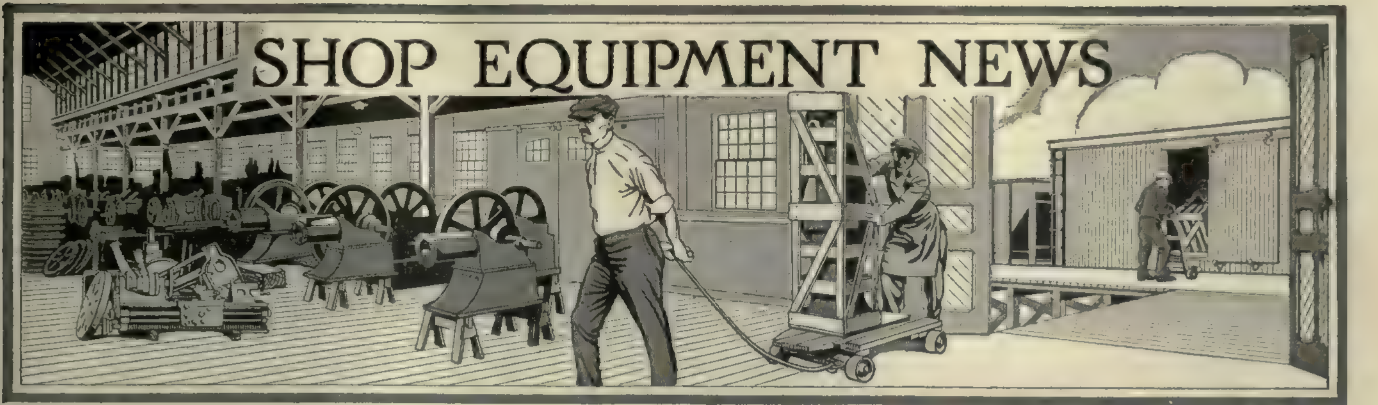
* * *

One of the very gratifying features of the loan was the whole-hearted and far-reaching response from shop and factory. Thousands of industrial establishments extended to their employees the opportunity of purchasing on the installment plan, and this opportunity was not allowed to pass. The financial interests also responded heartily to the call. New York City, the financial center now, not only of this country, but of the world, taking considerably over its quota of $1,500,000,000.

When it is taken into consideration, that the interest-bearing debt of the United States at the beginning of the war was about $968,000,000, the non-interest bearing legal tenders, etc., $369,270,811, and the miscellaneous obligations $1,500,000, a total of $1,338,770,811, an idea of what New York has done becomes more understandable.

* * *

We are now spending approximately $42,000,000 per day, and within a comparatively short time this amount will be increased to more than $80,000,000. But even this vast amount of money is of far less importance than that everyone of us put all our energy into doing our part in whatever line we may be at work.



This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

"Prestwich" Thread Gage

The special thread gaging fixture shown in Figs. 1 and 2 was designed by J. H. Wilhelm of the Frankford Arsenal for use on government inspection work on thread gages. The stand is entirely new, but the gage itself is the standard type of Prestwich fluid gage. The graduations on the vertical scale are ⅛ in. apart, each representing a variation of 0.0001 in.

Fig. 1 shows a plug thread gage being measured. It rests on two ground and lapped 60 deg. V-blocks and the contact piece of the gage spindle is a steel roller with a 60 deg. V-groove. This roller is carried in a swivel head, which allows various thread angles to be gaged from any position without inconvenience to the operator. A set of eight rollers are supplied for use on gages or other such parts having different pitches.

The gage is carried on an adjustable bracket, counterbalanced and operated up or down by means of a rack and pinion. A thumb-screw locks the bracket bar wherever set. The table on which the V-blocks rest is a carefully ground and lapped disk of steel 5 in. in diameter set into the base of the fixture and resting on a three-point contact. As the gage itself is only a comparator gage, definite measurements for any given thread diameter may be obtained by setting the gage spindle the proper height by the use of Johannson gage blocks, as shown in Fig. 2.

The base of the fixture is approximately 2 x 2 ft., the V-blocks are about 3 in. long by 1½ in. high, and the weight of complete fixture is about 250 pounds.

The fixture was made by the H. E. Harris Engineering Co., Bridgeport, Conn., and is for sale by the Coats Machine Tool Co., 30 Church St., New York City.

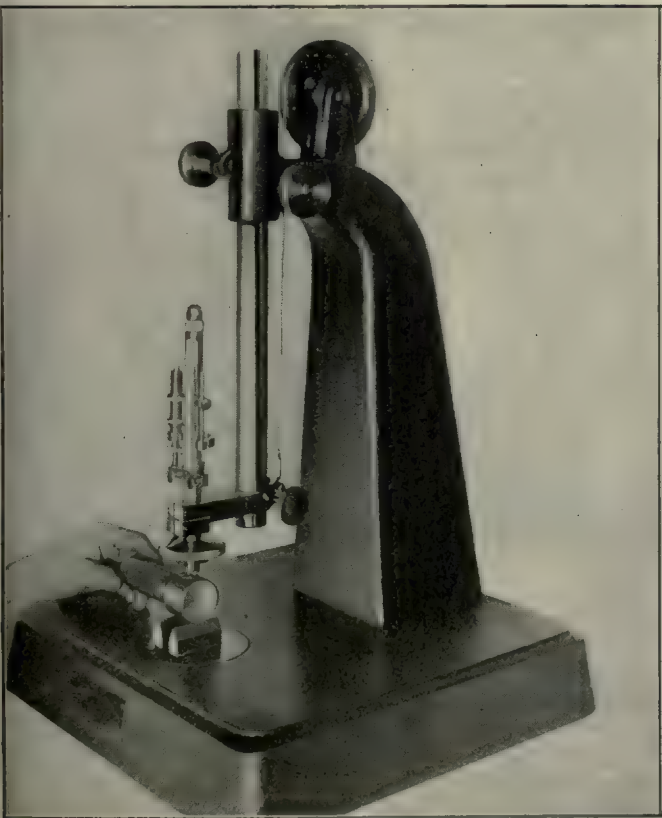


FIG. 1. THREAD GAGING FIXTURE

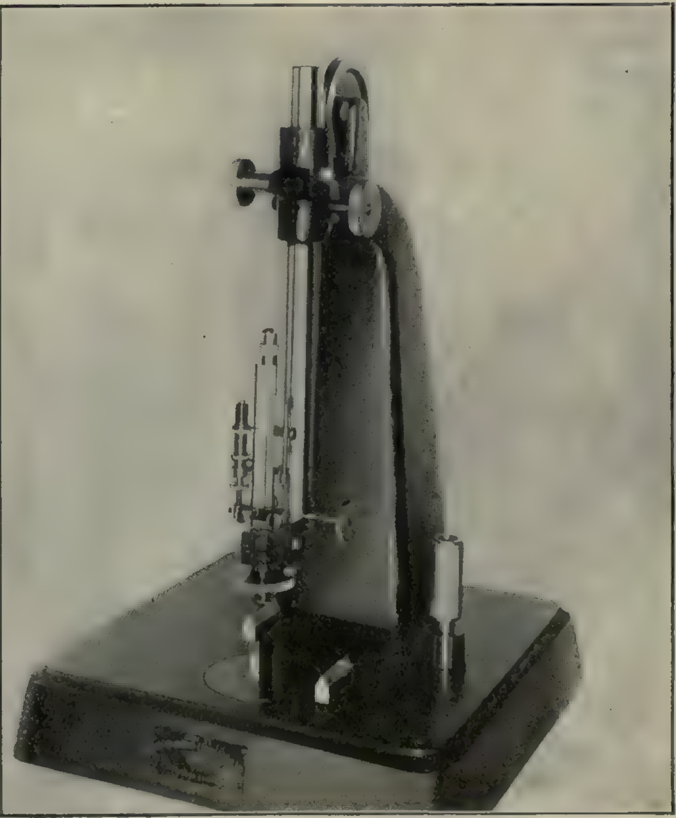
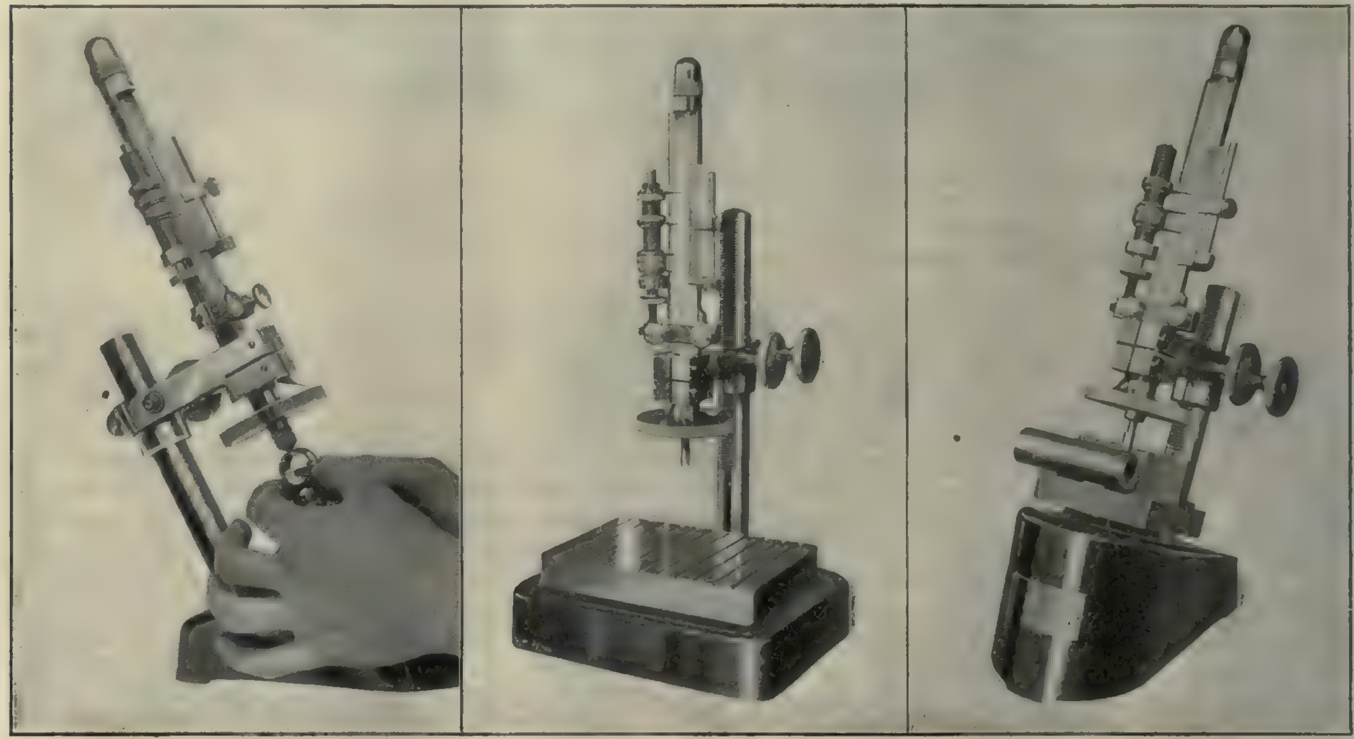


FIG. 2. SETTING FOR ABSOLUTE MEASUREMENT

"Prestwich" Fluid Gage Applications

The accompanying illustrations show some of the special fixtures for the use of Prestwich fluid gages, handled by the Coats Machine Tool Co., New York. Fig. 1 shows a tilted holding fixture for measuring ball races, the race being placed between two balls of the correct size held to the anvil and spindle of the gage as shown. Fig. 2 is a special fixture designed for gaging piston pins and Fig. 3 is designed for measuring pistons or work of a similar character.

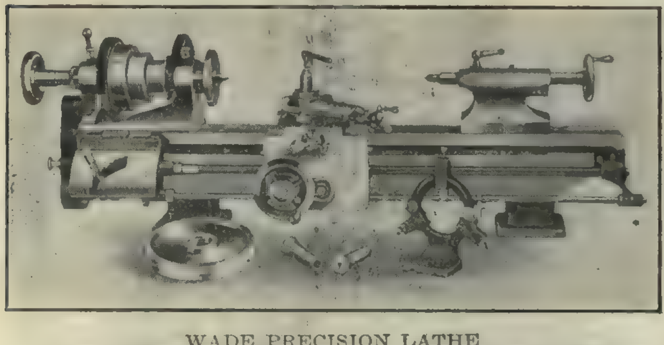


FIGS. 1 TO 3. SPECIAL GAGING FIXTURES

Fig. 1—Fixture for gaging ball races. Fig. 2—Gaging piston pins. Fig. 3—Fixture for gaging pistons

Wade Precision Lathe

Walter H. Wade, Boston, Mass., is now marketing the toolmakers precision lathe shown in the illustration. The bed is in the shape of a hollow square with cross ribs to insure rigidity. Its length is 45 in. giving a maximum distance between centers of 24 in. The ways are located directly over the supporting sides of the bed which obviates any pockets which might collect dirt and chips. The head is back geared, the spindle being of the cone-type made from hardened tool steel ground and lapped to size. Bearings are provided with suitable adjustments to provide for wear. The tailstock spindle has a bearing the full length of the tailstock which may be set over for turning tapers. A quick change gear box is provided which allows screw threads of 24 different pitches to be cut, these threads ranging from 12 to 120 per in. Feeds 2.9 times finer than any screw thread are obtained by operating the feed rod. The lead screw is of crucible machinery steel with an eight-pitch thread; the lead screw nut being of bronze. Spring chucks are furnished ranging in size from $\frac{1}{8}$ to $\frac{3}{4}$ in. by 16ths.

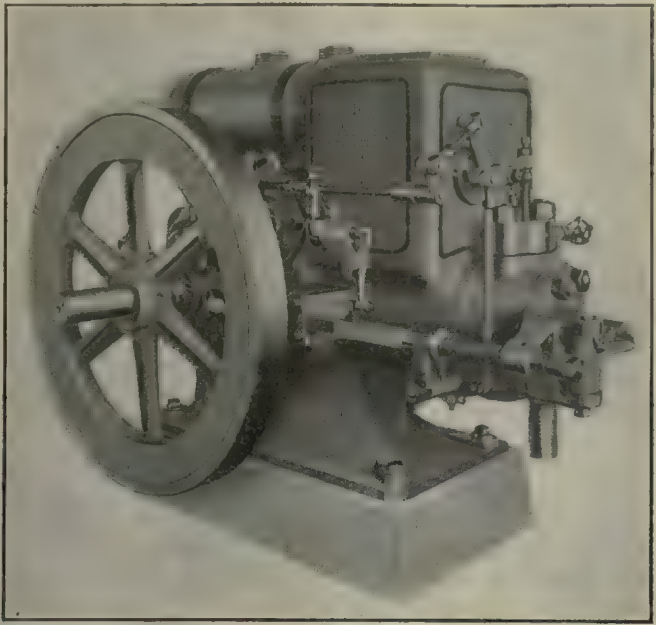


WADE PRECISION LATHE

Swing, $8\frac{1}{2}$ in.; maximum distance between centers, 24 in.; bearings, cone type; tailstock, set over; diameter of lead screw, $\frac{3}{4}$ in.; thread pitch of lead screw, 8; threads cut by means of gear box, twenty-four, 12 to 120 per in.; feeds obtained by feed rod, 2.9 times finer than threads; spring chucks, eleven, $\frac{1}{8}$ to $\frac{3}{4}$ in.; width of belt, $1\frac{1}{4}$ in.; weight, 450 lb.

The Evinrude Oil Engine

The Evinrude Motor Co., 326 Walker St., Milwaukee, Wis., has recently placed on the market the oil engine shown in the illustration, which at the present time is being manufactured in two sizes: $1\frac{1}{2}$ and 3 hp. The company contemplates adding other sizes in the near future. It is claimed that the engine will operate satisfactorily on any of the low priced heavier fuels such as kerosene, fuel oil, solar oil, crude oil, stove oil, and coal oil. The principle of operation is as follows: Beginning with the intake or suction stroke, pure air only is taken into the cylinder while a charge of oil enters the fuel cup. During the compression stroke part of the compressed air is forced into the fuel cup where a gas mixture is formed and exploded as the compression increases. This small explosion forces the oil, in a highly atomized state, into the main portion of the cylinder, where the combustion proper takes place, driving the piston forward. At the end of the power stroke the exhaust valve opens and the burnt gases are expelled. Th cylinder is water cooled the water being held in a hopper cast integral with the cylinder, no forced circulation system being used. A governor and forced-feed lubrication are provided. In order to overcome the noise caused by the inlet valve this part is fitted with an air cushion. The crank case is entirely inclosed, the lubrication, including that of the gears and governor, being effected by the splash system. A centrifugal oil ring serves to oil the crank pin. The makers claim that the consumption of kerosene or heavy fuel per horsepower per hour will not exceed $\frac{7}{10}$ lb., and that it will start as easily in cold as in warm weather.



EVINRUDE OIL ENGINE

Van Norman Internal Grinding Machine

The illustrations show the **latest** internal grinding machine that is now being marketed by the Van Norman Machine Tool Co., Springfield, Mass. The type of construction used on this machine allows both the work-holding head and the grinding-wheel head being mounted directly over the base; a feature that gives both heads a substantial foundation. The table-feed mechanism is disconnected, and the cutting wheel withdrawn by the single movement of one lever; when the workman with his other hand may release and carry the work-head out on the cross-slide ways at right angles to the wheel spindle, thus giving considerable clearance for test and inspection of the work. The return to position is controlled by spring latches that give uniform pressure against a stop, the operator simply returning the slide until the latch engages, when the spring mechanism presses the slide against the stop. The automatic cross-feed carries the cutting-wheel spindle, and has a finely graduated dial and an adjustable cutout latch device. Hand cross-feed is also provided. Any length of table stroke from $\frac{1}{8}$ to $1\frac{5}{8}$ in. may be secured by means of the automatic table traverse. The table may also be operated by means of a hand lever rack and pinion device, which gives a movement to the table up to $4\frac{1}{2}$ in. The work-head cross-slide is operated by a hand lever, which carries the head crosswise from the center of the wheel spindle, a distance of $4\frac{1}{2}$ in. The work-holding head has a swing over the table of 11 in. The machine is furnished either with or without a water system.

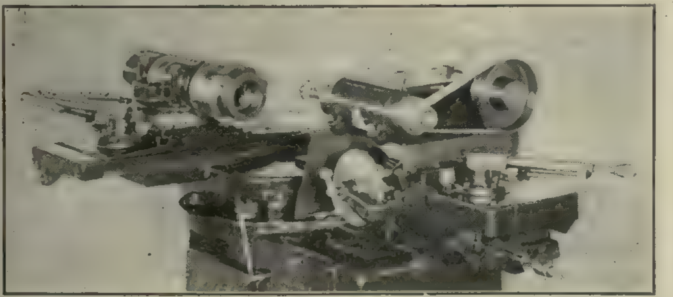


FIG. 2. DETAIL SHOWING HOW THE SPINDLE HEAD MAY BE MOVED OUT OF THE WAY

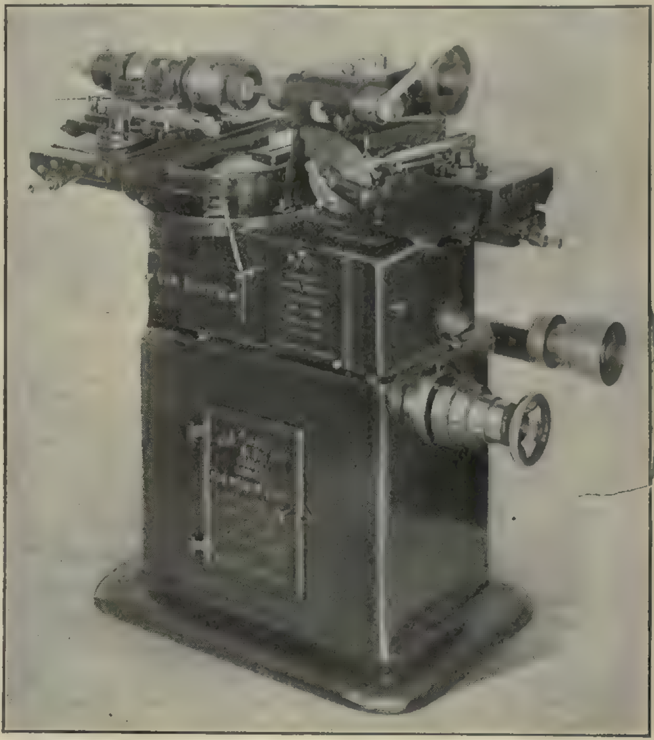


FIG. 1. AUTOMATIC INTERNAL GRINDING MACHINE

Automatic table traverse, $\frac{1}{8}$ to $1\frac{5}{8}$ in.; hand table traverse, $4\frac{1}{2}$ in.; motion of work-head cross-slide from center of wheel spindle, $4\frac{1}{2}$ in.; swing over table, 11 in.; distance from floor to center of wheel spindle, 44 in.; table traverse speeds, 4; wheel spindle speeds, 4; work-head speeds, 4; weight, 1850 lb.

Ford-Smith Milling Machine

The Ford-Smith Machine Co., Ltd., Hamilton, Ont., has recently added two new milling machines to its line. Fig. 1 shows its No. 3 universal milling machine. The column is of the box-type construction, fitted with shelves suitable for tools, wrenches, etc. The spindle is made from a crucible steel forging and has a $1\frac{5}{16}$-in. hole machined through its entire length, the front end being threaded to receive a chuck or cutter head. The threads on the nose are protected by a cap when not in use. Both spindle bearings are adjustable, the front being of the taper-type, while the one at the rear is of the standard form. Adjustment of the rear bearing is by means of a tapered bushing fitting a tapered hole in the column. A No.

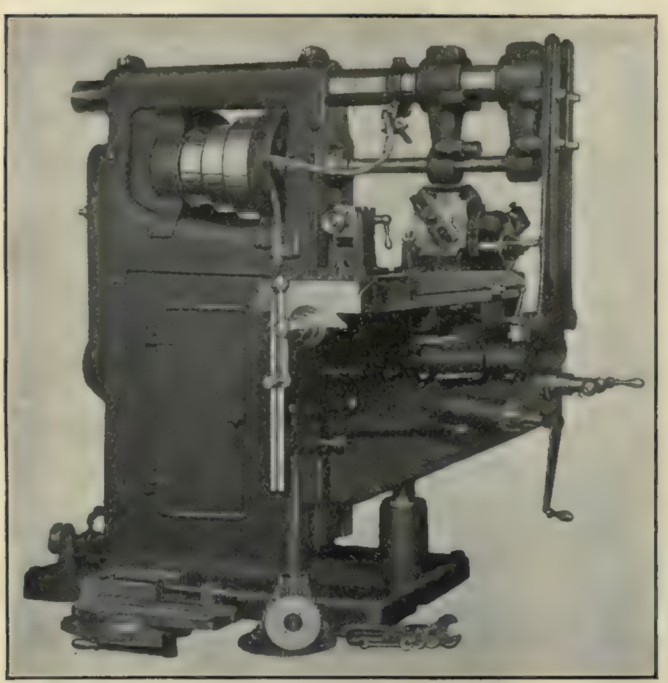


FIG. 1. NO. 3 UNIVERSAL MILLING MACHINE

Working surface of table, 52 x 12 in., equipped with three ⅝-in T-slots; longitudinal feed, 30 in.; cross feed, 10 in.; vertical feed, 19 in.; face of column to brace, 34 in.; diameter of front spindle bearing, 3⅜ in.; spindle speeds, eighteen, 12 to 260 r.p.m.; diameter of overhanging arm, 4½ in.; distance from overhanging arm to center of arbor, 9⅝ in.; width of belt, 3½ in.; feeds, twelve, 0.006 to 0.092 in. per spindle revolution; floor space, 95 x 115 in.; weight, 5750 lb.

11, B. & S. taper is used in the spindle, which is also slotted on the end to provide for a positive drive. The knee is a box-type casting adjusted in a vertical direction by a telescoping screw with ball thrust bearings. Feeds are provided for cross longitudinal and vertical movements, each being equipped with positive knock-outs. The slides are oiled by means of felt wipers, and protected from dust and cuttings. Two arbor supports are supplied for supporting the arbor in the center and on the end, and also the usual front brace. Countershaft is of the two-speed friction type. Oil pump, piping, etc., are furnished as extras when this equipment is desired.

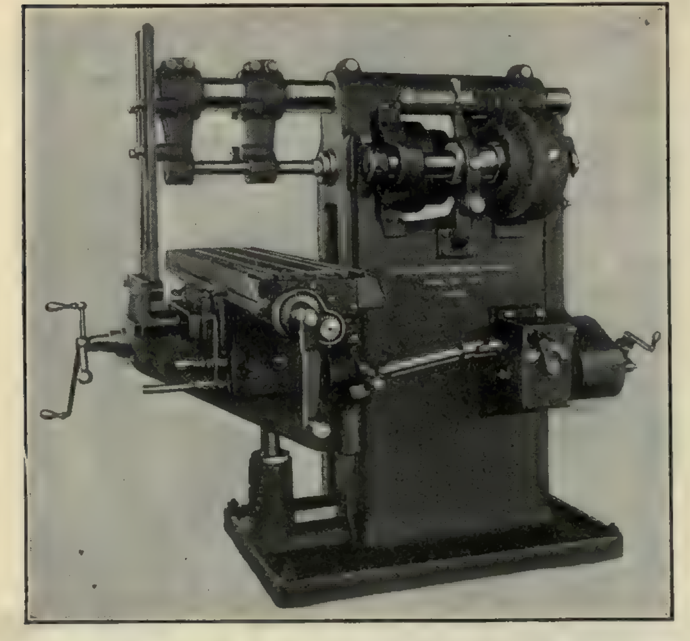


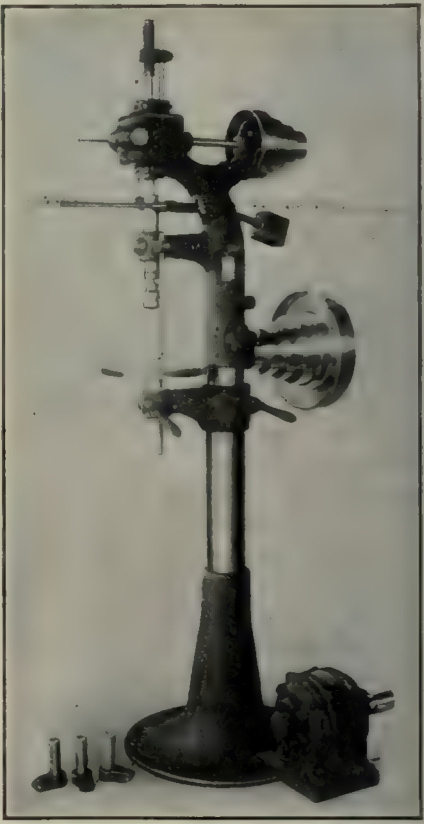
FIG. 2. NO. 3 PLAIN MILLING MACHINE

Working surface of table, 53½ x 13½ in., with three ¾-in. T-slots; longitudinal traverse, 34 in.; vertical traverse, 20 in.; cross traverse, 10 in.; distance from face of column to brace, 30¾ in.; diameter of front spindle bearing, 3⅜ in.; spindle speeds, eighteen, 12 to 260 r.p.m.; diameter of overhanging arm, 4½ in.; distance from overhanging arm to center of arbor, 9⅝ in.; width of belt, 3½ in.; feeds, twelve, 0.006 to 0.092 in. per spindle revolution; floor space, 95 x 115 in.; weight, 5500 lb.

Fig. 2 shows the No. 3 plain milling machine, which has automatic feeds in both directions, provision being made to install a vertical feed, should this be required at any time. The rest of the general construction of this machine is quite similar to that of the No. 3 universal milling machine.

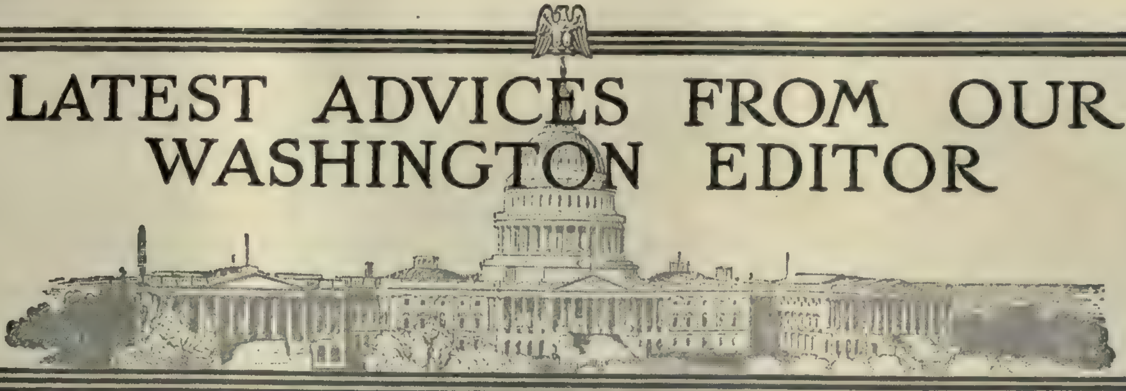
Simmons Automatic Tapping Machine

W. H. Simmons & Co., 208-212 Lawrence St., Cincinnati, Ohio, have placed on the market the automatic drilling and tapping-machine illustrated, which is known under the trade name of "Cinti." The machine is built in both the bench and floor types, with either motor or belt drive, and is designed for drilling work up to ½ in. and tapping work up to ⅜ in. The reversing mechansim may be set for any depth of work, and reverses and stops the spindle automatically. In order to secure a sensitive drive for light tapping, provision is made whereby the belt may be adjusted to any desired tension. This feature is secured by mounting the lower cone pulley on an eccentric shaft, which is operated by the knob at the right of the column. Bearings are of bronze, with felt oilers, reservoirs being used to insure continuous lubrication. The clutch and trip mechanism are entirely of steel, and all contact points are hardened. Carbon steel is used for the spindle, which is provided with an adjustable counterweight. Equipment includes four spindle lead attachments to tap 16, 18, 20 or 24 threads per in., but any other lead including those based on the metric system may be furnished as extras in case they are desired.



TAPPING AND DRILLING MACHINE

Maximum diameter of work, 12 in.; maximum distance from spindle to table, 25 in.; vertical adjustment of spindle, 3¼ in.; vertical adjustment of table, 5 in.; diameter of spindle in sleeve, 13/16 in.; diameter of table, 10 in.; diameter of cone pulley steps, 3½ to 7 in.; width of belt, 1½ in.; size of tight and loose pulleys, 7 x 1¾ in.; tapping capacity in cast iron, upto ⅜ in.; drilling capacity in cast iron, up to ⅜ in.; spindle speeds, 150, 250, 390 and 600 r.p.m.



LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Nov. 3, 1917—Those who have been following the gaging situation will be pleased to learn that this has now all been centralized in Washington, at the Bureau of Standards, as was originally proposed, although the inspection was for a time diverted to the Frankford Arsenal at Philadelphia. Further cause for congratulation is to be had from the fact that this is now being centralized under the control of Major Louis A. Fischer (better known as Dr. Fischer), who has been connected with the Bureau for many years.

Although much remains to be done, there is every indication that things are moving in the right way, and that the design and inspection will be handled properly and with as much expedition as possible under the present strenuous circumstances. Few realize the extreme difficulty in securing the right kind of men to design gages, to allow proper tolerances, and to handle the great variety of intricate work that is being presented in overwhelming quantities.

As an indication of what has been done, and what can be done by the Bureau of Standards in this connection, the following statement has been secured from them regarding the work of the gage section:

PURPOSE OF THE WORK

The testing of gages as carried on by the Bureau of Standards is primarily of benefit to the War and Navy Departments of the United States Government. The Bureau is equipped and has been occupied during the past several months in testing gages used in the production of ammunition. The gages tested include the master reference gages, the master inspection gages, inspection gages, and gages used directly on the work by the munition manufacturer.

In many instances the Bureau has coöperated with gage manufacturers in standardizing sample gages in order that the gage manufacturers might ascertain accurately the quality of their product. As there was available at the Bureau special apparatus and means of testing gages, the information supplied on sample gages often revealed defects not disclosed by manufacturers' testing apparatus. By ascertaining such defects, the source of error has in many cases been eliminated before the manufacturer proceeded with the bulk of his contracts.

The Gage Section is divided into three separate units; namely, the testing laboratory, the shop and drafting department, and the technical staff.

The gage-testing laboratory contains at present about 15 men actually employed in the testing of gages. The equipment is such that the laboratory can be expanded to several times its present capacity.

The shop and drafting-room force includes about 12 men. The main purpose of this department is to design and construct apparatus used in testing gages, and also certain master reference gages used as primary standards in testing other gages.

The technical section includes about six men who are engaged in the development of theoretical information on gages, formulas to be used in computations, data of interest in gage work, and the solution of general technical problems pertaining to gage work.

The laboratory is equipped with practically all forms of measuring apparatus as are used in ordinary shop measurements, such as micrometer calipers, vernier calipers, depth gages, surface plates, angle irons, sine bars, other toolmaker's measuring equipment, Pratt & Whitney measuring machine, special bench mircometers, pitch micrometers, special machine for measuring effective diameters of screws by the three-wire method, special machine for measuring lead of screws, lantern projector for examining form of screw threads, optical protractor for determining angle of screw threads and other devices for measuring screw threads.

The equipment of the shop includes one Brown & Sharpe universal milling machine, one Pratt & Whitney toolmaker's precision lathe, one Rivett precision bench lathe, one surface grinding machine, one universal grinding machine, drilling machines, and other miscellaneous small tools.

The work of the gage-testing laboratory is divided into classes; namely, testing of plug gages and gages having plain outside dimensions, testing of snap and ring gages and other gages having plain inside dimensions, testing of special gages such as profiles and indicator, or fixture, type of gages, and testing of screw gages.

Most of the measurements on the various forms of gages are made wherever possible by comparative methods using various forms of transfer devices with suitable standards such as Johansson blocks or other properly standardized end standards. Provision is made to eliminate errors of observation by having all work checked by a different observer, using wherever possible a different form of comparing apparatus.

The testing of plug gages and other gages having plain outside dimensions is carried on mainly by comparison with suitable end standards such as Johansson blocks and other forms of properly standardized end standards. The instruments used in comparison are ordinary micrometer calipers, certain types of bench micrometer calipers, and in cases where extreme accuracy is desired suitable machines such as the Pratt & Whitney measuring machine. In cases where ordinary micrometer calipers and bench micrometers are used the process is directly one of comparison with suitable end standards, and practically all errors in the transfer devices and personal errors in making measurements are eliminated.

SNAP AND RING GAGES

The testing of snap and ring gages is carried on either by direct measurement with Johansson measuring equipment or by transfer devices such as inside micrometer calipers according to the nature of the gage being tested. The same procedure for eliminating errors is followed as in the case of testing plug gages.

The testing of profile gages is carried out either by a direct comparison with properly standardized check gages or by direct measurement of the gaging surfaces. In many cases it is necessary to regenerate the gaging surfaces and note the deviations from the standard dimensions by means of suitable indicators.

The test of screw gages with various elements of the screw thread are measured independently by suitable devices. The results are then examined and the fitness of the gages determined. The fundamental methods used in testing screw gages consist of the three-wire plan of measurement for effective diameters, a pitch-measuring device as designed by the National Physical Laboratory of Great Britain and constructed by the Bureau of Standards for testing pitch, projection lantern for examining the form of thread, and an optical protractor for determining angles; also standard test points for use in checking angles as measured by the optical protractor.

In the work of testing gages at the Bureau, every effort is made to expedite the immediate test of all gages received. In many instances gages are received, tested and shipped on the same day. It is necessary, however, in order that the work may be carried on efficiently that a certain stock of gages be on hand, and it is the desire and aim of the Bureau to keep the stock of gages awaiting test as small as possible and ship gages within three days or one week of the date of receipt.

WHOLESALE COOKING BY ELECTRICITY

Some idea of the many and intricate problems which beset the various departments of the Government in such a time as this, can be had by noting one or two instances that have recently come to the surface. The great training camp at Ayer, Mass., known as Camp Devens, was one of the first to be completed, and was erected in record time. This, to be sure, was done by offering almost unheard-of wages to carpenters, and had the effect of drawing many men from other trades in that vicinity. Any man who could use a saw, without breaking it, or drive a nail without missing it over half the time, could obtain a job at a high wage. This is one of the great difficulties of the "cost-plus" plan.

The present problem, however, is entirely different. This camp is, of course, electrically lighted. In order to save time and presumably avoid fire risk, there have also been installed elaborate electrical cooking outfits for the whole camp. This has many desirable features, but it also introduces a serious situation in an entirely different line.

This whole section of New England has been very largely educated to use electric power, and has come to depend upon it. Many of these industries are being enlarged to meet war demands, and are confronted with the very serious proposition of not being able to secure additional current, even though called for in their contracts, on account of the large amount which is being used at Camp Devens.

This means a serious delay to the manufacturing industries of this section of New England, and it includes shops over a hundred miles away, these shops being directly engaged in the product of either munitions or machinery for making it.

PRIORITY OF POWER

If the use of electric current is continued on this extremely large scale it will necessitate putting in individual power plants in many of the shops, and this adds seriously to the question of fuel, as well as its transportation over the railroads, which are already congested and on which freight and even express matter is being seriously delayed.

This is one of the many instances where priority control seems absolutely necessary, and, as can be seen, it extends far beyond the question of machine tools, coal, or even transportation. It is also very probable that we shall be up against the question of priority in labor, just as has been the case in England, and we may as well prepare to face it, together with some of the annoyances that such regulation may bring.

Personals

Norman B. Hickox has been appointed sales and advertising manager of the National X-Ray Reflector Co., Chicago, Ill.

George D. Bryson has been appointed assistant advertising manager of the National X-Ray Reflector Co., Chicago, Ill.

Hugh D. Butler, formerly manager of the Chicago sales office of the National X-Ray Reflector Co., has been appointed assistant sales manager.

E. L. Cameron, formerly sales manager of the National X-Ray Reflector Co., Chicago, Ill., has severed his connection with this company and is now located in Seattle.

Guy R. Hastings, formerly assistant Chicago manager of sales of the National X-Ray Reflector Co., has been appointed manager of the Chicago sales.

A. W. Hatch, superintendent of the gunstock department of the Bridgeport works of the Remington Arms-Union Metallic Cartridge Co., was tendered a banquet on Oct. 21 by the workmen of his department.

John A. McGregor, San Francisco, Calif., has been made the chairman of the executive committee of the Bethlehem Shipbuilding Corporation, Ltd., the new steel merger which includes the Union Iron Works and the Risdon Plant.

Charles T. Main has been nominated for President of the American Society of Mechanical Engineers and Spencer Miller has been nominated for one of the vice presidencies. The following have been nominated for managers: Fred A. Geier, D. R. Yarnell and Fred N. Bushnell. William H. Wiley, who has held the office of treasurer since 1884 has been renominated.

Business Items

The Brown & Sharpe Manufacturing Co. has moved its Philadelphia office to 1103-1105 Liberty Building, Philadelphia.

The Laughlin-Barney Machinery Co., Inc., has moved to larger quarters in the Union Arcade Building, Pittsburgh, Penn.

The Aborn Steel Co., Inc., has moved its New York warehouse and office building from 105 Le Roy St. to 22 Clarke St.

The Capital Die, Tool and Machine Co., Columbus, Ohio, has taken over the plant formerly operated by J. B. Hoover, at 619 North 4th St. It will continue the manufacture of dies, jigs, gages, tools and all classes of machine shop and production work on an enlarged scale. The company will also manufacture heat treating furnaces. The new organization has as officials, J. B. Hoover, president and chief designer; R. B. Ralston, mechanical engineer and vice president; H. L. Gibney, formerly machine foreman in the Pennsylvania R.R. shops, secretary and general manager.

Catalogs Wanted

H. Mueller Mfg. Co., Decatur, Ill., manufacturers of brass goods for water, plumbing and gas work, are desirous of compiling a catalog file, and would like to receive for this purpose catalogs from manufacturers of metal working machines, including drill presses, lathes, automatic screw machines, etc.

Trade Catalogs

Colored Lacquers. Moller & Schumann Co., Marcy and Flushing Aves., Brooklyn, N. Y. Bulletin No. 2. Contains samples of the different shades of lacquers.

Hauck Oil Burners. Hauck Manufacturing Co., 140 Livingston St., Brooklyn, N. Y. Bulletin No. 91B. Pp. 16; 6 x 9 in.; illustrated. This bulletin explains how waste and destruction in machine shops can be stopped by the use of proper heat applications, and contains illustrations of the burners in different operations. Formulas for brazing and welding fluxes and spelter are given.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association., Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Grinding Machine, Surface
Abrasive Machine Tool Co., Providence, R. I.

"American Machinist," Oct. 25, 1917

Feed capacity, 22 in. longitudinal, and 8 in. cross-feed, both automatic; vertical adjustment, 12 in.; takes grinding wheels up to 7 in. diameter by 5/8 in. face; weight of belt drive machine, 1900 lb. May be equipped for motor drive, the motor being located in the base, while the belt runs up through the hollow column at the rear. Can be fitted with lubricant or with vacuum exhaust system

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Gun Barrel Calibrating and Straightening Machine
Sponsel Co., Inc., 647 Main St., Hartford, Conn.

"American Machinist," Oct. 25, 1917

Is used for measuring and straightening the bore of gun barrels, for the determination of reamer pockets, for the determination of eccentricity of the outside of the barrel in regard to the bore, for the location of sighting marks, and for the measurement and straightening of the bore after rifling. It is claimed that this machine enables inexperienced help to straighten barrels within very close limits. The machine straightens the work by producing a permanent set in the metal

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Tubes, Pyrometer Protecting "Impervite"
Charles Engelhard, 30 Church St., New York City

"American Machinist," Oct. 25, 1917

It is claimed that the body of these tubes is practically identical with that of the Marquardt, as are also the coefficient of expansion, the mechanical strength and the porosity. They are claimed to have absolutely no effect on platinum wire at high temperatures, and that the melting point is above 3500 deg. F. The glaze is claimed to be harder than that of the Marquardt tube after it has matured, and thoroughly impervious when uniformly applied and strongly resistant to fluxing action. It does not become sticky at high temperatures

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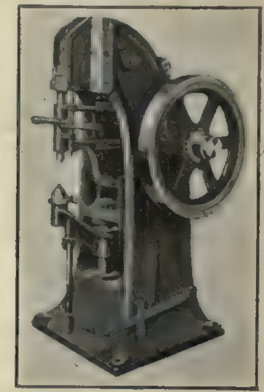
Riveting and Forging Machine, Electric, "Kobert"
New England Machinery Co., New Haven, Conn.



"American Machinist," Oct. 25, 1917

This machine is of the two-unit power type for heating and driving rivets at one operation, single-phase alternating current being used at a pressure of from four to six volts. May be used for forging work, it being possible to take work from the bar or coil, the material being heated automatically as fed

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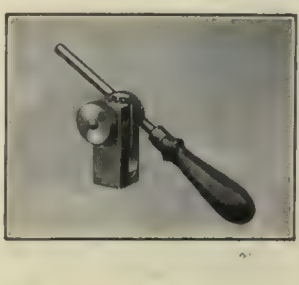
Diamond Toolholder "Hartford"
National Machine Co., 111-135 Sheldon St., Hartford, Conn.



"American Machinist," Nov. 1, 1917

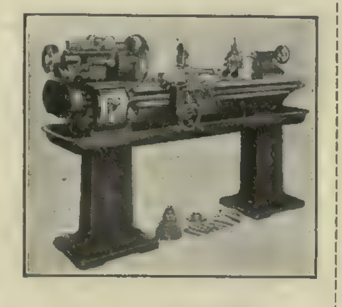
This device holds the diamond-tool at any angle and it is claimed that, as it is very firm, a truer cutting surface is obtained than when the tool is held by hand. A binder nut is supplied to fit any size of table slot or with blank nuts for special fittings. All adjustments may be made with one turn of the wrench. The overall size is 4 3/8 x 3 x 1 3/4 in., and the diameter of the tools may be from 5/16 to 7/32 in.

Lathe, 12-Inch Precision
Master Machine Tool Co., 110-112 West 40th St., New York City.

"American Machinist," Nov. 1, 1917

Swing over bed, 12 in.; swing over carriage, 7 1/2 in.; length of bed, 4 ft. 8 1/2 in.; distance between centers, 28 in.; hole through spindle, 13/16 in.; spindle nose threaded, 1 5/8 x 8 U. S. S.; front spindle bearing, 1 5/8 x 2 3/8 in.; rear spindle bearing, 1 1/4 x 2 3/16 in.; diameter of tail spindle, 1 1/4 in.; threads cut, 1 1/4 to 80 per in.; net weight, 767 lb.

Lathe, 13-Inch, All Geared
Master Machine Tool Co., 110-112 West 40th St., New York City



"American Machinist," Nov. 1, 1917

Swing over bed, 13 1/2 in.; swing over carriage, 8 in.; length of bed, 5 ft. 8 1/2 in.; distance between centers, 38 in.; hole through spindle, 1 1/16 in.; spindle nose threaded, 1 7/8 x 8 U. S. S.; diameter of spindle bearings, front, 1 7/8 in.; rear, 1 5/8 in.; taper of centers, Morse No. 3; diameter of tail spindle, 1 3/8 in.; cuts threads, 1 1/4 to 80 per in.; speeds of head spindle, six, 28, 46, 85, 135, 225, 418 r.p.m.; width of belt, 1 3/8 in.; speed of pulley on headstock, 300 r.p.m.; net weight, 1110 lb.

Grinding and Polishing Stand
St. Louis Machine Tool Co., St. Louis, Mo.

"American Machinist," Nov. 1, 1917

Made in a number of sizes. Specifications for No. 5 grinding and polishing stand. Diameter of arbor in collars, 1 in.; diameter of arbor in bearings, 1 5/16 in.; length of arbor, 42 in.; distance between wheels, 32 in.; length of bearings, 5 1/4 in.; height to center of arbor, 41 in.; size of base, 15 x 20 in.; weight, 415 lb.

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices, which went into effect Sept. 24, will have little effect on the general market for some time. Present warehouse stocks—bought at the old mill price—will probably be sold out before the present warehouse prices to ordinary consumers are reduced. The Government prices are: Pig iron, $33 per gross ton; steel bars (Pittsburgh-Chicago), $2.90 per 100 lb.; shapes, $3; plates, $3.25. New Government prices expected within two weeks.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Nov. 2, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	....	$20.00
No. 2 Northern Foundry, Chicago	33.00	....	26.00
*Bessemer, Pittsburgh	36.30	....	29.95
*Basic, Pittsburgh	33.00	$36.30	25.95
No. 2X, Philadelphia	33.75	33.00	25.00
*No. 2, Valley	33.00	....	25.00
No. 2, Southern Cincinnati	35.00	33.00	22.90
Basic, Eastern Pennsylvania	45.00	45.00	26.00

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Nov. 2, 1917	One Month Ago	One Year Ago	Nov. 2, 1917	One Year Ago	Nov. 2, 1917	One Year Ago
Structural shapes	$5.25	$5.25	$3.50	$5.00	$3.60	$5.00	$3.35
Soft steel bars	5.00	5.00	3.50	4.50	3.60	4.50	3.35
Soft steel bar shapes	5.00	5.00	3.50	4.50	3.60	4.50	3.35
Plates, ¼ to 1 in. thick	10.00	9.00	4.25	7.00	4.10	7.00	4.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Nov. 2, 1917	One Year Ago
Pittsburgh, mill	$5.00	$2.75
Warehouse, New York	4.75	3.50
Warehouse, Cleveland	4.45	3.45
Warehouse, Chicago	4.50	3.35

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Nov. 2, 1917	One Month Ago	One Year Ago	Nov. 2, 1917	One Year Ago	Nov. 2, 1917	One Year Ago
*No. 28 black	5.50-6	9.00	10.50	4.50	8.50	3.90	8.50	4.10
*No. 26 black	5.40-5.90	8.90	10.40	4.40	8.40	3.80	8.40	4.00
*No. 22 and 24 black	5.35-5.85	8.85	10.35	4.35	8.35	3.75	8.35	3.95
No. 18 and 20 black	5.30-5.80	8.80	10.30	4.30	8.70	3.70	8.30	3.90
No. 16 blue annealed	5.50-6	9.20	10.20	4.45	8.70	3.95	8.20	4.00
No. 14 blue annealed	5.50-6	9.10	10.10	4.35	8.60	3.85	8.10	3.90
No. 12 blue annealed	5.50-6	9.05	10.05	4.30	8.55	3.80	8.05	3.85
No. 10 blue annealed	5.50-6	9.00	10.00	4.25	8.50	3.75	8.00	3.80
*No. 28 galvanized	6.50-7	10.50	11.50	6.50	10.00	5.50	9.50	5.60
*No. 26 galvanized	6.20-6.70	10.20	11.20	6.20	9.70	5.20	9.20	5.30
No. 24 galvanized	6.05-6.55	10.05	11.05	6.05	9.40	5.05	9.05	5.15

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Nov. 2, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	40%	45%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Nov. 2, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	15.30	6.30
Chicago	14.00	5.75
Chicago	15.00	5.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

' Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Nov. 2 1917	Cleveland Nov. 2, 1917	Chicago Nov. 2, 1917
Tire	5.00	5.00	4.50
Toe calk	5.70	5.50	4.75
Openhearth spring steel	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of May 1, 1917, for steel pipe; of July 2 for iron pipe:

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜	42%	15½%	¾ to 1½	33%	17%
½	46%	31½%			
LAP WELD					
2	42%	29½%	2	26%	12%
2½ to 6	45%	32½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	38%	20½%	¾ to 1½	33%	18%
½	43%	30½%			
¾ to 1½	47%	34½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	40%	28½%	2	27%	14%
2½ to 4	43%	31½%	2¼ to 4	29%	17%
4½ to 6	42%	30½%	4½ to 6	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	37.9%	23.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	41.9%	26.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Nov. 2 1917	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	35.00
Tin, in 5-ton lots	65.50	61.75	45.00
Lead	5.50	8.00	7.00
Spelter	9.50	8.50	12.50

*Government price.

ST. LOUIS

Lead	5.25	8.00	7.00
Spelter	9.25	8.25	12.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Nov. 2, 1917	One Month Ago	One Year Ago	Nov. 2, 1917	One Year Ago	Nov. 2, 1917	One Year Ago
Copper sheets, base	35.00–37.00	35.00	37.50	36.00	38.50	34.00	36.50
Copper wire (carload lots)	36.00	38.50	35.00	32.00	33.00	33.50	37.00
Brass pipe, base	41.00–43.00	43.00	47.50	42.00	46.00	42.00	46.00
Brass sheets	40.00	40.00	45.50	35.00	43.00	35.00	38.00
Solder ½ and ½ (case lots)	39.25	39.25	28.50	37.00	27.00	38.00	34.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Nov. 2, 1917	One Year Ago
Mill	$29.00	$42.00
New York	35.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill........ 19.00

	In Casks		Broken Lots	
	Nov. 2, 1917	One Year Ago	Nov. 2, 1917	One Year Ago
New York	20.00	18.00	20.50	19.00
Cleveland	21.00	16.75	21.25	17.50
Chicago	21.00	17.00	21.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Nov. 2, 1917	One Year Ago
New York	15.00	13.50
Cleveland	16.50	13.00
Chicago	16.00	13.50

USEFUL DATA for SPOT WELDING WORK

By Lucien Haas,

SUPERINTENDENT BUFFALO PRESSED STEEL CO,
BUFFALO, N.Y.

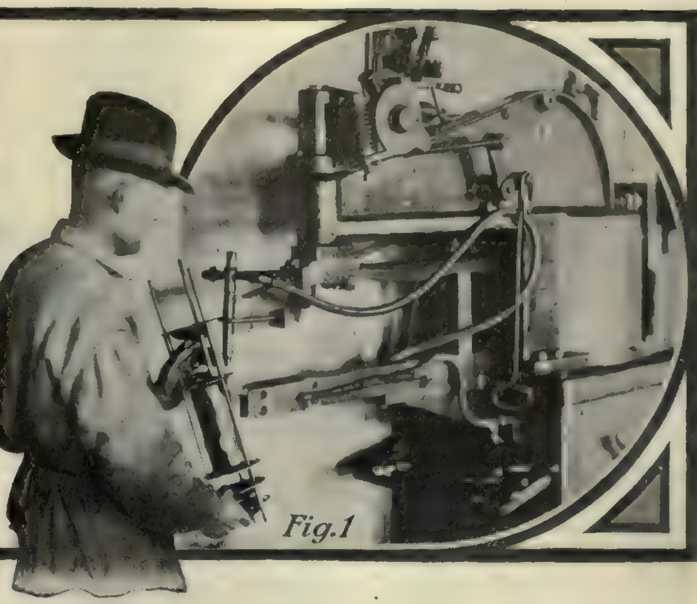


Fig.1

Some very useful data are here given for the guidance of those engaged in spot-welding work. The examples given are representative of a wide range of work which may be done by this method.

WE DO considerable spot welding in connection with silencer work and Figs. 1, 2 and 3 illustrate some of this. Fig. 1 shows an old-type National spot-welding machine, 220 volts, 25 cycles, 20 kw., tooled up for welding various cones on a rod-type job. In this particular case there are 5 cones, each requiring 3 spot welds in connection with the key fastened on the rods, making a total of 15 welds. One man welds at the rate of 15 complete assemblies per hour.

Fig. 2 illustrates the same machine and welding points welding the heads in an all-steel short-cylinder type (no rods) silencer. The material in the head is 18-gage, while the shell or cylinder is made of 20-gage. One man welds 900 of these pieces in a 9-hour day.

Fig. 3 shows the method of welding the cylinders or shells along the seam, shown in detail, Fig. 7. Eight welds are required, and these are made at the rate of 80 shells per hour on a 10-gage capacity National spot-welding machine, 10 kw., 220 volts.

Several good examples of spot-welding work are shown in Fig. 4. Part *A* is an accelerator pedal pad, made of $\frac{1}{16}$-in. and $\frac{3}{32}$-in. steel, requiring 6 spot welds. These parts are completed at the rate of 35 per hour. Part *B* consists of 3 pieces. Each piece is made from 20-gage steel. To insure the 3 pieces coming in the proper relation with each other, 3 holes are perforated in each piece. They are then put in a jig having a corresponding number of pins, on which these parts fit, and are then welded together. The time of putting these parts in the jigs and welding is about 2 minutes.

Jigs for properly locating and holding two or more pieces together for welding are very necessary, and when designing or making these jigs considerable time and care should be given to see that a minimum amount of time is spent in placing and removing the work. This is the greatest factor in spot welding, for the time consumed in actually making the weld is very small compared to that of jigging it. No clamps should be used unless extreme accuracy is required.

Part *H* is a fan pulley, and part *J* its jig. In this case it is absolutely necessary that these 2 pieces be welded concentric with each other, and it was at once decided to clamp these pieces in position before welding. The results are very gratifying, as these pieces do not run out 0.010 in. after the 8 spot welds have been made. A few words in connection with the operating of the jig may be interesting. The work, which consists, of course, of the 2 pieces, is first placed in the large ring. The small ring is screwed into it by means of the spanner wrench, and as soon as the ring begins to bind the work, the operator takes the jig between his hands, holds the attached spanner firmly in place, and hits the spanner wrench on the bench, thus tightening it, and when releasing it performs a similar operation. These parts are made from 16-gage steel, and are welded at the rate of 38 per hour. This time, of course, includes putting the work in the jig and welding.

Part *C* is a pedal pad, which is readily recognized by anyone driving an automobile. The inner part, which has the lugs on, is made of $\frac{5}{32}$-in.-thick sheet steel, and the pad of 18 gage. Part *D* is its welding jig, and both parts are held in the jig by the fingers until the first weld is made. The work is then removed from the jig, and the additional 3 welds added, one man welding an average of 300 per day.

Frequently it is much cheaper to resort to plugging up holes than it would be to make up new pieces. Part *E* represents a part where this was done. This part had 3 holes, which were not in correct location to a corresponding part, and these holes were plugged up in one-third the time it would have required to make up a new part. The material is 20-gage, and the holes $\frac{5}{16}$ in. in diameter. A slug of the same material and diameter was used.

One-half-inch wide 20-gage steel strips are welded on the inside of a hot-air box, part *F*, at the rate of 800 per day; and the $\frac{3}{16}$-in.-thick supports on pedal-pad cover, part *G*, are welded in a jig similar to that used for part *C*. Some 20,000 of these parts have been made at an average of 350 per day per man. This particular part is interesting, inasmuch as it embodies the welding of heavy stock to light material, and it is always preferable to have the light stock on the bottom welding point, and this point should be as blunt as possible. The small welder point, which comes in contact with the heavy material, should be from ¼ to $\frac{5}{16}$ in., so as to heat the heavy stock a little faster than the light stock.

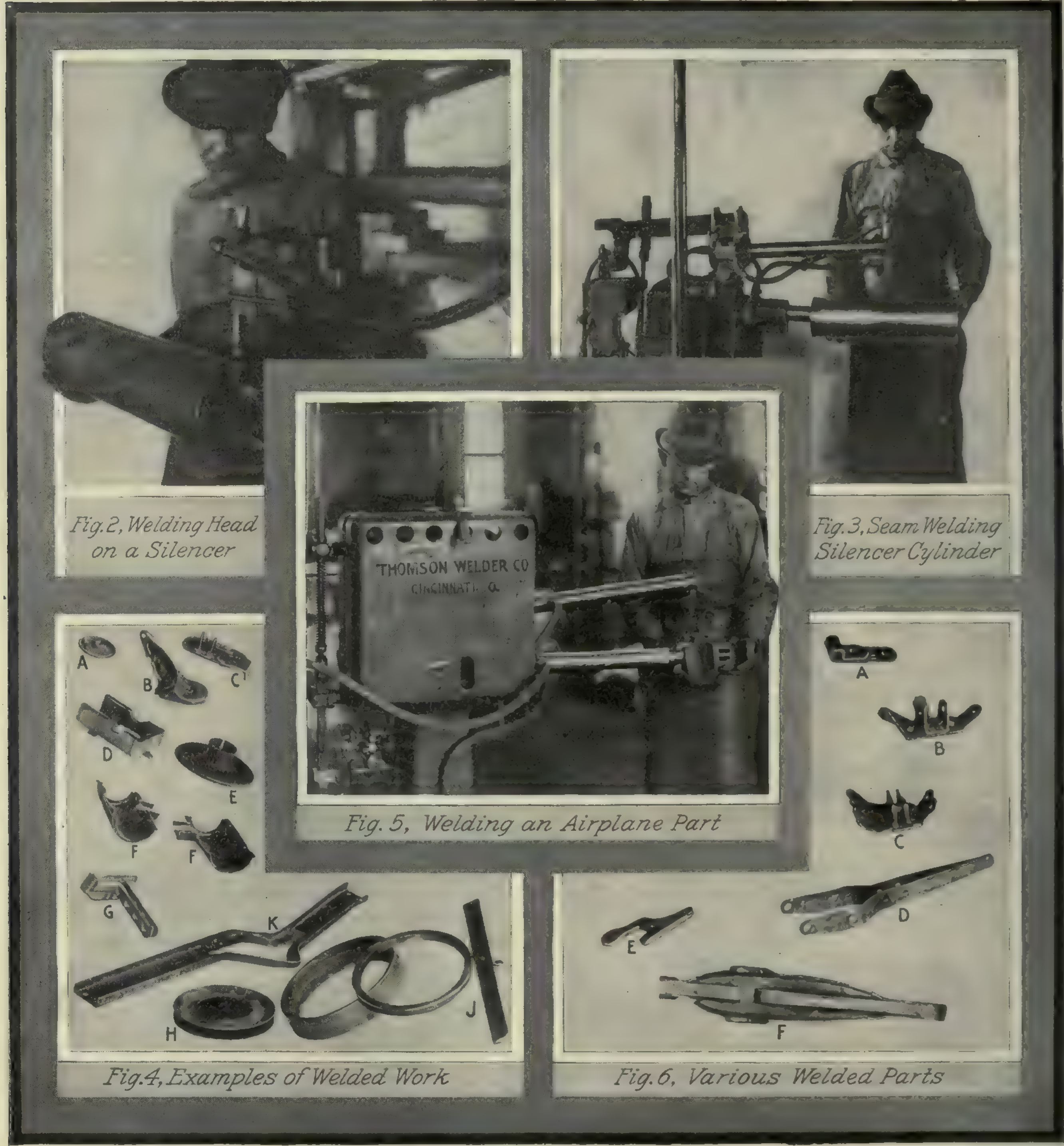


Fig. 2, Welding Head on a Silencer

Fig. 3, Seam Welding Silencer Cylinder

Fig. 5, Welding an Airplane Part

Fig. 4, Examples of Welded Work

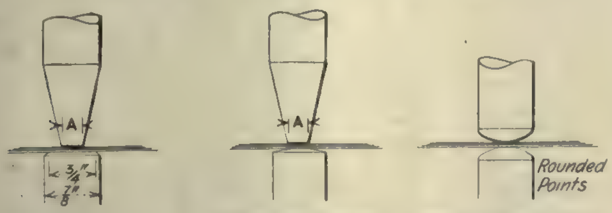
Fig. 6, Various Welded Parts

A big thing in spot welding is to get current and pressure balance. More pressure is required for welding heavy gages of material than lighter gages, and unless the parts are brought firmly together, the current will not flow as it should. In welding brass, aluminum, german silver, galvanized iron, terne plate, tin and all coated metals, less pressure and more current is required. There is no cheaper process known than spot welding when it is desired to reinforce or strengthen such parts as illustrated at *K*. The material of which this part is made is 16-gage, and the reinforcements shown on the inside are ⅛ in. thick. These were welded in at the rate of 400 per day.

There is no work that requires more extreme care than the welding of airplane parts. For this reason caution should be exercised to see that the welding points are always clean. This is very essential, for should a weld fail, it can readily be traced to either scale on the material to be welded, or dirty welding points. The cleaner the material the less current is consumed, faster time can be made and the points do not wear near as quickly. Dirt, scale, oil or grease are nonconductors, and, therefore, retard production, and frequently are the cause of spoiling expensive work through overheating or burning. The running water attached to the machine, therefore, should be so placed that the outlet can be seen at all times by the operator. This is not only necessary to prevent the welding points becoming overheated, but as well adds to the life of the machine itself.

Fig. 5 illustrates a Thomson spot welder, 220 volts, 25 cycle, which has been found most suitable it seems for welding various airplane fittings, such as shown in Fig. 6, parts *A*, *B*, *C* and *D*, and Fig. 8. In connection with all of these parts the welding consists of mostly reinforcements, which it is necessary to spot weld to the main body of the stamping, previous to acetylene welding. This reinforcement is shown very plainly on parts *B* and *C*. Part *A* is a formed piece, one portion of which is lapped over on to the other portion, and is spot welded at that end. Part *D* is welded at the point of the tapered end, and the bosses shown thereon at the other end are spot welded previous to acetylene welding.

TABLE I. APPROXIMATE POINT SIZES FOR WELDING TWO PIECES OF SAME GAGE AND MATERIAL



GAGES	A
28-26-24-22	1/8"
20-18-16	3/16"
14-12	1/4"

IRON AND STEEL	
GAGES	A
11-10	1/4"
9-8-7	5/16"
6-5-4	3/8"
3-2-1-0	1/2"

GALVANIZED IRON	
GAGES	A
22-20	1/8"
18-16-14	3/16"
12-10	1/4"
9-8-7	3/8"

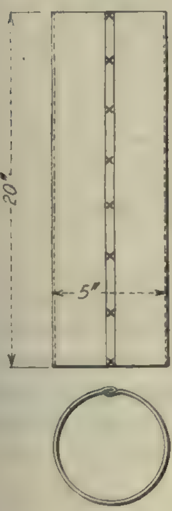


FIG. 7
DETAILS OF WELDED SEAM

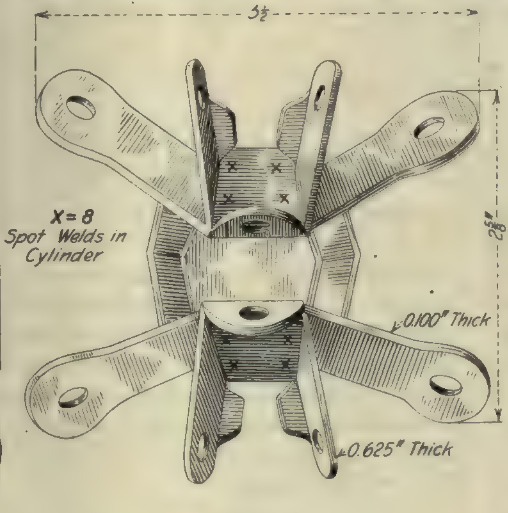


FIG. 8
METAL CLIP FOR AIRPLANE

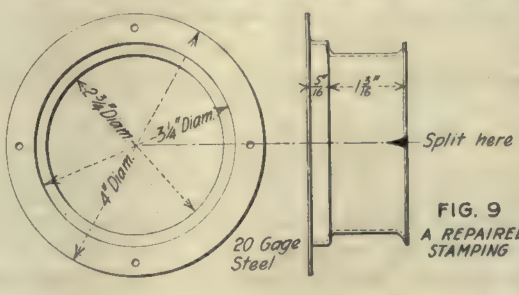


FIG. 9
A REPAIRED STAMPING

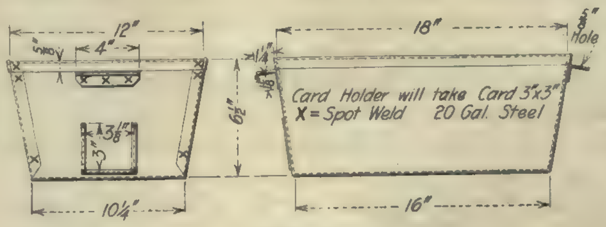


FIG. 10
A LARGE-SIZE TOTE PEN

FIGS. 7 TO 10. A NUMBER OF SPOT-WELDING OPERATIONS

The material used for most of these airplane fittings is a 20- to 30-point carbon steel, and it is advisable in regulating the current to start with the lowest point, until one becomes accustomed to the work in hand, as on clean cold-rolled stock 1 point on control lever will weld as good, and even better, than 3 points on hot-rolled stock. This is all due, of course, to the scale, which does not let the current flow as fast as on clean stock.

Part *F*, shown at Fig. 6, is an adapter used for a rapid-firing gun tripod. This part is classed and is treated in welding the same as the various airplane fittings as heretofore mentioned. The bosses and reinforcements through the center and at the end are first spot welded in position, after which they go through the process of being acetylene welded.

The repairing of damaged stock can also be done on the welder, and if a little care is taken, it can be done quicker and very much cheaper, as well as making a better-looking job, than can be done by torch welding. This is entirely up to the operator, who can control the heat the same as in torch welding or brazing. For plugging it is advisable to take punchings or slugs that are a little thicker than the work. This will make a neat-looking job, and if ground or polished, cannot be seen. Part *E*, Fig. 6, a stamping ¼ in. thick, was treated in this manner, namely, the holes were plugged and the pieces saved.

TABLE II. DATA FOR WELDS FOR VARIOUS GAGES OF MATERIAL

SPOT WELD DATA

Gage	Thickness in Decimals	Thickness in Fractions	Approx. Kw. Capacity	Time in Sec. to Make Spot Weld	Cost per 1,000 Welds at 1c. per Kw.
28	0.015625	$\frac{1}{64}$	5	0.5	0.005
26	0.01875	$\frac{3}{160}$	6	0.6	0.006
24	0.02500	$\frac{1}{40}$	7	0.7	0.01
22	0.03125	$\frac{1}{32}$	8	0.8	0.013
20	0.0375	$\frac{3}{80}$	9	0.9	0.018
18	0.05	$\frac{1}{20}$	10	0.10	0.025
16	0.0625	$\frac{1}{16}$	12	0.11	0.0350
14	0.07812	$\frac{5}{64}$	14	1.2	0.040
12	0.10937	$\frac{7}{64}$	16	1.6	0.060
10	0.14062	$\frac{9}{64}$	18	1.10	0.080
9	0.1562	$\frac{5}{32}$	20	1.80	0.11
8	0.1718	$\frac{11}{64}$	23	2.2	0.16
7	0.1875	$\frac{3}{16}$	25	2.7	0.21
6	0.2031	$\frac{13}{64}$	28	3.5	0.31
5	0.2187	$\frac{7}{32}$	30	4.6	0.42
4	0.2343	$\frac{15}{64}$	33	6.2	0.56
3	0.2500	$\frac{1}{4}$	35	8.3	0.68

Fig. 9, a somewhat expensive stamping, was repaired at the split, shown on the illustration, with a strip of stock which was about 16-gage and ⅛ in. to ¼ in. wide. The ends of this stock were tapered and overlapped the broken edges of the split very little, and while the weld was still red hot, this strip was broken from the part. The result was very good, and very little filing or grinding was necessary to complete the repair.

Fig. 10 illustrates a large-size tote pan. There are two other smaller-size tote pans which nest in the one shown. Each pan has 22 welds, and a man welds 400 per day.

Fig. 11 illustrates a running board with six clips welded to same. These clips are made from $\frac{3}{32}$-in. material, while the material used in the board itself is $\frac{1}{16}$-in. steel. These clips are located on the board by means of the jig shown in Fig. 12. The production of these boards was materially increased by the spot-weld operator tacking these clips on the board, after which the board was passed along to a second welder who did the final welding, the two operators completing 250 boards in 9 hours.

Fig. 13 represents standard forged welding points that, after considerable study, have been adopted as standard. It has been found that these various shapes and sizes will take care of a very large variety of work.

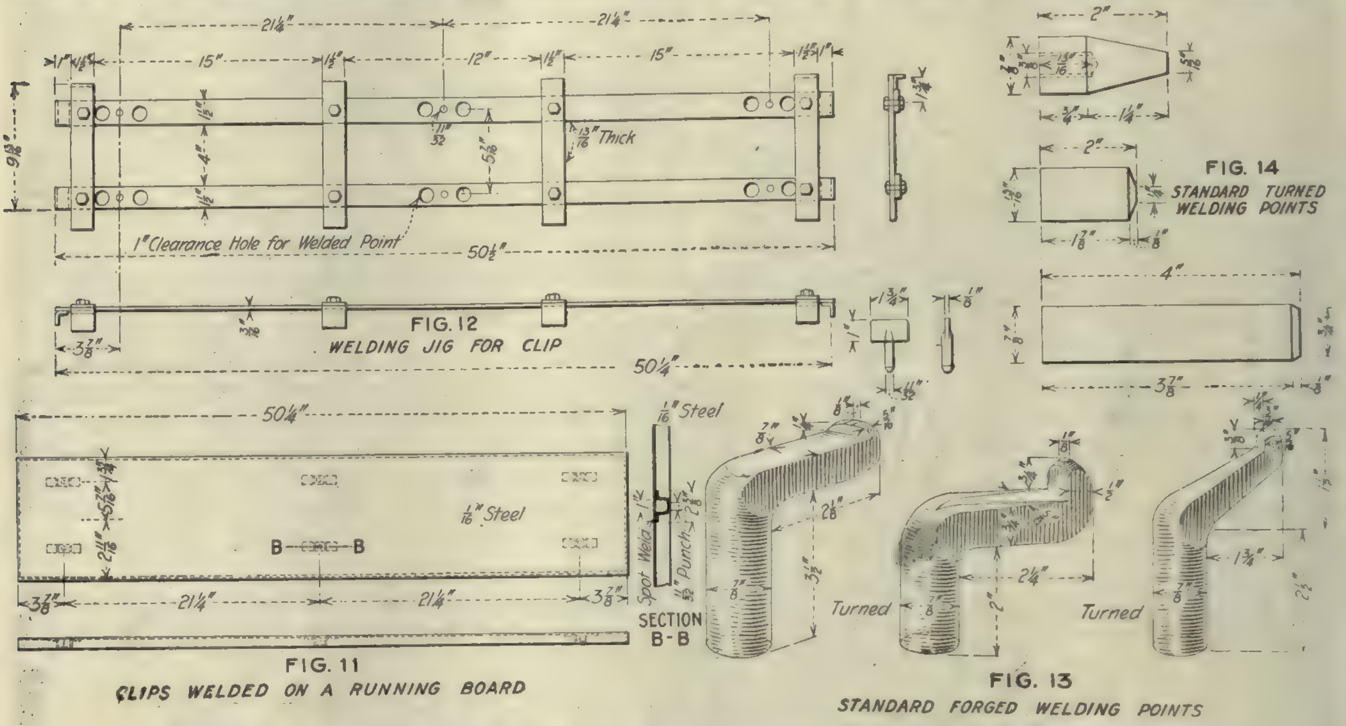


FIG. 12
WELDING JIG FOR CLIP

FIG. 11
CLIPS WELDED ON A RUNNING BOARD

FIG. 13
STANDARD FORGED WELDING POINTS

FIG. 14
STANDARD TURNED WELDING POINTS

FIGS. 11 TO 14. WELDING WORK AND STANDARD TURNED AND FORGED POINTS

Fig. 14 shows turned welding points, which are also considered standard, inasmuch as they also take care of the greater portion of flat spot-welding work. These are turned up in small quantities and kept in stock for the welder's use.

In welding heavy scaled and rusty stock the welding points should be clean and free from burns. This is done by filing the points so that they come together evenly. If contact is not made when welding points strike the metal, a little twisting should make it. In welding rusty stock it would be better to cut some of the rust away with a file. This will make it easier to weld, and not so liable to splash. A good method of cleaning stock that may be oily, greasy, scaly or rusty is to tumble it if possible. This will facilitate production and make a neat, clean-looking job when the parts are finished.

The wearing of goggles is preferable and should be encouraged whenever possible, as the splash or spark, so frequently occurring when welding coated stock, is sooner or later liable to hit the man's eye, and in time results in serious eye trouble. Blacksmiths' leather aprons are ideal things to furnish a welding operator, as this will prevent his clothes from catching on fire, which is no uncommon occurrence.

In welding painted stock care should be taken that both welding points meet. The top point should be about $\frac{1}{4}$ in. in diameter, and not more than $\frac{5}{16}$ in. The bottom point should be as blunt as possible (see Fig. 18). If both points are the same, they will burn the metal before the paint burns off and will cause a rough spot, which makes it look spongy and burnt, instead of welded. If in welding two pieces the current does not flow when points are together, a little wiggling or shaking of the work should make the contact.

Table I gives the approximate size of welder points for welding two pieces of stock the same gage and material. In this table the illustrating of the rounding of welder points is very useful.

Table II gives spot-welding data, time in seconds and cost per kilowatt for making welds of various gages of material. As the rate charged for current in various places, 10c. per kw.-hr., is given as a basis for calculating the cost of welding. By multiplying the price given for the rate per kw.-hr. charged by the company furnishing the electricity, it will give the cost of current for 1000 welds.

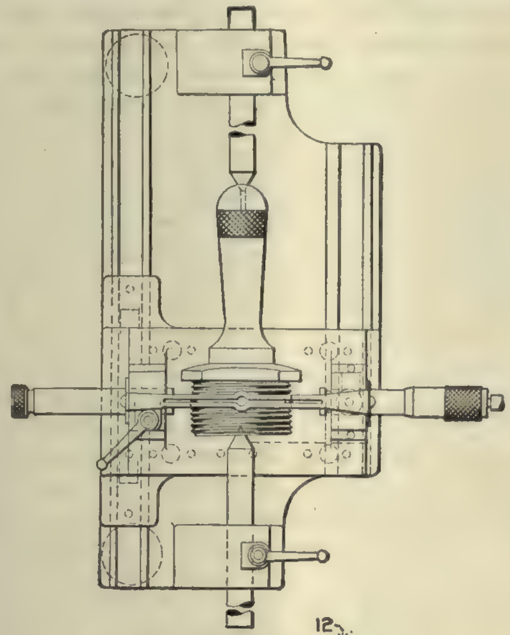
Screw Gage Measuring Machine

By H. J. Bingham Powell
British Ministry of Munitions of War in U. S.

Herewith are shown details of a screw gage measuring machine intended to assist screw gage manufacturers, in measuring accurately and quickly the pitch and root diameters of plug screw gages. This machine is similar to the one used in the Gage Department of the British Ministry of Munitions. Fig. 1 shows details of the instrument, and Figs. 2 and 3 details of the parts.

The employment of such a machine for checking screw gages required to be correct within small tolerances on their governing diameters is most essential, and my experience is that there is no other machine or method of doing this like this one.

The "feel" obtained by the micrometer over the wires used for measuring the pitch diameter, and over the little triangular pieces employed for the root diameter, is almost perfect.



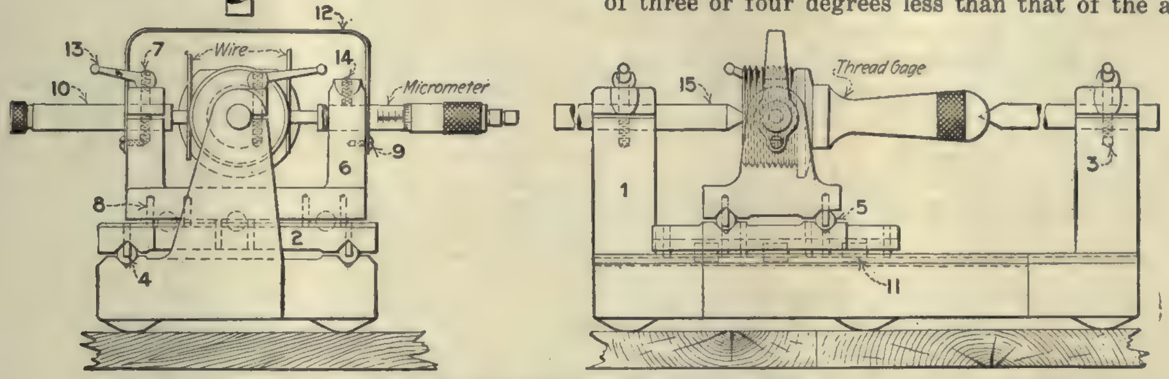


FIG. 1. SCREW GAGE MEASURING MACHINE

The assembly drawing is self-explanatory of the functioning of the machine, and here I would only wish to add that at least two sizes of wires should be used in measuring the pitch diameter of a screw; one which bears in the thread at the theoretical pitch diameter and the other which lies in the thread just below the crest. The diameter of the latter is one and a half times that of the former.

The diameter of the wires to bear on the pitch diameter of the thread can be obtained from the formulas for the several types of threads as follows: Whitworth: $D = 0.5637\,P$. U. S. S.: $D = 0.5774\,P$. British Association: $D = 0.5463\,P$. D = mean of the diameters of the wires used in the machine. P = the pitch (or lead) $= \frac{1}{\text{no. of threads per inch}}$.

The wires should be round, and the combined error of the roundness and diameter ought not to exceed 0.00005 inch.

Besides wires, whether used in this machine or not, it is advisable to check the pitch diameter also by accurate thread micrometers; first, to check the correctness of the angle of slopes at the lower portion of the thread and secondly, to observe (under a magnifying glass) the form of the thread against the micrometer point. The latter proceeding will generally show up a staggered thread or one with imperfections in the slopes.

The little triangular pieces for measuring the root diameter can be of an included angle between the sides of three or four degrees less than that of the angle of the thread of the gage. There should be a slight rounding on the piece at the angle where there is bearing on the thread.

To use the wires the constant K must be calculated, which deducted from the micrometer reading over the wires gives the pitch diameter of the screw.

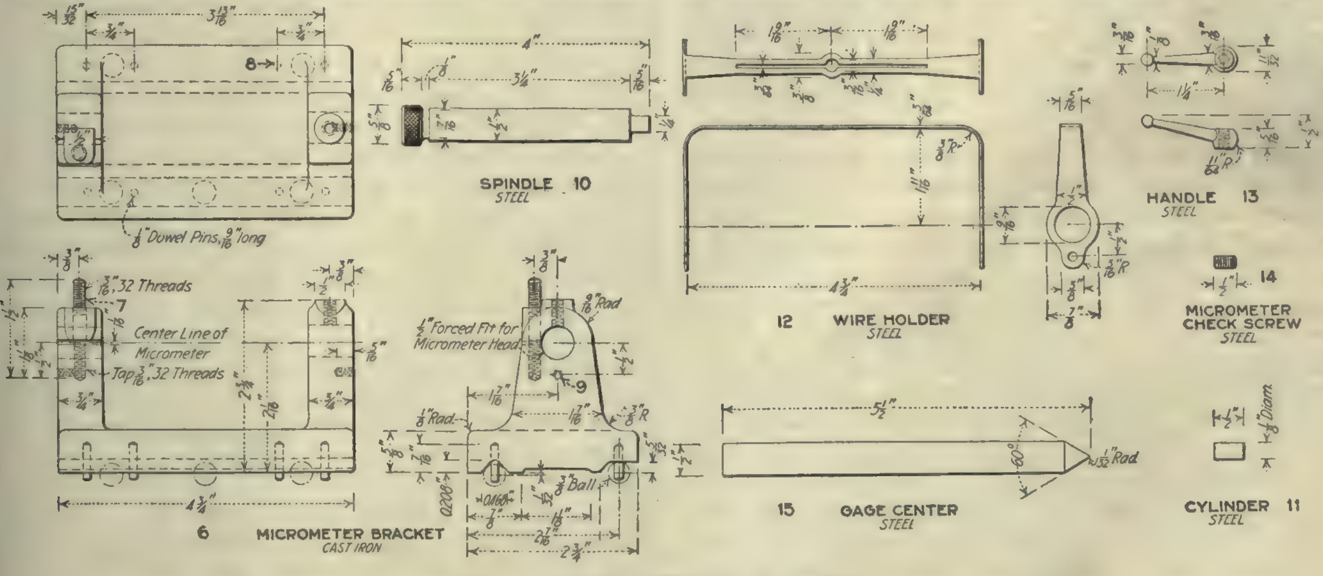


FIG. 3 OTHER DETAILS OF PARTS

For the several types of threads we have: Whitworth: $K = 3.1657D - 0.9605P$. U. S. S.: $K = 3.0000D - 0.8660P$. British Association: $K = 3.4829D - 1.1363P$.

The only condition made in the free use of this design is that the letters N. P. L. be engraved on each machine, the design being that drawn and constructed by the men employed in the National-Physical Laboratory, England.

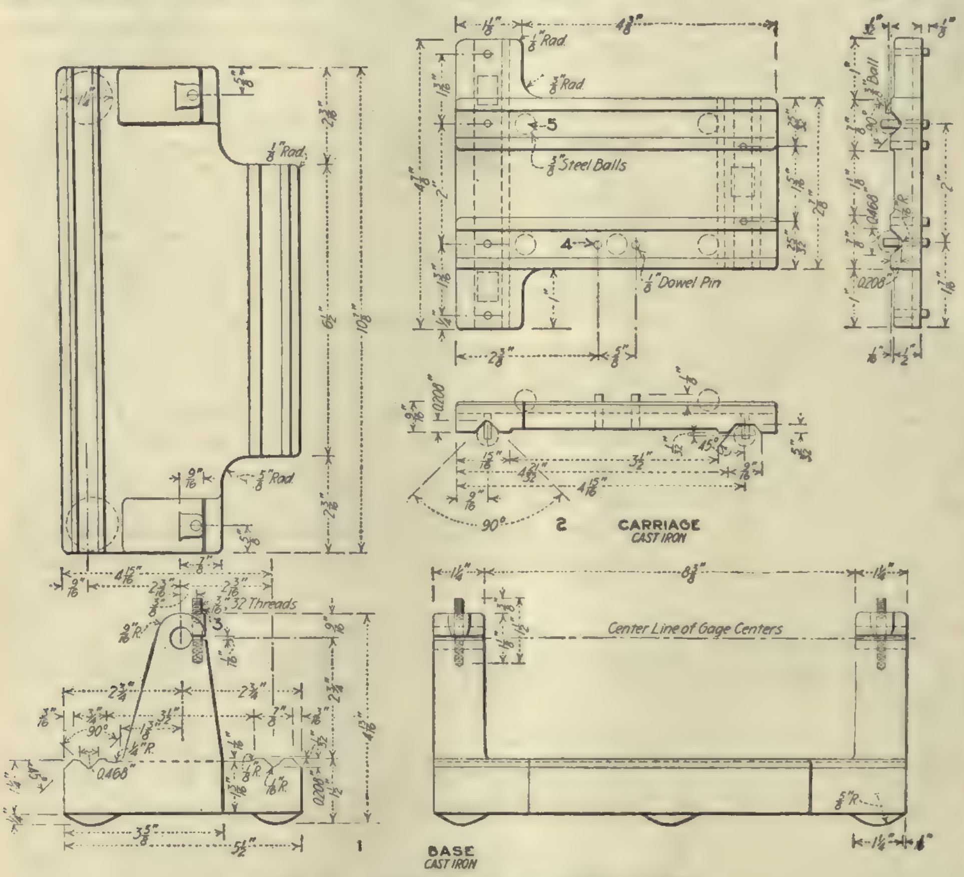


FIG. 2. DETAILS OF MACHINE PARTS

From Jack to Bill—Work in a Locomotive Shop

Deer Bill—Well here I be in Misshergun but not in that shop you no Bill ware thay pase evrybody 5$ but in anuther. Ile tel you howcome it Bill. A man sum kine of copp caim to the shop ware Ide lurned to be awl them kines of speshlists and ast a lot of qestshuns. I shode him my burth sifficit and he went off but him or sum uther nozy gink rote to my hoam town in Jurzy and found out thare want no Jack L blonged thare—you no L is my new midl naim Bill—but a Jack without no L but not no thurtyfore yeers oald like my sifficit says I bee. So the copp guy cums and tels mee Ile be drafteded and I has to say sumthin so I ups and tels him I blong in Cannerdy—you no my oald man he yused to live thare Bill. Then he gose away but anuther gink cums and tels me I ort to inlist in the Hylandrs and fite for my kink and countrey and thay was havin a lawr maid so Cannerdy cood git me. Woodent I look fine amung them Killtys with my nees bair. I hoap Ive got two mutch reel moddisty and then them pipers asqeelin laik a pigg in undr a gait. No not for me Bill, so I lites out for Misshergun mity durn quick.

Well I gose to hire on and the man tels me thay hasent no vacunsy at prezzent and I speeksup sharp and tels him I doant want no vacunsy but a jobb. Hee says no you look like you had awl the vacunsy nesesarey and him and too uthers laffs. Wat fool things sum foaks wil laf at Bill. Then I fines out that Misshergun is a lott neerer Cannerdy than wat I wish and Ime sum ankshus but a good feller ware I boreds he tels me no A 1 mecannik like wat you says you be wil be drafteded if he wurks for a ralerode for the tranes has to be kep runnin. Then he shoes me a bigg pickshur of a enjun and spens harf the nite teechin me naims of parts and I pase for the beer. In the mornin I goes to hire on and the man ast me a fue like pielot and drorbarr and then asts wich reechrod is longist rite or lefft and I dident rerember seein no sutch but I annsers rite on moast rodes and he lafs and I tels him sum rodes prefurs em the uther way. Then he asts did I wurk in front or bakshop at hoam and I rerembers wat my friend sed to be hummbl and not clame too mutch so I says bakshop. You no I nevver was the pooshin kine or swelheded Bill. Then he doant ast no moar only wich end of a driving bocks wej is thikist and I tels him the bigg end and he gives me a card and sends me to the bakshop fourman and he givs me a jobb on a masheen I nevver sawr no nor hurd of—a slottur.

I'm a doin drivin bockses do you no wat thay are for Bill. I carnt gess. I toald him I coodent take no purmnunt job for no moar than a fue munths cause I mite disside to inlist bein as Ime of a fitin fammerlie. But wat I reely thort Bill was that the 5$ shop mite send for me. Dident you think bilers was holler Bill? I did but yistidy I lookd threw a biler and its fool of litl paips. I doant see how thay keap the watter in them paips to bile it do you. Oh I furgot a qestyun the hiring on gink ast me. How many siderods has a 2-2-2 shiftr? And I toald him I was aftur a jobb not no plezunt convrsashun and I nevver sawr no sutch enjun and it sowndid to me moar like a wisl and he sed youl do. Wel Bill I no Ime doin fine for the big bos tawkd with the foarman and the foarman sed Ive a good man hear, sellon lwee. I doant no wat that sellon lwee meens but sumthin fine for the big bos says he seams to be awl rite.

Reely wat the foarman sed was sellon lwee Mame, but I thort he maid a slip for thare want no Mame thare nor no uther feemail atall but Ide like to no wat them wurds meens. Ast sumwun wil you Bill.

The foarman ast me ware my tooles was and I sed the Xpres compny hadent of brort em yit, witch is true two, but Ive moar than I yused to hav for I pikd up wun sum gink dropd and I doant no the naim shaipd like a hed of a bow narrer with marks on it like a scail. A man cawled it a senter gaij. Wat is it for Bill?

And Ive bort mee a sirfis gaij. Thats wy I havent sent you none of the munny you leant me that and becors the man that shode me awl the parts on the pickshur of an enjun borode 5$ off mee but Ile send sum wen paday cums Bill. Ime agittin 45 cents a nour and 67 and ½ for oavrtime but I think thares a ketch in that for I nevver sawr no half sents did you Bill. If I evver git to be bos hear as Ime hoapin too for Ive lurned a lott this weak I wunt hav no harf sent trapps to cheet men out of wat theyve urned by the swet of thare browse. But this is a good shop Bill showr barths but we aint obblijed to yuse em, and if we gits hert a horspitle to git wel in and prity nerses and awl that. So no moar Bill from JACK.

PS—Bill Ive a letr from hoam and my oald man has merrid agen. I do hoap he wunt go and hav a sun oalder than wat I be to maik things unplezzunt if I evver want to vizzit the oald man.

Center for Fluting Small Reamers

BY HUGO F. PUSEP

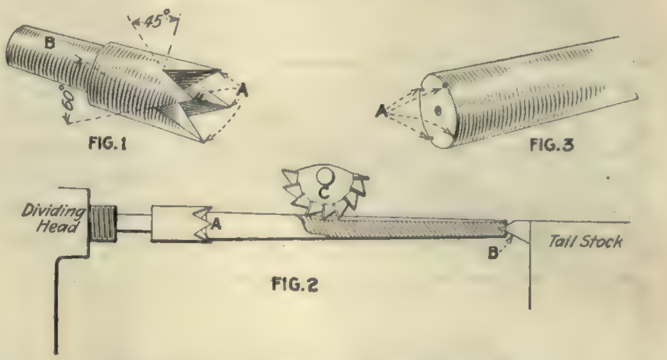
The most expensive operation in the manufacture of small reamers is undoubtedly that of milling the flutes. Where quantity production is of paramount importance, as at present, it is up to every progressive shop man to use methods and appliances for cutting down handling time to a minimum. Very often the actual machining time per piece on small reamers compares favorably with any other of its kind, but there seems to be something the matter as regards final results. The source of trouble can almost invariably be found in the methods of handling the different operations.

In Fig. 1 is shown a holding center to be used for holding small reamers while fluting. It is made of tool steel, and the four prongs *A* are hardened. The shank *B* can be either straight, where collets and drawbar are furnished with the dividing head of the miller, or tapered to fit the center hole in the dividing head. It can also be used successfully while being held in the dividing-head chuck.

As can be clearly seen, the cutting of the four prongs is accomplished with a 60-deg. milling cutter. Fig. 2 shows the method of holding reamers while fluting and also brings out the advantages of this holding center over the old way of placing reamer blanks between centers, with a dog on one end.

The shank end of the reamer blank is held between the prongs of the holding center, as at *A*, Fig. 2, and the tail center brought up and entered into the center hole of the reamer blank. Now a little pressure with the tail center *B* will cause the prongs of the holding center to sink slightly into the reamer blank, thus holding it securely against any tendency to turn while the cutter *C* is in motion. The action of tightening and loosening the tail center is all that is required in order to place a new reamer blank preparatory to fluting, or to remove the finish-fluted reamer, thus cutting the handling time down to a minimum. In Fig. 3 is presented an enlarged view of a reamer end after removal from the holding center. The four nicks *A* were left by the prongs engaging it.

This method of holding small reamers not only saves handling time, but allows the fluting cutter to work closer to the shank end of the reamer in cases where the reamers are comparatively short shanked. A holding center having ½-in. diameter over the prongs will take any size reamer blank from ⅜ in. down; but where the diameter of the reamers fluted is very small, a correspondingly smaller holding center can be made very quickly. A female tailstock center is often used where the diameter of the reamer blanks is too small for a center hole.



FIGS. 1 TO 3. HOW THE CENTER IS USED

Safeguarding Women in Machine Shops

BY C. J. MORRISON

The article, on page 507, entitled "Women in the Machine Shops" by Mr. Colvin, is very interesting, and it brings up one very important question. Machines which may be thoroughly safeguarded for men operators may be extremely dangerous for women unless the women wear caps.

Three of the illustrations in this article show women with uncovered heads working around machines. Strands of hair will catch on polished shafts and the possibilities for catching in drills, taps, threads, and any rough surfaces, are almost unlimited. A number of sad accidents where girls have been seriously injured testify to the danger. Caps similar to bathing caps, but made of some light material, should be provided for all women who operate machines, and they should be compelled to wear the caps. These caps should be held to the head by elastics under which all loose strands of hair can be tucked. Foremen and inspectors should see to it that the caps are worn.

Possibly the most dangerous machine for a bareheaded woman to operate is the drilling machine, for the reason that there are many parts upon which strands of hair would readily catch.

The time has come when women must be used in the machine shops and it is therefore very important that they be safeguarded from all injury. As there is already some prejudice against using women in machine shops, it would only require a few accidents to make it almost impossible to secure them for machine shop work.

Standard Subpress for Tools

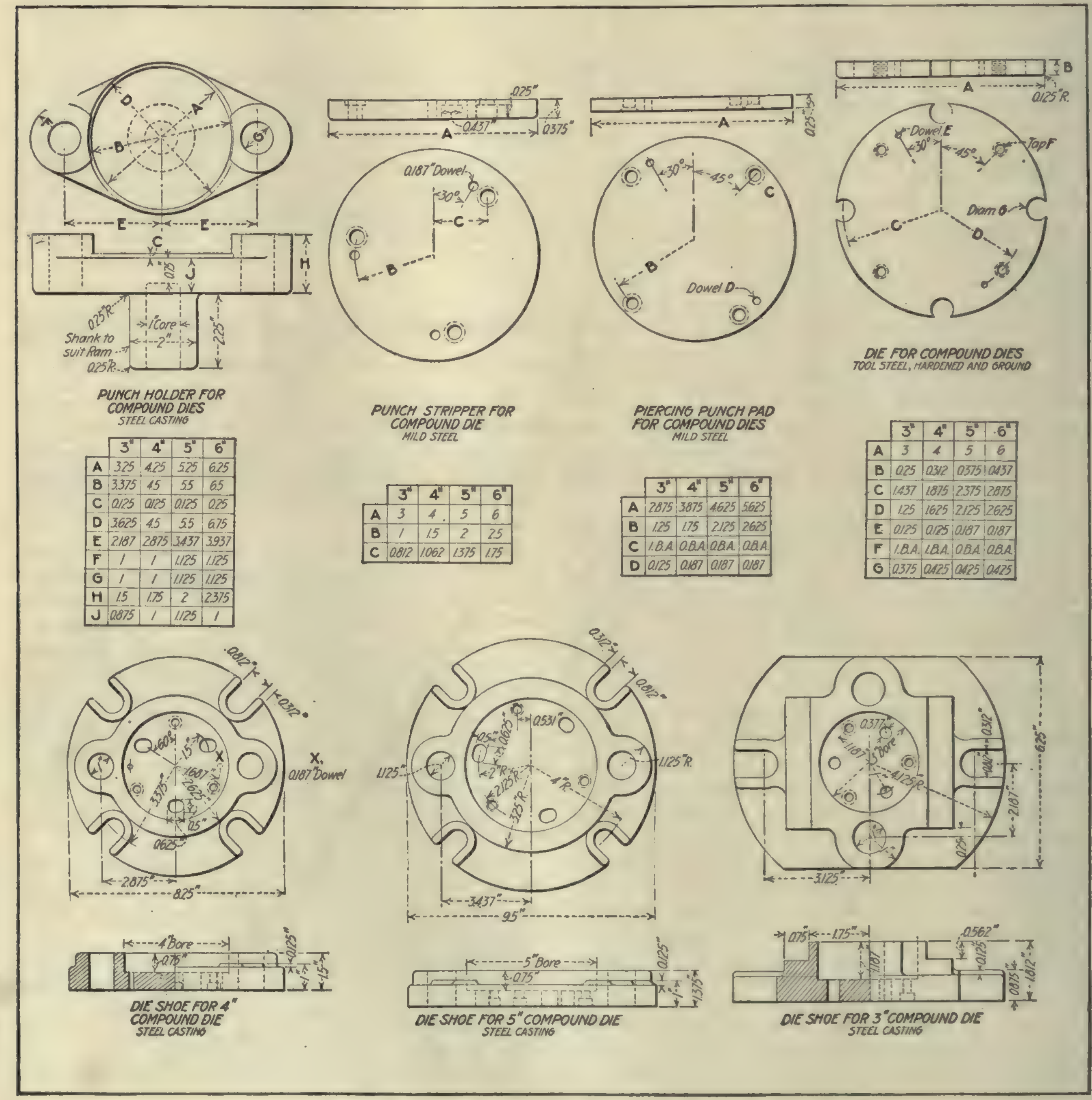
By H. KAY

Considerable time and money is lost in a large number of shops, where a variety of presswork is turned out, owing to delays occasioned in setting up different jobs. Here are some valuable suggestions.

ONE is often surprised by the absolute disorder in the average press-tool store. The multiplicity of design, or rather lack of design, is astounding. Generally it is left to the toolmaker to develop a tool. A drawing of the piece to be produced is supplied, but the type of tool is left entirely to him. The tools shown herewith were developed in a factory engaged on small press-tool work in an effort to evolve some sort of order out of a state of chaos. The drawings given in detail will be found self-explanatory.

All components are kept in stock, machined, the various parts being drilled together for dowels or screws. The only work required when an order comes through is to make the punch and bore the pads to suit.

In many instances the shape of the punch is intricate, and to produce this shape in the punch pads would be expensive. Where possible, the punch is turned down and the pad bored to suit. These tools have proved efficient and are neat in design. Of course, the shank and bolt lugs must be made to suit the press.



PUNCH HOLDER FOR COMPOUND DIES
STEEL CASTING

	3"	4"	5"	6"
A	3.25	4.25	5.25	6.25
B	3.375	4.5	5.5	6.5
C	0.125	0.125	0.125	0.25
D	3.625	4.5	5.5	6.75
E	2.187	2.875	3.437	3.937
F	1	1	1.125	1.125
G	1	1	1.125	1.125
H	1.5	1.75	2	2.375
J	0.875	1	1.125	1

PUNCH STRIPPER FOR COMPOUND DIE
MILD STEEL

	3"	4"	5"	6"
A	3	4	5	6
B	1	1.5	2	2.5
C	0.812	1.062	1.375	1.75

PIERCING PUNCH PAD FOR COMPOUND DIES
MILD STEEL

	3"	4"	5"	6"
A	2.875	3.875	4.625	5.625
B	1.25	1.75	2.125	2.625
C	1.B.A.	0.B.A.	0.B.A.	0.B.A.
D	0.125	0.187	0.187	0.187

DIE FOR COMPOUND DIES
TOOL STEEL, HARDENED AND GROUND

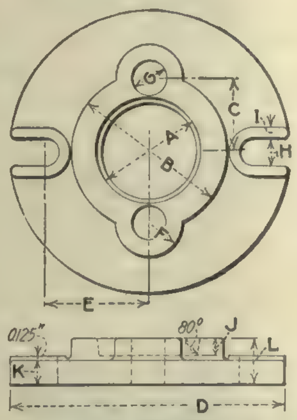
	3"	4"	5"	6"
A	3	4	5	6
B	0.25	0.312	0.375	0.437
C	1.437	1.875	2.375	2.875
D	1.25	1.625	2.125	2.625
E	0.125	0.125	0.187	0.187
F	1.B.A.	1.B.A.	0.B.A.	0.B.A.
G	0.375	0.425	0.425	0.425

DIE SHOE FOR 4" COMPOUND DIE
STEEL CASTING

DIE SHOE FOR 5" COMPOUND DIE
STEEL CASTING

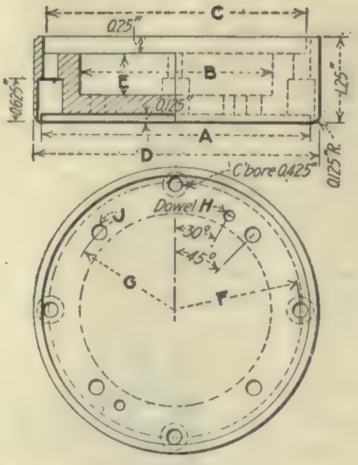
DIE SHOE FOR 3" COMPOUND DIE
STEEL CASTING

A NUMBER OF STANDARD COMPONENTS OF SUBPRESS TOOLS



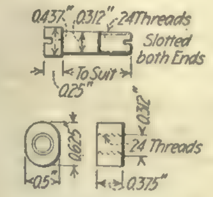
DIE SHOE FOR SIMPLE BLANKING DIE
STEEL CASTING

	2"	3"	4"	5"	6"
A	2	3	4	5	6
B	3	4.5	5.25	6.5	7.75
C	1.75	2.125	2.75	3.312	3.812
D	4.5	8.25	8.25	9.5	11.25
E		3.125	3.375	4	4.75
F	0.875	1	1	1.125	1.125
G	0.75	1	1	1.125	1.125
H		0.812	0.812	0.812	0.812
I		0.312	0.312	0.312	0.312
J	0.5	0.5	0.5	0.625	0.625
K	0.625	0.75	0.875	0.875	1
L	1.25	1.375	1.375	1.375	1.875

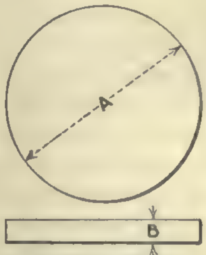


DIE HOLDER FOR COMPOUND DIE
MILD STEEL

	3"	4"	5"	6"
A	3	4	5	6
B	2.25	2.875	3.75	4.75
C	2.875	3.875	4.625	5.625
D	3.25	4.25	5.25	6.25
E	0.687	0.625	0.562	0.562
F	1.437	1.875	2.375	2.875
G	1.25	1.625	2.125	2.625
H	0.125	0.125	0.187	0.187
J	1.B.A.	1.B.A.	0.B.A.	0.B.A.

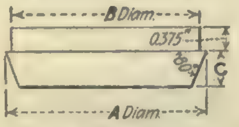


STRIPPER SCREWS FOR COMPOUND DIES



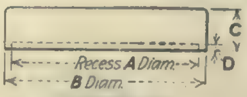
DIE STRIPPER FOR COMPOUND DIES
CAST STEEL, TOUGHENED

	3"	4"	5"	6"
A	2.25	2.875	3.75	4.75
B	0.312	0.312	0.312	0.375



DIE BED FOR SIMPLE BLANKING DIE
TOOL STEEL

	2"	3"	4"	5"	6"
A	2	3	4	5	6
B	1.812	2.812	3.812	4.812	5.812
C	0.5	0.5	0.5	0.625	0.625

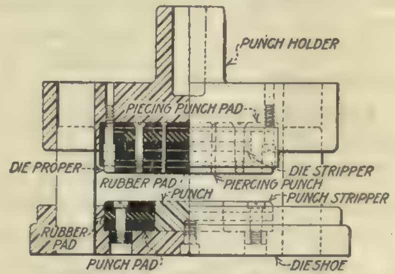


STRIPPER FOR SIMPLE BLANKING DIE
MILD STEEL

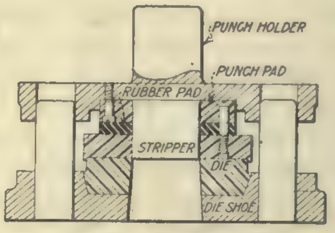
	2"	3"	4"	5"	6"
A	1.812	2.812	3.812	4.812	5.812
B	2	3	4	5	6
C	0.625	0.625	0.75	0.75	0.875
D	0.093	0.093	0.093	0.093	0.093

	2"	3"	4"	5"	6"
A	1.75	2.25	3.25	4	5
B	0.5	0.5	0.625	0.625	0.75

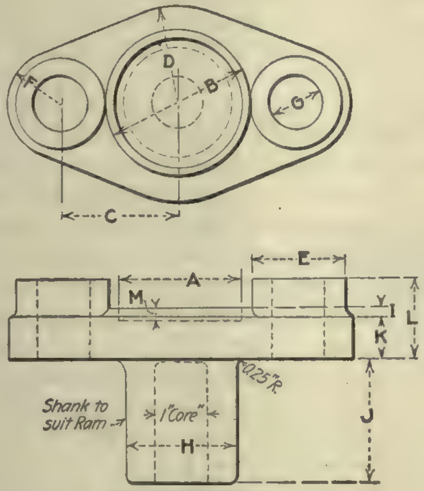
PUNCH PAD FOR SIMPLE BLANKING DIE
MILD STEEL



COMPOUND BLANKING AND PIERCING DIE

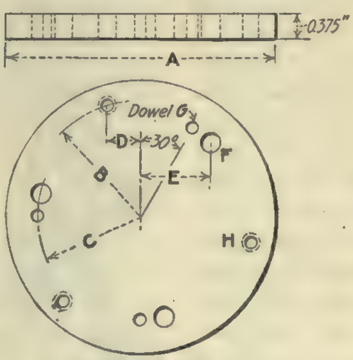


BLANKING PUNCH AND DIE



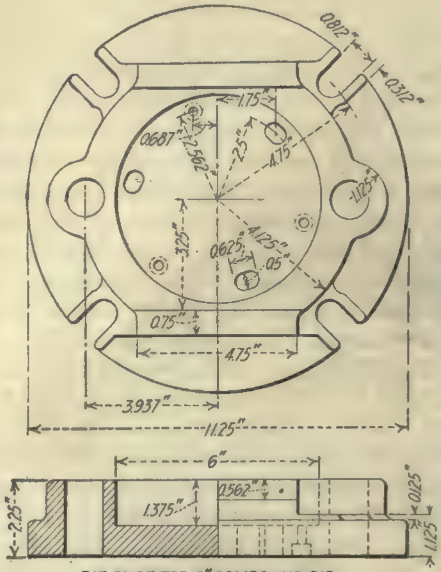
PUNCH HOLDER FOR SIMPLE BLANKING DIES
STEEL CASTING

	2"	3"	4"	5"	6"
A	1.75	2.25	3.25	4	5
B	2.125	2.75	4	5	6
C	1.75	2.125	2.75	3.312	3.812
D	1.25	1.75	2	2.5	3
E	1.25	1.75	1.75	2	2.25
F	0.75	1	1	1.125	1.25
G	0.75	1	1	1.125	1.125
H	1.5	2	2	2	2
I	0.125	0.125	0.125	0.125	0.25
J	1.75	2.25	2.25	2.25	2.25
K	0.625	0.75	0.875	1	1.125
L	1.125	1.375	1.5	1.5	1.75
M	0.125	0.125	0.125	0.25	0.25



PUNCH PAD FOR COMPOUND DIES
MILD STEEL

	3"	4"	5"	6"
A	3	4	5	6
B	1.187	1.687	2.125	2.562
C	1	1.5	2	2.5
D	0.593	0.842	0.531	0.687
E	0.812	1.062	1.375	1.75
F	0.375	0.312	0.312	0.312
G	0.187	0.187	0.187	0.187
H	0.25	0.25	0.312	0.312



DIE SHOE FOR 6" COMPOUND DIE
STEEL CASTING

VARIOUS STANDARD COMPONENTS FOR SUBPRESS TOOLS

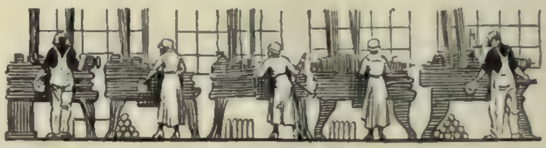
Responsibility of Machine Tool Builders[*]

By HENRY JAPP, C. B. E.
Deputy Director General in U. S. for British Minister of Munitions

I DESIRE to convey to you on behalf of Lord Northcliffe, Chairman of the British War Mission in this country, his regrets at being unable to be present with you today, and you can realize how busy he must be here with such a large organization as the British War Mission under his care. With regard to the future, in a recent interview he is reported to have said: "Smash the Germans first and then talk about what is to be done next." Need I tell you how much all the various Allies, more especially the British Empire, appreciate the work that the machine-tool builders of this country have done toward winning the war? In equipping the munition works of this country alone you have done marvels, but when one considers the millions of dollars worth of machine tools and accessories you have exported to Great Britain, France, Russia, Italy and Canada, it is surely with a deep feeling of gratitude that we must regard the great work you have accomplished; and let me say we still need your help, we depend on you, gentlemen, and we know you will not fail us. Every machine ordered from United States by Great Britain is urgently required for munition work, so please hurry deliveries, and don't forget that above everything, the boys now at the front must be kept supplied. To withhold their needs in any respect would be disastrous. This is a war of machinery; the building up of a machine in three years to smash the war machine of Germany that was surreptitiously built up in the last forty years with malice aforethought to conquer the world. As you are aware, the machine-tool department of the British Ministry of Munitions is under the care of Sir Alfred Herbert, a well-known machine-tool builder. In order to prevent machine tools standing idle or being insufficiently employed, he has established a machine-tool clearing house. In the last seven months his clearing house has investigated 22,000 applications and released 43,000 machines, which are valued roughly at $15,000,000.

The production of munitions, of course, depends almost solely on machine tools, and you will be glad, and probably astonished, to hear that the output of England is today twenty times what it was two years ago. The Woolwich arsenal, which was our main supply in 1914, employed then a staff of 11,000, and the staff today is 74,000, and while in 1914 only 125 women were employed in this arsenal there are now 25,000 employed there.

The cost of the manufacture of munitions for Great Britain has resulted during the last year in a saving of $200,000,000 over the costs of production for the previous year, and workmen have been so prosperous that out of their savings they have contributed $200,000,000 to the war funds. The employment of women in the manufacture of munitions and the dilution of labor with women, in the case of machine work, amounts to as high as 60 per cent., and these women have been able to earn, working piece-work, 90 per cent. in excess of the time rate. They are employed in all manner of industries; namely, gage making, machining shells, foundry molding, glass blowing and shipbuilding, and, of course, agriculture. In the inspection of munitions, which employs some 50,000 people, 60 per cent. are women, and in one large powder factory the proportion is 290 girls employed for each man worker. The above information is taken from the reports of Doctor Addison's speech in the House of Commons.



It is encouraging to learn that the maimed soldiers are being carefully equipped with artificial limbs and trained as skilled workmen. Queen Mary's training workshop at Brighton has been particularly successful in this beneficient work as well as that at Roehampton. The problem of making the maimed soldiers independent of charity is a most important one and the cheerful way in which these brave men have faced the problem of making themselves useful and independent is very inspiring.

PARTICIPATION OF THE UNITED STATES

Now that this great country has enlisted with the Allies to destroy the destroyer in self-defense, final victory is assured. I am sure that you all realize that you are not fighting to save France, or the British Empire, but you are fighting in self-defense. It is your war as much as ours, and among other things victory will bring freedom to the German people in much the same way that George Washington, without knowing it, helped to bring freedom to the English people, and his victory in America over George III, the German King of England, established not only the democratic government of the United States, but also of Great Britain and of the British Empire. With wonderful wisdom, President Wilson guided this country along the lines of strict neutrality until the people learned for themselves of the schemes of Germany to place this country, along with the rest of the world, under the heel of autocracy. Gradually the people were prepared for the great decision as bit by bit the evil intent of Germany was uncovered and revealed until the point was reached when President Wilson said: "The time has come to conquer or submit, for us there is but one choice, we have made it." And although to some it may seem to take a long time for your army to strike, make no mistake, this country is getting under way; it is like a huge flywheel, which takes time to reach its full speed and to develop its full energy, but ultimately becomes irresistable, overcoming all opposition in victory. The time will come for every country that is neutral today to decide whom they shall serve as there appears to be no neutrality possible for country or individual in this war of right against might, of good against evil.

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[*] Paper presented before the National Association of Machine Tool Builders at a recent convention.

This country has been putting its house in order for some time since the financial adjustment after the panic of 1907, and the gradual awakening from the condition of a country seemingly parochially interested only in its own affairs to a country today with world-wide interests, indicates that you are destined to be an even greater power for good in the immediate and future history of the world than you have been in the past, if that were possible.

Now, as to the possible duration of the war, I am no prophet, but each year the suggestion has gone out from Germany that the Germans cannot hold out another winter. This is the same old effort to put the nations to sleep that was practiced for forty years while the Germans were preparing for the conflict.

Make no mistake, let us not be deluded; the war, whether it ends this year or later, must be prosecuted as if it were to last for many years, but combined effort must not relax or the good work already done will be lost. Germany is the nation that passed through the thirty-year war, so we know they have a great reserve of staying power and we must not be deluded by false predictions of early breakdown.

From the past we learn that it required only seven days for the Germans to steal a part of Denmark, seven weeks to steal a part of Austria, and seven months to steal a part of France. Let us hope it will not take seven years to force restitution, and to destroy the belief and delusion of the German people that war is profitable. It is very evident that we cannot dissociate the German people from the German government in all the lawlessness and brutality of the last three years, for they are one. The present success of Haig in Flanders, and Petain in France, points to an early withdrawal of the Germans to the Antwerp-Brussels-Verdun line, but the present bad weather may postpone this till next spring, just as the Somme advance last fall resulted finally in the withdrawal to the Lens-Lafere line in the following March, but the condition of Italy and Russia is not so hopeful.

Meantime the submarine campaign is still serious, and in a recent speech, Doctor Addison, lately Minister of Munitions, said that the submarine losses of vessels carrying munitions from this country was nearly 6%, and Mr. Lloyd George is reported as saying that although twice as many German submarines were destroyed during the past year as in the previous year, the sinking of allied steamships is still heavy, so we must hasten our shipbuilding everywhere.

But if Germany hopes to put Great Britain out of business before the United States is ready, it is evident they have made a miscalculation. They made the same miscalculation when they thought that they would put France and Russia out of business before Great Britain was ready.

When you consider that Great Britain has more than five million men under arms and that the United States has a population of more than double that of Great Britain and has practically unlimited resources, it is impossible to understand those who doubt that the final outcome will be the defeat of Germany.

As to the outlook after the war and the restoration that will be necessary, let us look forward with hope and courage. This is a wonderful time we are living in and a wonderful war we are waging, inasmuch as we are not only destroying the lust for conquest and military power in Germany, but throughout the world, and we are setting ourselves and the peoples of the earth free from bondage to all manner of abuses.

We are establishing a universal democracy, the democracy that will be the universal form of Government with the extension of the franchise to women, who have done so much by their wonderful work during the war to open our eyes to the folly of thinking a man is entitled to more rights than a woman.

READJUSTMENT

Alcoholism or John Barleycorn is vanishing from sight, with all his attendant evils and economic waste; all of Canada and Newfoundland, except the Province of Quebec, have gone dry since the war commenced and this country is rapidly following suit. Wealth is being redistributed more evenly, and in England the abject poor have virtually disappeared.

The employer and workmen, the rich and poor, the educated and the uneducated, are meeting in the trenches and spilling their blood together for the brotherhood of man, and in doing so are learning to admire and love each other, and can we doubt that a new Heaven and a new Earth are being revealed today and that the lookout is bright with promise.

The business world is already preparing for the readjustment necessary by scaling down the excessive stock-exchange values, and plans are now under way to provide work for the returning soldiers after the war.

If the British army is disbanded at the rate of 40,000 men per week it will require three years for the work, but as arrangements are perfected this work will no doubt be accelerated. Probably the same scale will apply to all the Allies.

The skilled tradesmen should be released first so that by their industry there will be built up the supply of necessities that will be required for the devastated sections of France, Belgium and Servia, and to replenish the depleted stocks throughout the world.

The reforestation of the British Isles in itself would have been a big undertaking before the war, but now since the forests and plantations have been denuded for use at the front it is a task that will require immediate attention and employ large numbers of the returning soldiers.

The huge credits that have been established to carry on the war, amounting to $35,000,000 a day in Great Britain alone, cannot be halted immediately after the war is over, but will continue until the commercial pursuits are reëstablished. These huge daily disbursements have shown us that wealth is not so much a stock of gold as it is credit; in other words, confidence, and we can surely supply unlimited stocks of that.

Before the war we had not sufficient courage to spend $35,000,000 a year on welfare and betterment work, but today we spend that much per day for destruction, so that we will never again fear to invest our capital in pulling down and rebuilding the wretched hovels in which the poor of Europe are housed and in carrying on other beneficient work.

Before the war, Great Britain was a creditor nation, with a credit of $750,000,000 annual interest on foreign investments coming to her shores as an excess of imports over exports representing a capital investment of some $15,000,000,000; while on the other hand the United States was a debtor nation with a debt of $350,000,000 interest on investments in this country by foreigners, which was paid for by an excess of exports, over imports, representing a capital investment of some $7,000,000,000.

Now, while Great Britain has loaned, I understand, $7,000,000,000 to her Allies and partners of the British Empire, many billions have been spent in this country for munitions and other supplies, and on account of the debt incurred Great Britain must in the future reduce her excess of imports over exports by becoming more self-supporting as to agricultural produce, and by greater productive capacity in manufactures for exports, while this growing country will undoubtedly have to import a greater proportion of its needs when it takes the place of a creditor nation, as the interest cannot be paid excepting by merchandise.

But no matter how much money the Allies may owe you at the end of the war, I feel you will still have the moral debt you owe for the protection they have given you for the past three years; first, by the British Navy, and second, by the blood and treasure spent in the trenches in France, a debt you will appreciate more and more as the struggle continues. This moral debt is also shared by the small neutral nations of Europe; as who can doubt what their fate would have been had Germany been victorious?

WORK TO BE DONE

There will be endless work to be done after the termination of the war in construction and reconstruction so that all mankind will be fully and actively employed. The building of steamships to make up the curtailed building and losses sustained during the war will keep the shipyards busy for several years to come.

The supplies required to reinstate the devastated industrial sections of France and Belgium, to say nothing of making up for the neglect in the upkeep of the British railway systems and other public utilities on account of all facilities being impressed during the war for munition work, will surely keep the machine-tool trade fully occupied for many years, especially as at present so much machinery is allowed to run without repair, and the same applies to all other industries that supply the needs of man. So, let us look forward cheerfully to the future, inspired by the self-sacrifice that our boys are making for all we hold dear.

This war is undoubtedly a warfare of ideals—on the one side we have autocracy or the mastery of the few ruling at the expense of the many warring against democracy, or the Government of the people, by the people, for the people, the democracy of Lincoln.

Before the war it was surely an inspiring sight to see the great liners and cargo ships steaming majestically down the Hudson on their way to Europe, but now to see these ships with the brave men handling them go out to meet the lurking dangers of mines, and torpedoes without a murmur, and without the praise that is their due, fills me with wonder and admiration.

These men are of the race that first said: "Women and children first," the race which is fighting for the British Empire today and founded this great democracy sprung from the Pilgrim fathers, who sailed from the Motherland; the Motherland which stood for women and children first, the Motherland that is today fighting the Fatherland that murders women and children first in all of the unspeakable atrocities that have driven the world to arms to destroy the ruthless aggressors.

GERMAN PROPAGANDA

The world is just beginning to awake to the fact that the enmities and resentments existing between the various nations have been largely instigated and fostered by German propaganda. The mutual suspicion and resentment which seemed to exist between Great Britain and America was certainly the result of this propaganda, and the trouble which has existed for years between Great Britain and Ireland has been fostered in the same dastardly way. If the war resulted only in the freeing of the world from the international suspicion engineered by this diabolical propaganda a great benefit would result.

If all suspicion is removed, then it will be possible for the nations to combine in the maintenance of a policing force, sufficient to overcome any aggressive nation that attempted warfare in the future.

One of your greatest citizens, Elihu Root, has described the war as waged by the Allies as "The great peace movement."

In conclusion, let us remember our debt of gratitude to the brave men in the trenches and on the high seas. What tribute shall we pay the brave boys of all the Allies in the trenches fighting the good fight, even though not without fear for the horrors of this cruel war, always cheerfully facing discomfort, danger and agony, and giving their lives for our cause, and our men of the navy ever watchful and alert in storm and shine guarding the world, standing between the Central Powers and world dominion while our armies prepare.

Gentlemen, can we do less than back them with all we are worth until they have broken the war machine of Germany, for we cannot have peace until that is accomplished. So, let us go about our duty cheerfully and unafraid, guided by principle in all our business and daily experience, and by our honesty, fidelity and sacrifices to hasten the day when the nations of the earth, each retaining their individuality, shall all be brothers; a great democracy governed by the Golden Rule.

The Panoramic Sight

By

W. L. Olmstead

VI. Optical Elements

This article takes up the making of the lenses used in the panoramic sight and describes the kind of glass used, how it is tested for flaws, how it is cut, ground and polished.

THE lenses and prisms of the panoramic sight must be made from the best-quality glass, free from bubbles, flaws, striæ and strains. These defects are due to improper mixing of the materials of which the glass is made.

Small bubbles and flaws can be readily detected with the eye and have a more or less detrimental effect according to their location. Striæ distort and darken the image. With strained glass no distinct image can be obtained. Bubbles and flaws are visible when the two flat sides of the glass have been polished and the glass is examined by holding up to the light. To detect striæ, especially when they do not show prominently in layers, but appear in threadlike form, requires a practical man with a trained eye. In examining the glass for striæ the ends or sides are ground and polished and the glass held to the light so that the body of the glass can be observed from end to end. The presence of small bands of color, channels or threadlike sprays renders the glass unfit.

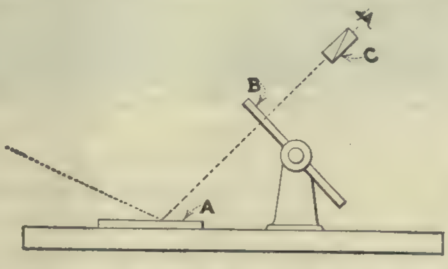

FIG. 66. INSPECTING FOR STRAINS

Strains cannot be detected with the unaided eye. For detecting strains a polished piece of flat glass (darkened on its back surface) is placed upon a flat surface, as shown at *A*, Fig. 66. The glass *B*, which is to be inspected, can be held by the fingers against a holder, similar to Fig. 66. At *C* is shown the rectangular-shaped Nicol prism through which the observation is made. The Nicol prism is made from quartz, in two parts cemented together. The glass *B* is placed between the plate *A* and the prism *C* so that light reflected from the plate *A* will pass through the plate *B* and the prism *C* before entering the eye. When the glass is rotated on its axis, light and dark shades appear successively, according to the angle at which the glass *B* is held. If the various shades of light (or dark) appear to be evenly distributed over the entire surface, the glass is free from strain.

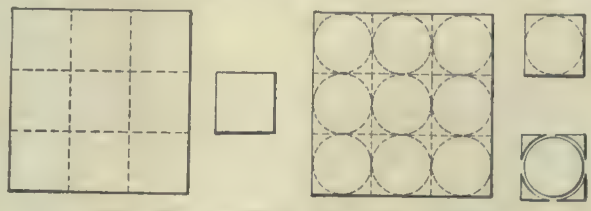

FIG. 67. LAYOUT ON THE GLASS

To test the stability of glass, both sides are carefully cleaned and the glass is placed under a glass bell and exposed to muriatic acid fumes for from 24 to 30 hours. It is then carefully sealed in a place free from dust and ammonia fumes for about 24 hours. If after this time a coat of moisture (which is easily wiped off) is found on the polished surface, then the glass is not suitable for optical purposes. Another test is to slide the finger across the polished surface with the surface held at an angle toward the light, and examine

Glass liable to become spotty when coming in contact with moisture or the weak acids present in perspiration can be distinguished by iridescent patches of a metallic luster. If no moisture can be perceived, the glass is suitable for optical purposes, if free from defects.

Thin plates of polished glass are cut with a diamond glass cutter. For ground or frosted glass, either a hand glass cutter having a hard steel wheel or a hard

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thin covered file is used. After marking the glass as shown in Fig. 67, the pieces are easily separated by a slight pressure.

For cutting circular pieces from thin glass a circular glass-cutting machine is used. With the diamond of the circular cutting machine, the circles are laid out as shown in Fig. 67, and the glass is cut into squares and separated. The corners are then removed and the circular piece obtained.

The cutting of glass ½ in. thick and over requires a special machine. The machine shown in Fig. 69 is used for separating square slabs of rough glass into suitable lengths and widths for manufacturing prisms. In this illustration the operator is clamping the glass slab to the holder. The slabs rest lightly upon the top edge of the slitting wheel, the amount of pressure being governed by the counterweight at *A*. The copper slitting wheel *B* is $\frac{1}{16}$ in thick, 12 in. in diameter and heavily charged with diamond dust on the outside diameter. It revolves at 210 r.p.m.

The glass slab is marked off for the width and length of the pieces wanted. It is then adjusted in the holder so that the marks will rest at the proper place on the cutting wheel. The holder is pulled down so that the work rests upon the wheel. Enough weights are placed upon the counterweight *A* to allow the work to bear lightly upon the disk. Oil pans under the saw contain coal oil, through which the lower edge of the disk passes. The oil washes away the refuse glass from around the saw and allows it to cut freely. After the various cuts on the work have penetrated to within $\frac{1}{16}$ in. of the brass plate of the holder, the work is removed. Knocking lightly on the opposite side from which the cut is made will separate the pieces.

The life of the saw depends upon the way it is used. Too much pressure of the glass against the saw will quickly cut away the diamond dust embedded in the copper disk. The saw should always rest upon a flat surface of the work and should never be started upon the sharp edge or corner of the slab.

After the saw has been in use for some time and the diamond begins to wear away, the saw needs to be recharged. To charge a disk with diamond dust, the outside diameter of the disk is turned true and flat. Diamond when received from the dealer is too large to use and has to be crushed fine. The diamond is placed in a suitable receptacle and pulverized until a fine uniform grade has been obtained.

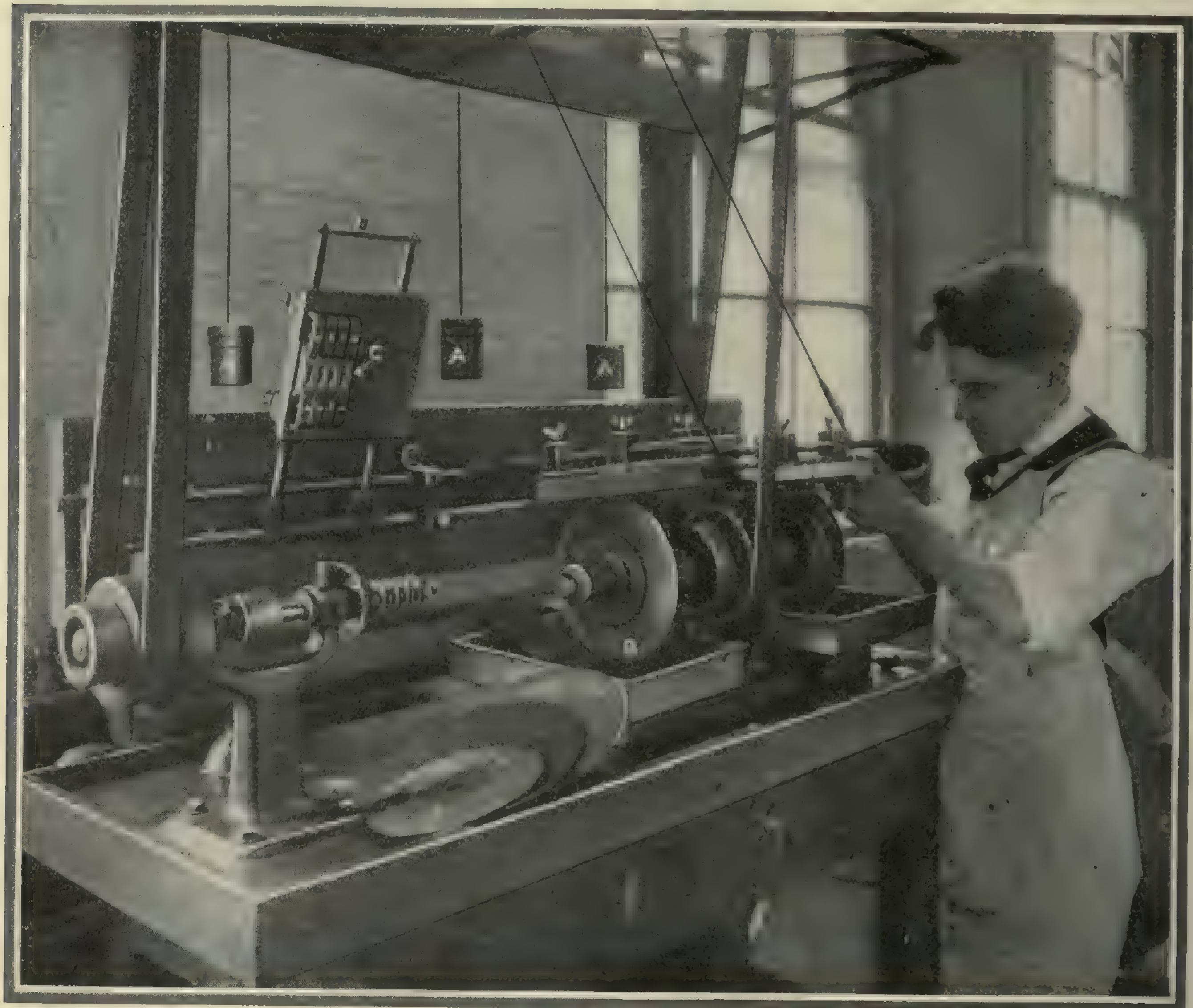


FIG. 69. GLASS SLOTTING AND CUTTING MACHINES

Place the fine diamond on a flat steel plate, and mix with oil. Hammer the copper disk down upon the diamond until the latter is firmly embedded in the copper; at the same time rotate the disk so that even distribution can be obtained.

In the illustration, Fig. 69, is also shown the method of grinding the semi-circular slot in the rotating prism. The grinding operations are the same as for slitting. The width and the diameter of the disks are governed by the size required. The speed of the disks is 240 r.p.m. In slitting the glass for making prisms, an allowance of about 0.2 in. over the required dimensions for a finished prism is made. This gives sufficient thickness for the rough-grinding operations. One side of the prism is ground flat and used as a base for the grinding of the prism. The surfaces of the prism are squared from this base with No. 150 grade of roughing emery. The rough grinding of the prisms is performed upon the machine shown in Fig. 70. This machine carries a 4-ft. circular cast-iron plate $\frac{7}{8}$ in. thick, which revolves 160 to 170 r.p.m. Emery mixed with water is thrown upon the plate, and the surface to be ground is held thereon with the hands.

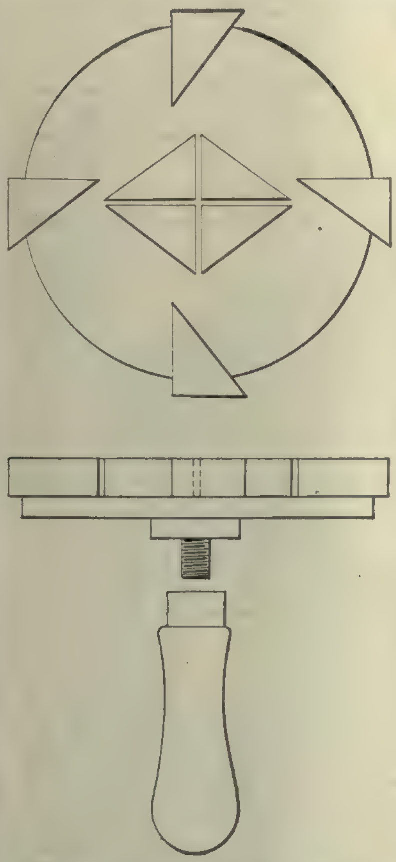


FIG. 68. HOLDER FOR PRISMS

After the rough grinding with No. 150 emery has been completed, the fine grinding is done. For the fine grinding, a smaller machine is used, similar to that shown in Fig. 70, except that the wheel is 18 in. in diameter and revolves at 236 r.p.m. With the smaller grinder the surfaces of the work are ground with No. 220 emery, and after that with smoothing emery. The latter is not graded by letters or numbers, but is called fine emery for smoothing.

After the sides of the prisms are smoothed, they are ground to thickness. If a large number of prisms are to be ground, a circular cast-iron holder is used, similar to Fig. 68. The holder is heated to a degree that will melt yellow beeswax. The wax is then spread like a film over the surface of the plate, and the flat side or base of the prism is pressed firmly upon it. When the tool is cold, the block is ready for grinding. Four of the prisms are allowed to overlap the plate, as shown in Fig. 68, for the purpose of measuring with a micrometer and keeping the thickness uniform. When the overlapping prisms have been ground to a uniform thickness, all the rest of the prisms on the plate must be of the same thickness.

In grinding a block of prisms, No. 90 grade of emery is used first—after that, Nos. 150 and 220 and, last, smoothing emery. No especial rule can be given as to when to change from one emery to another. In roughing down with the roughing emery, the coarse emery grains chip the edge of the work and cause a pitted edge formed by the rough emery grains. The roughing is brought as close to the finish size as possible and still allow enough stock to grind out the ragged edge with the fine and smoothing grades of emery. This depends upon the judgment of the operator.

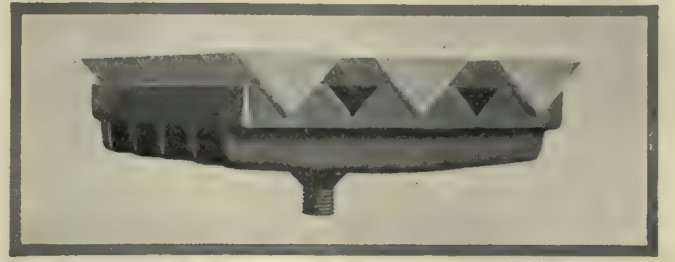


FIG. 71. BLOCKING TOOL FOR ROTATING HEAD PRISMS

In grinding the height of the rotating-head prism, the blocking tool, Fig. 71, is used. The tool is heated and a film of beeswax applied. The right-angle sides of the prisms are then pressed into the grooves, arranged so that each end will overlap slightly so as to permit micrometer measurement. The grinding is then performed. This blocking tool is also shown on the grinder in Fig. 70. Another view of the same blocking tool is given in Fig. 72. This illustration shows the tool arranged for grinding one side of the roof of the lower reflecting prism of the panoramic sight. In this set-up a brass strip cut with 45-deg. angle slots is held against one side of the V-slots in the holder with melted wax. The prisms are pressed into the hot wax and held in this way at the correct angle for the purposes of grinding.

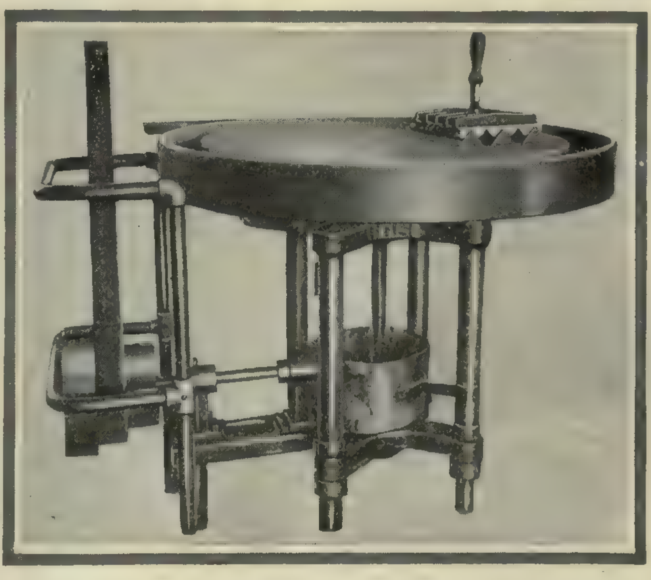


FIG. 70. MACHINE FOR HAND GRINDING PRISMS

In order to fit into places with interfering edges or corners, the prisms are usually beveled or rounded on the sides and ends (*A* and *B*, Fig. 73). This is also done to reduce the weight of the instrument. In beveling, about 10 prisms are arranged in pairs with the bottom surfaces or hypotenuses together, as shown at *C*, Fig. 73. These are cemented together with beeswax; and a glass strip is cemented to the side, so that the prisms may be held in an upright position while grinding. Held in this position, the bevel at *D* is obtained. For getting the bevel at *E*, the prisms are held at an angle while being ground. In rounding the ends *B*, a special fixture is used similar to that shown in Fig. 74. The prism is centered in the holder with the gage *D*, and the slide rest *C* is lowered until the prism touches the grinding plate *A*. The holder *B* works on an arm running through the slide *C*, which allows it to be rotated for grinding the radius.

After the prisms have been ground and beveled, the next operation is polishing. For blocking, the work is mounted upon perfectly flat blocks or disks the diameter of which depends upon the quantity of work to be polished. The diameters vary from 8 to 16 in. The blocking tool is heated to a degree that will melt paraffin wax. Small pieces of plate glass are first placed near the edge of the block, as shown in Fig. 75. The block is then filled with the prisms to be polished, placing the side to be polished down on the block in the wax.

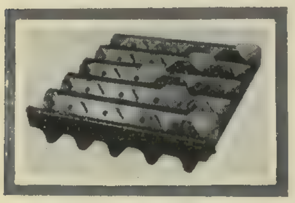


FIG. 72. BLOCKING TOOL

In blocking the prisms for polishing, the smallest surface is usually blocked first. The prisms are pressed firmly down on the tool, and it is allowed to cool. Melted beeswax is then applied to the exposed surfaces of the prisms with a camel's-hair brush. This is done to prevent the plaster of paris, which is later poured on the prisms, from sticking to the glass. A brass band is then fastened around the block, as shown at *A*, Fig. 75. This band should be deep enough to clear the largest prism on the block.

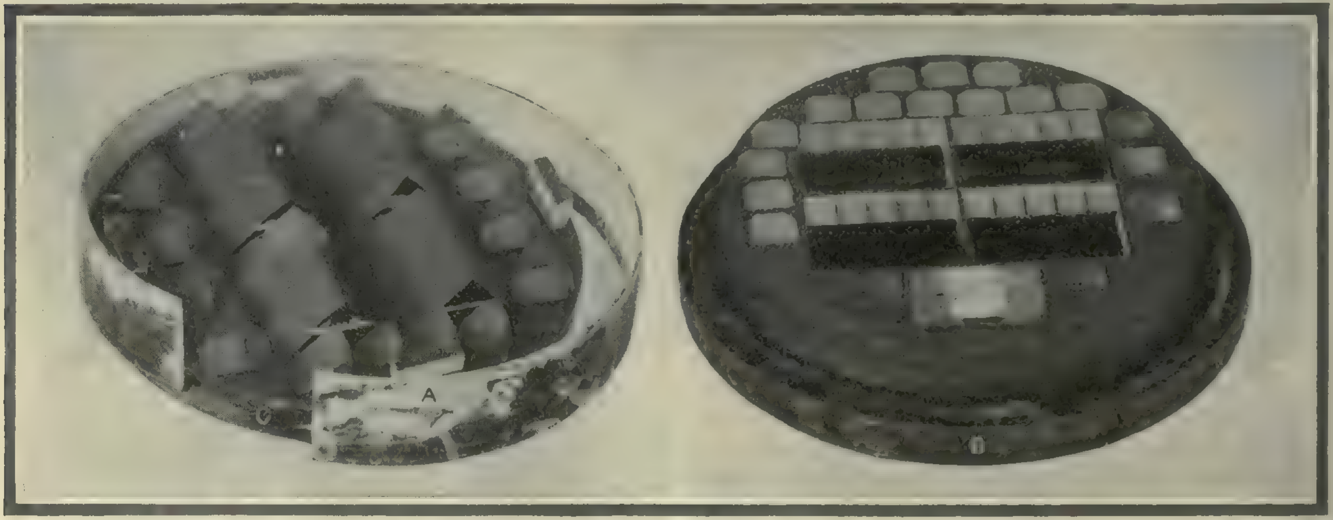


FIG. 75. PRISM BLOCKS FOR HOLDING THE PIECES OF GLASS DURING POLISHING OPERATION

After the band has been fastened to the block, we have a hollow compartment with the prisms seated firmly on the bottom. A mixture of plaster of paris and cement, about ten parts of plaster and one of cement, is mixed with water and poured into the compartment, covering the prisms. The plaster is poured even with the top edge of the brass ring *A*, Fig. 75. The driving tool *A*, Fig. 76, is then attached. This tool has a flat surface, is about 1 in. thick and has a threaded hub that screws into the driving spindle of the machine. Four or five holes about 1½ in. in diameter are drilled through the tool. The driving tool is also shown at *B*, Fig. 75, with the prisms in their plaster cast as they appear when ready for the polishing machine. In attaching the driving tool, it is placed on the top of the soft plaster and its surface clamped to the top edge of the ring *A*, Fig. 75. Plaster is then poured into the holes in the tool and allowed to harden. The blocks should be allowed to stand for from 12 to 16 hours.

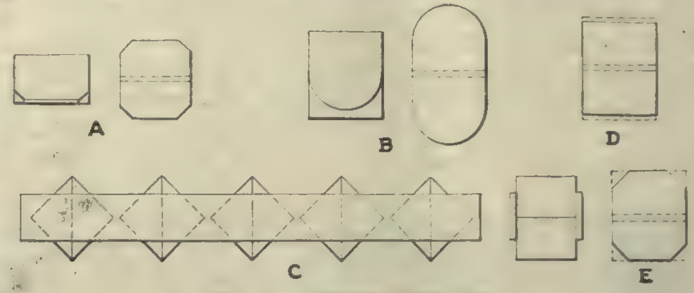


FIG. 73. PRISM DETAILS

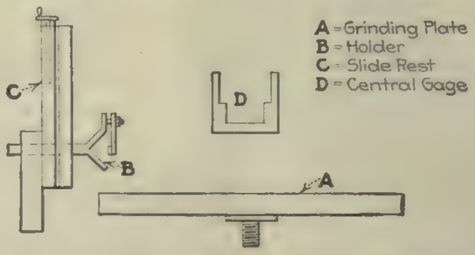


FIG. 74. FIXTURE FOR ROUNDING PRISM ENDS

After the plaster has become hard, the band *A* is removed. The blocking tool *C*, Fig. 75, upon which the prisms were first placed in wax; is also removed. In order to remove the blocking tool from the cast, it should be heated sufficiently to warm the wax, after which the plaster cast will slide off easily.

We now have a plaster of paris block with the prisms firmly embedded and the surfaces to be polished exposed. The plaster is cut away from the exposed surfaces of the prisms to a depth of about $\frac{1}{8}$ in., so that nothing but the glass surfaces can come in contact with the polisher. The blocking tool *C*, Fig. 75, is again brought into use at this point. The flat surface is carefully cleaned and the blocking tool heated just enough to be able to bear the hand upon it. The plaster cast of prisms is inverted and placed upon the blocking tool *C*. Weights are placed upon it so that, when the tool is cold, the surfaces of the prisms will be perfectly flat with each other. The slight readjustments that take place when the heat from the blocking tool reaches the plaster cast are made possible by the fact that the melted beeswax, which was applied just before the plaster was poured, once more becomes soft and pliable with the heat; and when again allowed to cool, it holds the prisms securely with perfectly flat surfaces exposed for polishing.

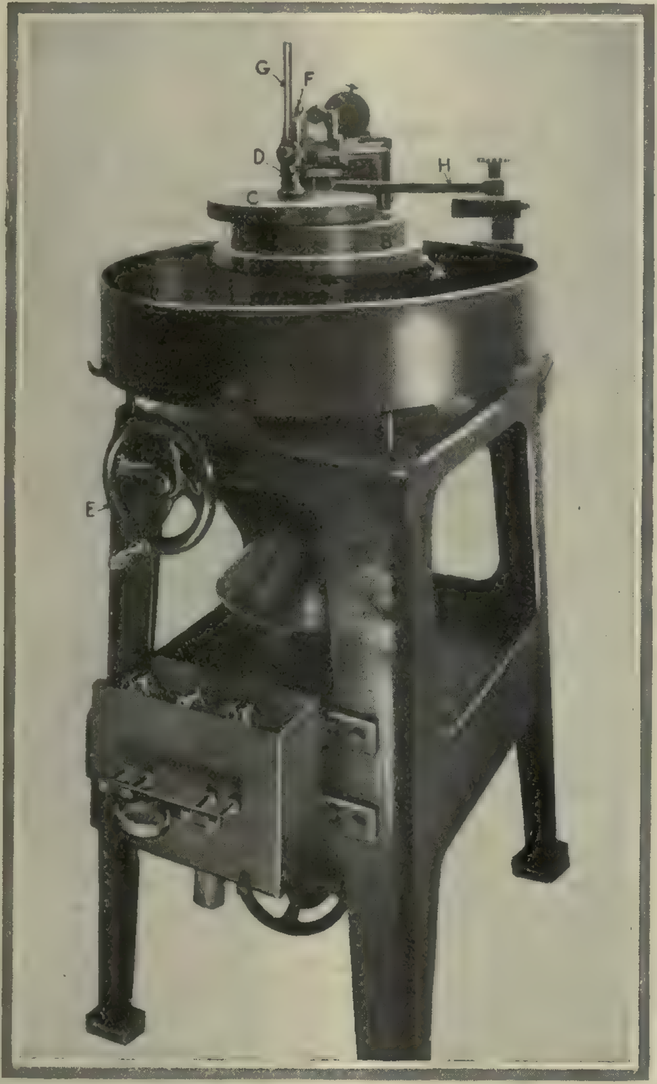


FIG. 76. PRISM-POLISHING MACHINE

After the block has cooled, it is removed from the tool, and the plaster on the top and sides is covered with liquid shellac. The shellac prevents the water used in polishing from being absorbed by the plaster. After the shellac is dry, the block is ready for the fine-grinding operation that precedes the polishing.

The fine grinding is done by hand. A grinding plate is used which will screw into the spindle of the machine shown in Fig. 76. The grinding plate is $\frac{3}{8}$ in. thick and should always be of the same diameter as the block to be ground. The top of the plate should be slightly convex instead of perfectly flat, so that, during the fine grinding, the center of the work will have a tendency to grind faster than the outer edges. This makes the next operation of polishing easier, as it is easier to polish level when a slight departure from perfect flatness is shown by a low center.

The finest smoothing emery is used for the fine-grinding operation, numerals not being used to distinguish the grade. The emery and water are distributed on the plate, and the block with the glass side down is placed upon it. When the machine is started, the speed at which the plate revolves can be regulated by the handwheel *E*, Fig. 76. The plate is rotated evenly from side to side with a lapping motion. The emery is not allowed to become dry. When it begins to dry, a little more emery and water are placed upon the plate. After grinding for a few minutes, the block is removed and the emery cleaned off with a wet sponge; the surface of the glass is then closely inspected with a magnifier to ascertain whether the grinding has produced a uniform finish, free from scratches, minute pitmarks or holes left from the previous grinding with rough emery. The hand grinding continues until all the defects disappear. The block of prisms is then ready for polishing.

Before the block of prisms is polished, the surface of the block is thoroughly cleaned with a small brush, great care being taken that all the emery is removed from around the prisms. Rouge is used in polishing. In some cases while a block is being polished and the finishing touches are being given, it happens that a grain of emery overlooked in cleaning becomes dislodged. If this occurs, it is liable to scratch the polished surfaces of the prisms, in which case the block has to be reground.

The polishing of the block of prisms is done with the automatic machine shown in Fig. 76. In this illustration *A* is the holding tool, to which the plaster cast *B* is attached. As previously mentioned, the cast is held firmly to the tool by the plaster entering the four holes in the tool. This block revolves under the polishing block *C*. Various speeds are used, according to the size and condition of the block to be polished. The speed changes are made with the handwheel *E*, which operates the speed cone.

When ready for polishing, the block is screwed to the machine and the top carefully cleaned, as described. The polishing tool *C* is placed on the block, and the overhanging arm *F* is lowered to its horizontal position. The height of the finger *G* is then adjusted to enter the hole in the hub of the polishing tool. The diameter of the hole is nearly twice as large as that of the finger, so that plenty of room for the polishing movement can be obtained. An eccentric motion is imparted to the polisher by the eccentric *H*, which is attached to the overhanging arm *F*. The range of spindle speeds is from 30 to 170 r.p.m. The ratio of one complete turn of the eccentric to one revolution of the spindle is 1 to 4.

Norwegian pitch is used for making the polishing block *C*. The pitch is heated and strained through about 10 thicknesses of cheesecloth, so that all dirt and impurities are removed. In cold weather, when the pitch has a tendency to become very hard, it is kept pliable by mixing pine tar with it. For making a polishing tool, the pitch is heated until it becomes liquid. The liquid pitch is poured upon the flat surface of the polishing tool to a depth of about ¼ in. Wet paper strips are placed around the edge of the tool to prevent the pitch from running off. When the pitch becomes hard, the paper strips are removed, and six strips are cut in the pitch.

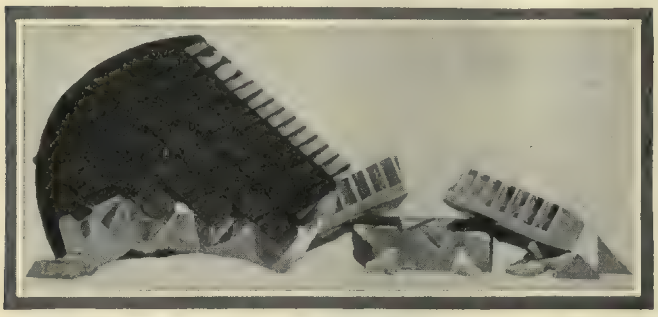


FIG. 77. CAST AND PRISMS

The strips are cut ½ in. wide clear through the pitch to the plate. Three are cut equally spaced in one direction and three at right angles also equally spaced. This divides the polisher into squares, with ½-in. spaces between the squares.

Rouge, a compound of copper and oxalic acid, is used in polishing. A mixture of rouge and water is applied to the surfaces of the prisms. The block revolves, and the polisher revolving with it is worked from side to side over the glass by the arm *H* of the machine, Fig. 76. Polishing takes from eight to ten hours. The work should be lubricated frequently and a color test made every two hours. The color test is used to determine the degree of flatness on the surfaces of the prisms. For the color test a piece of plate glass 2 in. square and 0.3 in. thick is used. The glass is polished on both sides, one side being perfectly flat. The flat side of the test glass is placed upon the work that is being polished. When one broad color is seen, the work is perfectly flat. A magnifier should be used to see whether the surfaces of the prisms are free from light scratches and small emery pits.

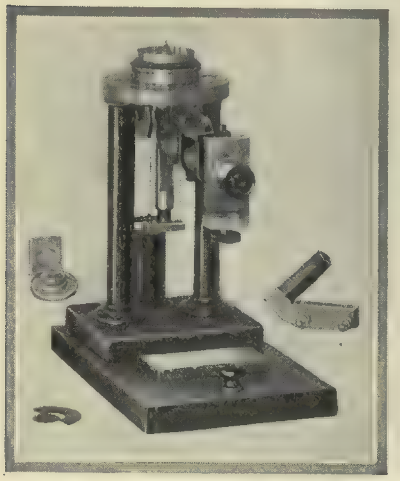


FIG. 78. THE SPHEROMETER

When the polishing has been finished, the prisms are removed from the plaster by entering a sharp chisel at the bottom of the cast. By knocking lightly with a hammer, the cast will come away from the tool. Then by hammering lightly upon the bottom of the cast, the plaster is easily broken and the prisms are separated from it. They are washed in benzine to remove the beeswax. The cast is shown in Fig. 77.

After one surface of the prism has been polished, the next surface to be polished is tested from it for squareness. Knife-edge squares are used for this purpose. If, when the square is held to the work, light is perceived along the edge, it shows that the angle is greater or less than that desired. To obtain the right angle, rub the unpolished side on a flat lapping block, using smoothing emery and pressing upon the end that is high. After this surface has been corrected, it is ready to be polished. The same operations are performed upon all sides that are to be polished.

MANUFACTURE OF LENSES

In the explanation of the manufacture of lenses it is necessary to divide the subject into three parts: Large objective lenses 2 in. and over, small lenses with flat curves, and small lenses with short curves. Glass for lenses usually comes in large slabs, with the exception of the glass for 3-in. objectives. This comes in square slabs, large enough to produce the one type of lens, crown or flint.

In the manufacture of large objective lenses the corners are first removed from the slab selected by chipping off with a pair of wire cutters. After the corners are removed, we have a circular piece that should be at least 0.2 in. larger than the diameter of the finished lens. Remove all the sharp edges from this piece by grinding on the plate. One side is then made flat with No. 220 emery. When a number of lenses are to be made, they are blocked on a flat tool and ground to within 0.02 in. of the finished thickness. The next operation is the grinding of the curve from this glass. If a concave surface is required, a cast-iron or brass tool with a convex grinding surface is used; and for a convex surface, a concave tool, Fig. 79. The grinding is performed by putting No. 54 emery upon this tool as it rotates at fast speed (200 r.p.m.) and rubbing the lens upon it. After the curve has been rubbed, all the other grades of emery before mentioned are then used in succession until the surface is ready for polishing.

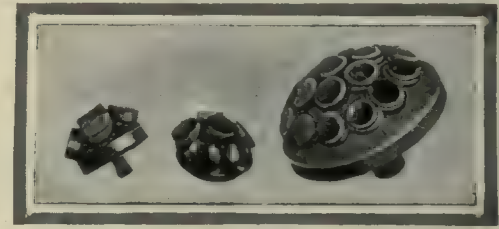


FIG. 79. BLOCKED LENSES

Polishing is usually performed on cloth first and is known as rough polishing. In polishing convex surfaces, the lens to be polished is cemented to a stock with black sealing wax. This stock is a little smaller than the lens and threaded so as to fit in the spindle of an automatic machine. A brass concave tool with a hole in the flat side having the same curve as the lens is used for the polisher. The hole in this tool is made for the pin on the arm of the automatic machine. Heat the tool so that sealing wax will melt when placed upon its surface. Place a piece of thick cloth on this tool in the wax and press out with the lens. The cloth used is a very heavy weave of broadcloth, which looks much like felt. It is then plunged into cold water, so that it will cool as quickly as possible and in this way prevent the wax from going through the cloth. For concave work the cloth is put on the lower spindle that fits on the automatic machine, and the work on the stock that has the hole in.

Convex surfaces are polished by the revolving of the lens on the machine and the rotating of the polisher from side to side over the glass. Concave surfaces are polished by revolving the polisher and the rotation of the work over the cloth. The proper curvature and regularity of surface are determined by the use of the color test, using the same principle as mentioned in the polishing of the prisms. These color tests are only made up when a number of lenses of the same curve are to be made, in which case a gage is made and the same principle is applied for testing as for flat work. When only one or two lenses are to be manufactured, a spherometer, Fig. 78, is used. The lens is placed upon the ring, and the pin in the center is moved up or down according to the curve of the lens. This pin manipulates a scale, which is seen by looking through the microscope. In this manner the height is determined and the curve of the lens calculated by using mathematics.

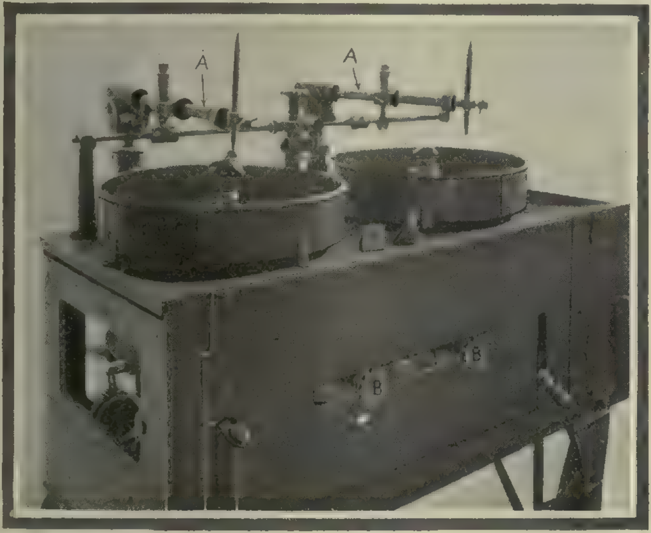


FIG. 80. LENS-POLISHING MACHINES

After the lens is polished on cloth, it is ready to be centered. By centering we get the optical center of the lens to coincide with the geometric center. In this operation a brass tool of the diameter of which the lens is to be made is used. A thin edge or wall about $\frac{1}{16}$ in. wide is made by turning out the center of this tool to a depth of about $\frac{1}{2}$ in., according to the curve of the lens. This tool is fastened to a bench lathe. Heat is applied so that when sealing wax is placed on this edge it will become soft. Warm the lens and place upon it this wax, putting the surface with the shortest curve inside. Allow the lens to rotate, heating the tool. Place upon a T-rest a piece of soft-wood sharpened on one end, and press it against the lens near the edge. By looking at the lens, the images that are seen will appear to be moving. When these images remain perfectly still, the lenses will be central. Keep the stick against the lens, and hold on the tool a sponge wet with cold water. This will harden the wax and keep the lens central. A certain amount of the surplus glass is removed by cutting off with a sharp file, and the rest is removed and the lens made the correct diameter by grinding with emery. To remove the lens, heat the tool.

After the lens is centered, it is polished with pitch for a while, so that the surface will be made as nearly correct as possible and free from any light scratches or pits left from the cloth polishing. To polish a convex surface to the proper curve with pitch, the sweep of the polisher is regulated. If a color test or gage is used and the surface is found to be low, light cuts are made in the center of the polisher with a knife and the sweep is widened. Put rouge and water on the lens and polish until dry. Test the surface to see if a change has been made; and if it has, cut the polisher again, but leave the sweep as it is. In this way the surface will polish gradually up to the desired curve. If the sweep is made too wide, the surface of the lens will polish off on the edge and none in the center and give it what is known as a bevel. To remove this bevel, lessen the sweep and polish until a trifle low. Then polish as mentioned above, until the surface comes to the proper curve and the bevel disappears.

When a surface is high, the polisher is cut near the edge and a very short sweep is used. When the surface in this case is polished down too fast, we get what is termed a hole; that is, the surface is polished low in the center and stays high near the edge. A slight increase in the sweep will remove this.

POLISHING CONCAVE SURFACES

Concave surfaces in the work, if they are low, are polished to the proper curve by making cuts in the center of the polisher; and a short sweep is given to the lens. If the surfaces are high to the gage, make cuts near the edge and widen the sweep of the lens. In the foregoing operations experience is the best teacher, and no limit can be given to the number of cuts that should be made or to the length of the different sweeps. All pitch polishing is worked on the above principle, using slow speed for 2- to $3\frac{1}{2}$-in. lenses (about 50 r.p.m. on an automatic machine). After fine polishing, the lenses are cemented together. Place upon a stand the crown and the flint lens that are to be cemented. Turn up the surfaces that go together. Put clean Canada balsam in the concave surface, and heat it until a drop of the balsam on the end of a knife appears to be brittle. Place the crown upon this balsam and press it down until the bubbles that form disappear. Set it aside and leave it to cool. To remove the balsam that covers the outer surfaces, use alcohol.

Smaller lenses that have flat curves are ground or roughed the same as the larger lenses. On account of the flat surfaces a number are usually polished together, as in Fig. 79. Heat the lenses and put about $\frac{1}{2}$ in. thickness of black sealing wax upon one surface. In blocking convex surfaces, a convex tool is used. Moisten the tool and place the lens in it with the clean surfaces down. Heat a convex tool and place it upon this wax. Cool by putting in cold water; and when the convex tool is removed, the lenses will be cemented to it.

These lenses are ground fine for polishing in the same tool that serves for blocking. Only pitch is used in the polishing of these blocks, the same principle being employed as mentioned in the polishing of prisms. After the lenses are polished, insert a knife under the wax near the tool and knock until the lens is removed from the tool. Centering and cementing are then performed.

All fine-grinding and polishing operations mentioned above are performed on an automatic machine, similar to Fig. 80, but small lenses that have sharp curves are ground and polished separately on a bench lathe. A rough curve is made by cutting the glass with a sharp file as the lens rotates upon the lathe. No. 150 emery is first used, and then the other grades until ready for polishing. The same operations are then performed as mentioned in connection with large objectives, only in the polishing the *lens* is placed in sealing wax on a wooden stock and rotated by hand.

The machine shown in Fig. 80 is used for grinding and polishing lenses. It is motor driven. The spindle speed for each spindle is regulated by the knob *B*. Speeds from 44 to 400 r.p.m. can be obtained. The oscillating arm *A* makes one complete sweep for each turn of the spindle.

Making Use of the Practical Letters

By Cathal MacChoinnigh
Tralee, County Kerry, Ireland

The value of a paper such as the *American Machinist* to the shop man who has to use his head as well as his hands is almost incalculable. It keeps him in line with the latest machinery practice. The articles on production methods give him a standard to work up to or to better. The advertisements keep up his hope that he will eventually get those reamers and milling cutters which he needs, but which nobody seems to make now that every firm is manufacturing something totally different from its pre-war products. But few features are of more direct value than "Letters from Practical Men." Again and again, I have been able to evade troubles without the usual expenditure of gray matter and cuss words by having at my disposal some other man's experience gleaned from these pages.

To take one instance only out of many: We had a loose pulley on a drilling machine which our millwright, who is given to scriptural forms of expression, described as being "possessed of a devil." For no particular reason this pulley would seize, generally at the most unexpected moments, so that anyone who happened to be tightening up a chuck in the machine stood a good chance of having a finger broken or of getting the chuck key in the face. As a consequence, that machine began to get unpopular.

We fitted oilers to the loose pulley, cursed the shop kid for not attending to it regularly, cut oil ways, eased out the bore, swore, fitted bigger oilers—and still it seized, though every part of that pulley was oily except the bore. Then someone who had been through the mill wrote to the *American Machinist*. We took his tip, cut a keyway in the pulley, fitted a "key" of felt to rub on the shaft with an oiler at the back to keep it moist, and we are still waiting for it to seize again.

Sometimes it is possible to adapt ideas. For example, there recently appeared some correspondence concerning shrinking rings by dipping out from a red heat, so that the outside cools more quickly and closes in on the hole. Now everyone with any experience in hardening must have observed that in dipping out a ring there is a tendency to shrink; but as far as I know, few seem to have thought of taking advantage of this phenomenon. I do not now remember how your original correspondent proposed to use it, but the suggestion itself was the valuable part, and possibly he may be gratified to know of a new application.

A friend works in a garage where a considerable amount of motorcycle repair work is done and where the equipment, to put it mildly, leaves much to be desired. Now, thanks to the fondness of the motorcycle designer for light connecting-rods and consequent high bearing pressures, the big and the small ends require frequent rebushing. In garage work, or at all events in the garage in question, the object in view is to get the work done cheaply and quickly rather than to obtain a high standard of workmanship. Therefore, I suggested that, instead of making a new bush in each case, the bushes be drawn and the eye of the rod, the average size of hole in which is about 1¼ in., be shrunk by heating red hot and dipping out with the length of the rod parallel to the surface of the water and the axis of the rod at right angles to it. In almost every case, except where there was very little metal round the eye of the rod, on pressing the old bush back into position it was contracted sufficiently to permit reaming out to fit the pin.

Moreover, it looks as if this kink will be worked hard in that particular garage, for I believe the manager, whose mechanical knowledge is not extensive, wants to know if worn motor cylinders could not be shrunk in the same way to fit the piston!

American War Locomotives for France

The first locomotive for American war-service railroads in France was completed in 20 working days, and engines of this type are now being turned out at the rate of about 30 per day. About 680 of these locomotives and over 9000 standard-gage freight cars are on order.

The first order for war locomotives was placed with the Baldwin Locomotive Co., of Philadelphia, on July 18, and the first engine completed on Aug. 9. This is in spite of the fact that the boiler is constructed specially for this type of engine and is what is called a "superheater." Otherwise, the locomotive is much similar to locomotives built by the Baldwin Co. for the English Government. It is not the most powerful type used in the United States, but on a road where the heaviest engines would haul a train of about 90 loaded freight cars this war locomotive would haul 60 loaded cars. Like all the equipment, it is painted battleship gray and bears the letters "U. S. A." The locomotive weighs about 166,400 lb., with the tender about 275,000 lb.—*Official Bulletin.*

A PACIFIC COAST TRUCK FACTORY

By Frank A. Stanley

I.

1. MACHINING HOUSINGS IN THE LATHE

This article describes a truck factory in the Far West turns out a large number of trucks of all sizes and makes use of many interesting shop methods. All parts are produced from special grades of steel. Details are here given of clutch and gear manufacture along with other features of importance.

THE Moreland Motor Truck Co., of Los Angeles, Calif., operates the largest factory devoted to this kind of business west of the Mississippi River and manufactures a most interesting and diversified line of vehicles.

In addition to building various sizes of standard commercial trucks, the firm produces special fire-department wagons, army trucks, street flushing and sweeping machines, trucks fitted up with moving-picture equipment, vehicles de luxe for touring purposes, and numerous other forms of trucks. All of them are operated by four-cylinder, long-stroke motors, the drive from the transmission being by special shaft to the worm-driven rear axle. These trucks are made to use distillate or other low-grade fuels, the motor being built with a device known as a "gasifier." It takes the place of the intake manifold and heats the air before mixing it with the gas in the carburetor, then dries out the moisture in the gas on its way to the cylinder. In this way the wet gas or vapor from the carburetor is transformed into a warm dry gas and carried direct to the combustion chambers while in this condition. A more detailed reference to this device will be made at a later point in this article.

The present shops of the Moreland company employ between 600 and 800 men, and the new plant now nearing completion in the near-by town of Burbank will give employment to over 1000 more, thus making this firm one of the biggest and most important manufacturing establishments on the Coast. The new factory will be devoted entirely to the production of parts. This policy will relieve the present plant of a certain amount of its detail work and leave a greater amount of floor space for the assembling of units and the erection of completed vehicles.

There are many interesting things to be seen in the Los Angeles plant in connection with the making, testing and assembling of truck parts. The manufacturing methods throughout are well worth attention upon the part of anyone engaged in mechanical pursuits. The finished product in the way of standard and special trucks is of an equal degree of interest to motor users, and it is believed that some of the work of these shops is entirely unique in its conception and execution.

Before taking up a detailed description of the shop methods here, I wish to refer briefly to what is considered one of the most thoroughly equipped vehicles ever turned out by a motor-truck factory. This truck is a squad wagon built for the Los Angeles Fire Department.

It carries in addition to the usual equipment of hose, nozzles, lanterns, axes, etc., a battery of five powerful searchlights, with generator for operating them; an oxyacetylene outfit with cutting heads for cutting openings through steel walls and doors; smoke helmets for the firemen; apparatus for reviving sufferers from smoke and gases; first-aid outfits and so on.

THE MORELAND GASIFIER

As already pointed out, the trucks built by this concern, whether the standard one-ton to five-ton machines that are manufactured in large numbers, or special constructions mentioned, all operate with low-grade fuels, distillate or other. The gasifier that makes this possible is built as part of the motor and takes the place of the intake manifold, as mentioned at an earlier point in this article.

2. Cutting Gears for Transmissions

3. Gear Test for Hardness

4. Assembling Transmissions on Floor Stands

5. Disk Clutches are Put Together Under Hydraulic Pressure

6. Air Tools Used in Wheel Assembling

The gasifier is of cast iron, to give it heat-retaining capacity, the intake and exhaust manifolds being cored through the outer shell, which envelops them completely. Fresh air is drawn through holes drilled in the top of this outer shell, directly upon the exhaust manifold. The air, now heated, is drawn down into the air intake of the carburetor, at the same time heating the intake manifold. This warm fresh air vaporizes the distillate, and the resulting mixture is carried through the heated intake manifold, entering the combustion chambers a perfectly dry gas, so that at the firing point the entire charge is consumed.

It will be noticed that the carburetor is in no way changed by the addition of the hot-air intake to permit the use of distillate. The device has been put on every truck built by the company during the past six years and more, with the result of saving in operation about one-half the cost of running with gasoline.

7. SOME OPERATIONS IN COMPLETING TRUCKS

Turning now to some of the interesting features of shop practice in the manufacture of truck parts, Fig. 1 represents one of the departments and shows a characteristic group of tools with certain operations under way. Thus, in the foreground will be seen a Le Blond heavy-duty lathe, used in this instance in machining the ends of axle housings. One end of the casting is shown gripped in a three-jaw chuck, while the outer end is supported in the steadyrest for finishing that portion of the work.

This lathe, like other tools in the factory, has a convenient stand at the end for holding tools, blueprints, chucks and other essentials for the work in hand. Throughout the entire plant, metal and wood cabinets, racks, stands and special trucks are found for facilitating the operations of machining and assembling all parts of motor vehicles.

A view in the gear-cutting department, where all transmission and other gearing is finished, is shown in Fig. 2. The Fellows gear shaping machine and Gould & Eberhardt hobbing machines are used here for cutting the teeth, the gear shaping machine in the foreground being shown at work on two gears in tandem on the arbor.

The transmission gears are made of low-carbon chrome-nickel vanadium-steel forgings that are first rough turned, then annealed by heating in the furnace and allowing the furnace and work to cool down. Next, the annealed blanks are finish turned, and the gear teeth are cut; then they are carbonized to a depth of $\frac{1}{32}$ to $\frac{1}{16}$ in. by packing in boxes with a special mixture and controlling the gas-furnace heat by a recording electric pyrometer. Following this, the gears are heat-treated, being heated first to 1500 deg. F. and quenched in oil to refine the case, then heated again to 1200 deg. F. and once again quenched in oil for the purpose of refining the core of the work. Finally, the gears are drawn in fish oil at 600 deg., where they are allowed to soak for 15 or 20 min.

The gears are tested for hardness in the Brinell testing machine illustrated by Fig. 3, where the process of going completely over the work is clearly represented. This test is applied as a check upon the care with which the preceding heat-treating operations have been conducted, but it may be stated that few gears that reach the inspector's bench fail to pass within the close limits of hardness required.

FEATURES IN ASSEMBLING

A view in the department devoted to transmission assembling is presented in Fig. 4. This illustration shows something of the orderly processes under which the various members of the transmission are put together one by one, with the operations carried on upon the work benches and special floor stands. The latter are of steel with legs made up of 4-in. channels firmly rivated to the top members and tied by riveted girts halfway up. The tops of the stands are either open to admit the walls of the transmission cases or fitted with flanges to support the work in the desired position.

Another view in the line of assembling is that in Fig. 5 which shows the method of putting disk clutches together. These clutches are made up of six 8-in. disks of steel which are blanked out, leaving 0.020 in. for grinding from the faces. The grinding is done on a magnetic chuck in the surface grinding machine, using an alundum wheel. The disks are of low-carbon steel; when assembled, "Thermoid" disks are placed between each pair of steel disks.

The work of assembling is carried on under the hydraulic press, Fig. 5, the complete set of disks being built up for each clutch and then placed on the table ready for application of heavy pressure. Fig. 6 illustrates a few operations required in the wheel department and shows incidentally the application of air tools in mounting wheel boxes. Fig. 7 is a view of some of the details attended to in completing the trucks for service.

Some other features of this plant, including work in foundry, forge and other departments, will be considered in another article to appear later.

Producing a Bulge in Tubing

By W. S. Quimby

I manufacture an appliance through which water is required to circulate, being led in and out through $\frac{5}{16}$-in. 20-gage copper tubes over which a rubber tube is slipped connecting with the water-supply and the waste.

In order to keep the rubber tubing on, I formerly filed in several grooves. Not only were the tubes weakened, but the rubber did not stay on. In casting about for a method of enlarging instead of reducing the copper, I hit upon the following:

Drill rod that will just pass freely through the tubing is cut into three pieces; *A*, Fig. 1, is about $\frac{3}{8}$ in. long, with one end flat and square and the other rounded off to about $\frac{1}{4}$-in. radius; *B* is the same length, but with both ends rounded; *C* is enough longer than the tube to provide a hold in the press ram *D* plus the thickness of a stripper plate *E*—in this case $\frac{3}{8}$ in.—one end of this rod being rounded similarly to the short pieces.

A number of lead slugs, the same diameter as the drill rod and $\frac{1}{8}$ in. thick, are provided and the rod *C* is mounted in the press with the rounded end down. The stripper plate *E*—a 12-in. piece of $\frac{3}{8}$ x $1\frac{1}{2}$-in. flat, with a hole a trifle larger than the drill rod—is first passed up over the rod *C* and suspended from the press ram by means of a cord. A slug is introduced at the tube end that has to be swelled, followed by the pin *B*, this by another slug and then the pin *A*, rounded end in. The flat end of the pin *A* is left protruding about $\frac{1}{16}$ in., to serve as a pilot when ejecting the middle pin. The tube is then passed up over the rod *C*, until the first slug brings up against the rounded end.

The bolster plate *F*, with a flat-bottomed recess *G*, the diameter of the rod and $\frac{1}{16}$ in. deep, is slid into place, and the tube, slugs, pins and all are lowered with the ram until the protruding end of the pin *A* rests in the recess. Pressure is applied, the rounded ends of the pins nosing into the lead and squeezing it out radially, producing two very neat bulges *H*.

The ram, with the tube adhering to the rod *C*, is then raised, and the bolster is shifted so that the protruding pin *A*, when again lowered, enters the hole *J*, of the same diameter as the recess. When a small amount of pressure is again applied, the pins are ejected, pushing their way through the two thin curtains of lead *I*. Two lead rings are left fitting tightly into the two bulges, giving an even, smooth bore. The lead is, however, afterward removed, as the tubes are filled with lead to secure a sharp right-angle bend, after which the lead is melted out. These slugs increase the diameter of the tube from $\frac{5}{16}$ to about $\frac{25}{64}$ in. By repeating the operation, using two new slugs, another $\frac{1}{32}$ in. could be added to the bulges, the tube reducing its over-all length about $\frac{1}{16}$ in. each operation. The tube is stripped from the rod *C* by merely bringing the weight of the two hands down on the stripper.

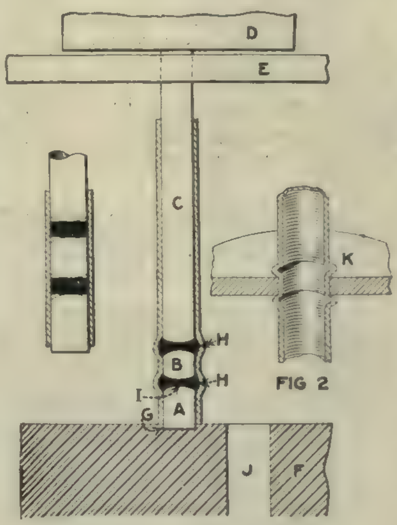


FIG 2

FIG. 1

FIGS. 1 AND 2. METHODS OF BULGING TUBING

This method works equally well on hard and on annealed tubing, the difference in the amount of pressure required being very little. To all appearances, any number of swellings might be made in a length of tubing, provided the end of the tube receiving the pressure of the bolster plate is faced square and true.

This is also an excellent way to attach a plate, or washer, *K*, Fig. 2, to a tube. The swellings are first produced, with the plate held between them, and then, bringing end pressure on the tube, the bulges are flattened down, securely locking the plate as though riveted on.

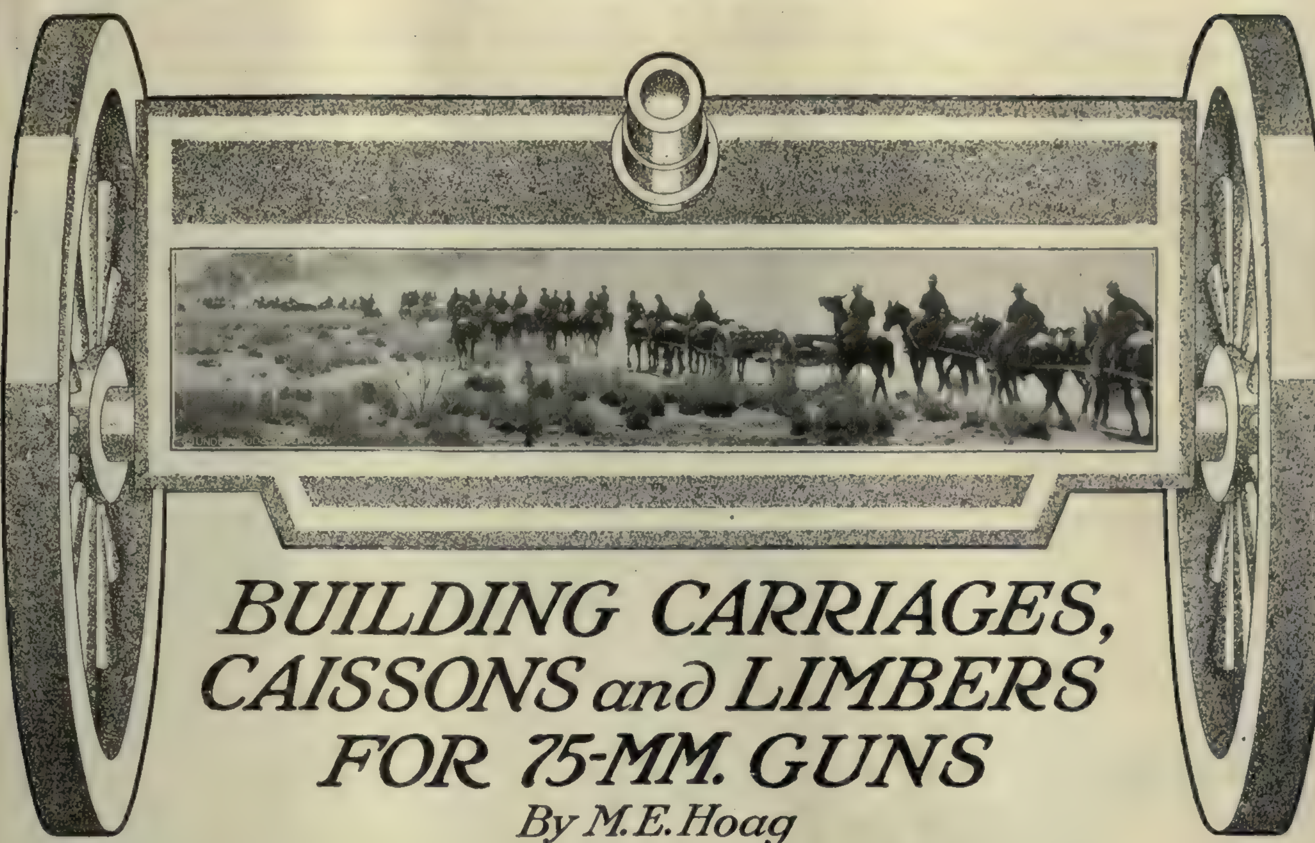
The press on which this work was done was a Bliss pendulum and toggle No. 269, using the longest stroke.

Locating Eccentric Center Holes

By Oscar Craft

For accurately locating centers in the eccentric mandrel on a milling machine, first indicate the vise jaws and fasten the mandrel firm in the vise. Fasten the indicator in the milling-machine spindle and indicate till it travels true around the end of the mandrel. Raise the milling table enough for the center to be off the desired amount. Be sure the center drill runs absolutely true.

After the first center is drilled, swing the vise halfway around, indicate the vise jaws, drop the table back to zero and proceed as in the first operation. Be sure that the mandrel is never unchucked until both centers are drilled. The mandrel must exceed in length the jaws of the vise used.



BUILDING CARRIAGES, CAISSONS and LIMBERS FOR 75-MM. GUNS

By M. E. Hoag

II. Die Castings and Forgings

THE 56-in. wheel is required for the 75-mm. 1916 model gun carriage, caisson and limber. The woodwork on these wheels is handled in practically the same manner as it is in factories that make heavy wheels for other purposes, standard machine equipment being used, so a detailed description of this part of the work will not be given. Some of the parts that are of special interest are shown in illustrations, Figs. 9, 10, 11 and 12, and these will be described in more or less detail as the complexity of the work may require. Owing to the fact that the arsenal where this material was obtained is working to full capacity, it has not in all cases been possible to obtain ill-

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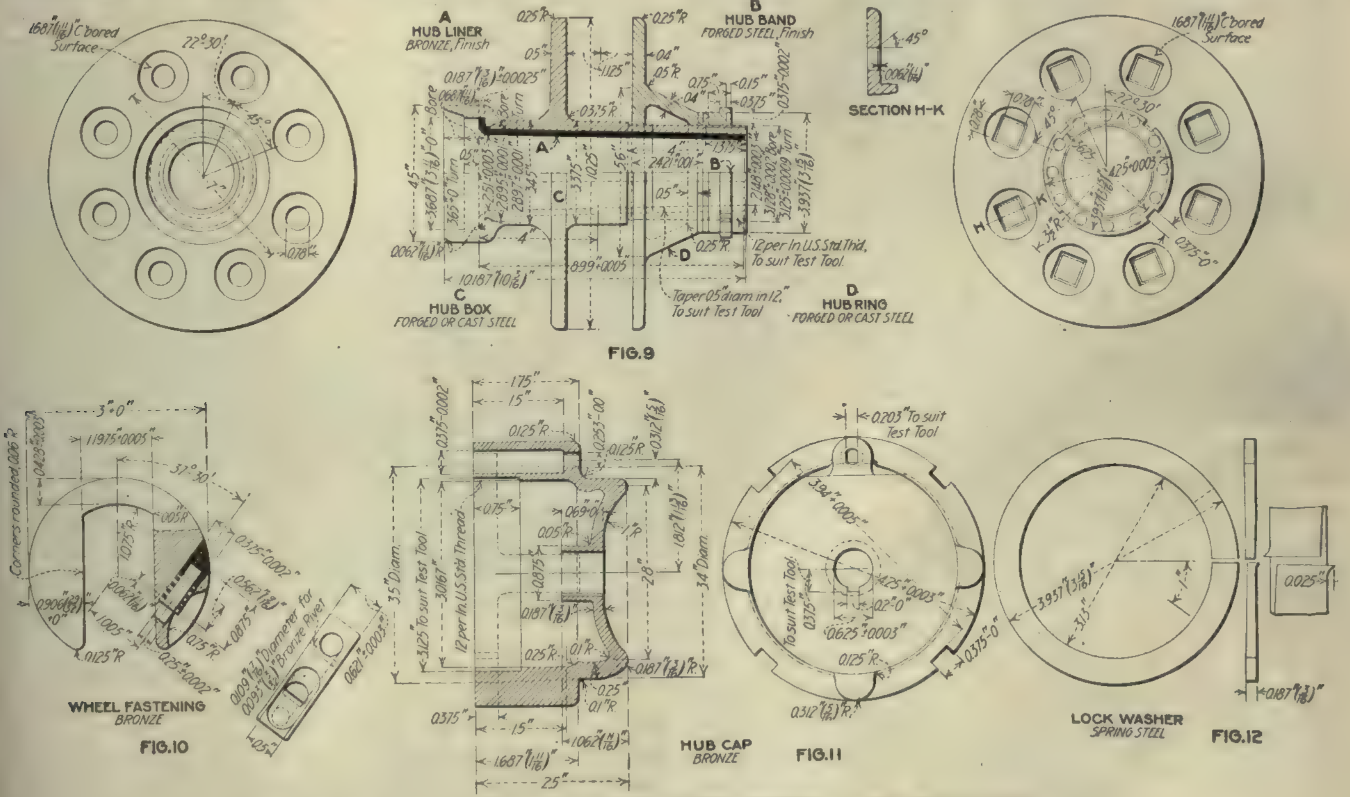


FIGS. 9 TO 12. DETAILS OF VARIOUS WHEEL AND HUB PARTS

ustrations of all pieces in process of manufacture, but this has been done wherever possible.

Reference to Fig. 9 will show the hub partly assembled with the bronze "hub liner" in place. This liner was formerly cast in sand molds, but the cost was found high on account of the making of molds, and the machining tools were rapidly broken down on account of the sand in the castings, so recourse was had to the metal molds shown in Fig. 13. The body of the mold is of cast iron, but on account of the difficulty in securing perfect castings, it was found necessary to use a steel liner. The mandrel *A* locates itself central with the bottom of the mold and is clamped centrally at the top by the arms *BB*, which contain the pouring gates. The lever *C* operates the knock-out, which frees the casting from the mold; *D* shows a casting just as it came from the mold. This method also greatly reduces the amount of excess metal required in the rough casting.

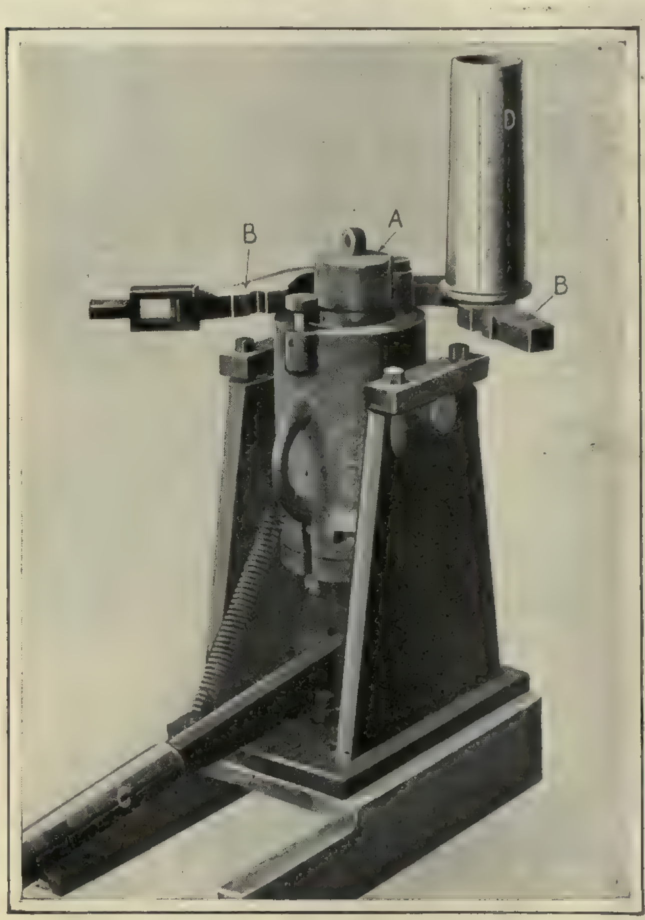


FIG. 13. METAL MOLD FOR HUB LINERS

The second operation is grinding to remove the gates, etc. In the third operation the castings are handled in a turret lathe, rough turned, and the outside of the shoulder is finished. They are then put into a "pot chuck" and bored and the large end faced and the radius roughed. They are finished all over on the milling fixture shown in Fig. 14. For this operation an arbor having the same taper as the bore of the liner is used, and the liner is driven onto it with a light rap of a babbitt hammer. As the arbor rotates, the fixture holding the cutting tools passes under it and brings the piece to exact finished size. As but a small allowance is made for press fit, the dimensions must be held very close; and this method of handling has proved very satisfactory. After once setting up on this job, the only adjustment required is moving the table in or out so that the gage *A* just touches the outside of the shoulder on the large end of the liner.

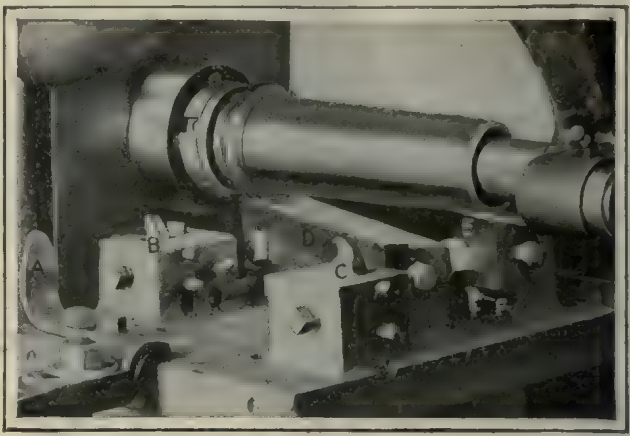


FIG. 14. MILLING FIXTURE FOR HUB LINERS

The tool *B* removes a light cut from the inside of the shoulder and partly forms the radius. The tool *C* faces off the small end to length; *D* removes most of the stock from the body of the liner and radius, and *E* takes the finishing cut. As it is necessary to keep the taper on these liners to gage, suitable means for adjusting the wide tools are very necessary and are supplied through the bolts and jackscrews, of which one is shown at *F*.

WHEEL FASTENING

The wheel fastening is also made of bronze and cast in metal molds, as shown in Fig. 15. One of the pieces as it came from the mold is illustrated at *A; B* is a locking lever that fastens the top in place, and *D* operates a shaft with two eccentrics and serves to open the mold. Operation 2 is grinding to remove burrs, etc. The third operation is to finish turn and face, and operation 4 removes burrs in the slot. In operation 5 the slot is finish milled to receive the axle and $\frac{1}{8}$-in. radius on the ends. Operation 6 is to mill a $\frac{1}{16}$-in. radius around the profile of the slot which receives the axle. Drill, ream, and counterbore for the rivet and plunger make up the seventh operation, while opera-

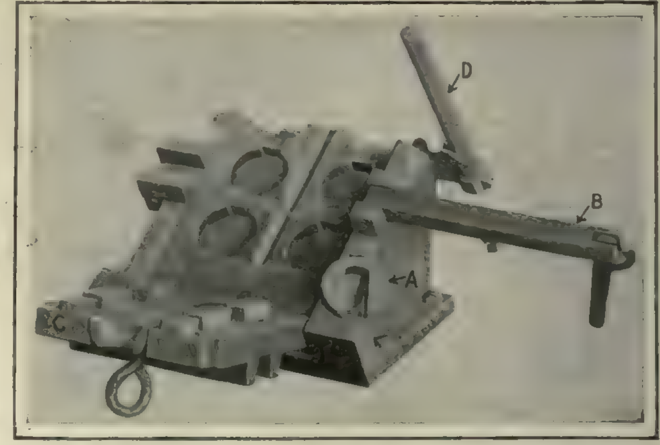


FIG. 15. METAL MOLD FOR WHEEL FASTENINGS

tions 8 and 9 finish mill the thumb slot, remove burrs and finish for inspection and assembly (see Fig. 10).

The lock washer, illustrated in Fig. 12, is very simple to make. The annealed spring stock is first coiled around a mandrel of suitable size. It is then held in a milling fixture, and the entire length of coil is slotted with a 1.16-in. milling cutter. The resulting rings are taken to the forging shop, and the lips are formed hot in suitable dies. Operations 4 and 5 remove burrs and finish for tempering. Temper as per drawing.

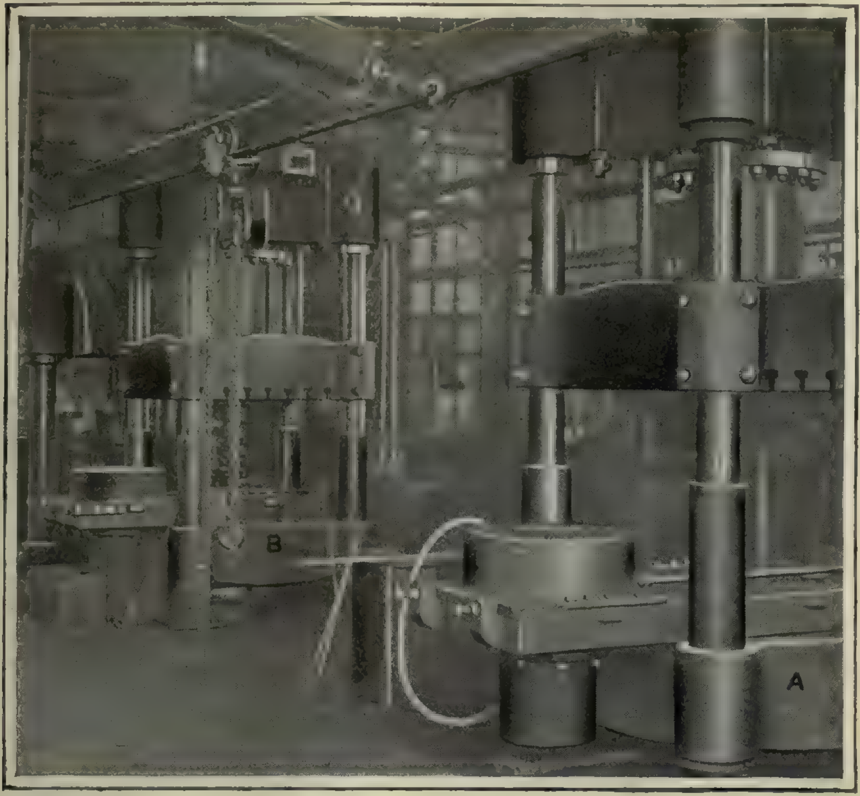


FIG. 16. HYDRAULIC PRESSES

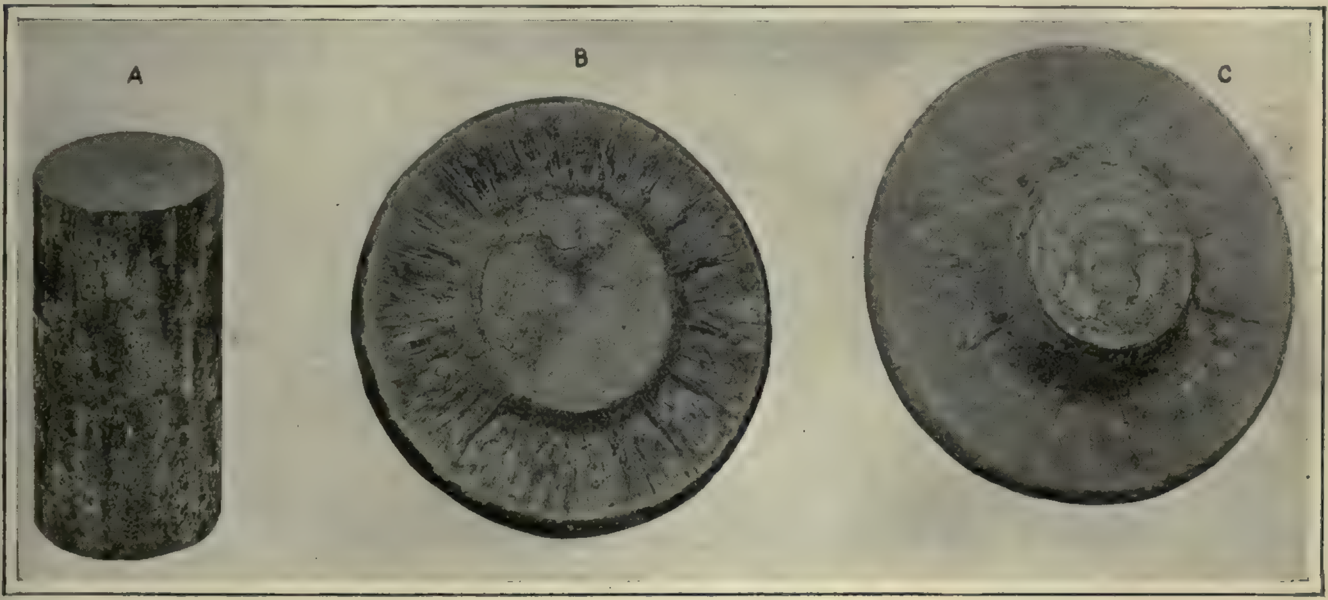


FIG. 17. HUB-RING FORGINGS

Fig. 16 gives a view of the hydraulic-press section of the forge shop. The two presses in the foreground are used for a great deal of the heavy and complicated forging and bending. The oil-fired furnaces are not seen in this illustration, but are directly opposite the presses and near enough so that the work can be handled rapidly. The presses are shown with the dies run out to receive the piece to be forged. The sliding mechanism of these dies, as well as the knock-outs, is actuated by compressed air and greatly facilitates the work. Fig. 17 shows the hub-ring forging in the various stages: *A* is the blank piece of stock; *B* is the piece after the first forging operation and shows the side which the piercing die enters to form the completed piece in the second operation, illustrated at *C*. The die in this operation does not go clear through the piece, but forms a good-sized recess and aids in forcing the metal into all parts of the die. Fig. 18 shows the hub ring as completed in the turret lathe. The methods of handling these operations are much the same as for the hub box. The operations are as follows: (1) Forge; (2) heat-treat; (3) pickle forging; (4) drill and counterbore through center of forging (hog-nose); (5) rough off surplus stock and finish bore, cut recess and finish outside surfaces; (6) finish spoke side, outside diameter of flange, and radius; (7) drill, chamfer and counterbore eight holes (this operation is done in a multiple-spindle drill); (8) square and bevel bolt holes (in this operation all eight holes are squared and the edges beveled at one operation with the dies shown in Fig. 18, two views of the hub rings being given here, before and after punching); (9) remove burrs and finish for inspection. The hub box is a rather difficult piece to forge and finish, and one requiring considerable special-tool equipment. The forging is handled in two operations with the hydraulic press. The first operation, in press *A*, Fig. 16, forms the flange in much the same manner as shown in the hub-ring forging, but the protruding ends of the stock are not changed materially. The piece is passed to a reheating furnace after this first operation and then to press *B*. In this second operation a lower die is used in conjunction with a split ring, which is placed over the end of the forging. The piercing die is brought down and forces the metal out and into this ring to form the "bell." The operations following are: (2) Heat-treat; (3) pickle forging; (4) rough drill 1¼-in. hole, then hognose 2⅜-in. hole through center; (5) spot large end for chucking, then spot small end of hole for pilot collar, finish face, turn outside diameter of large end, finish diameter and spoke side of flange; (6) finish bore, ream and counter-

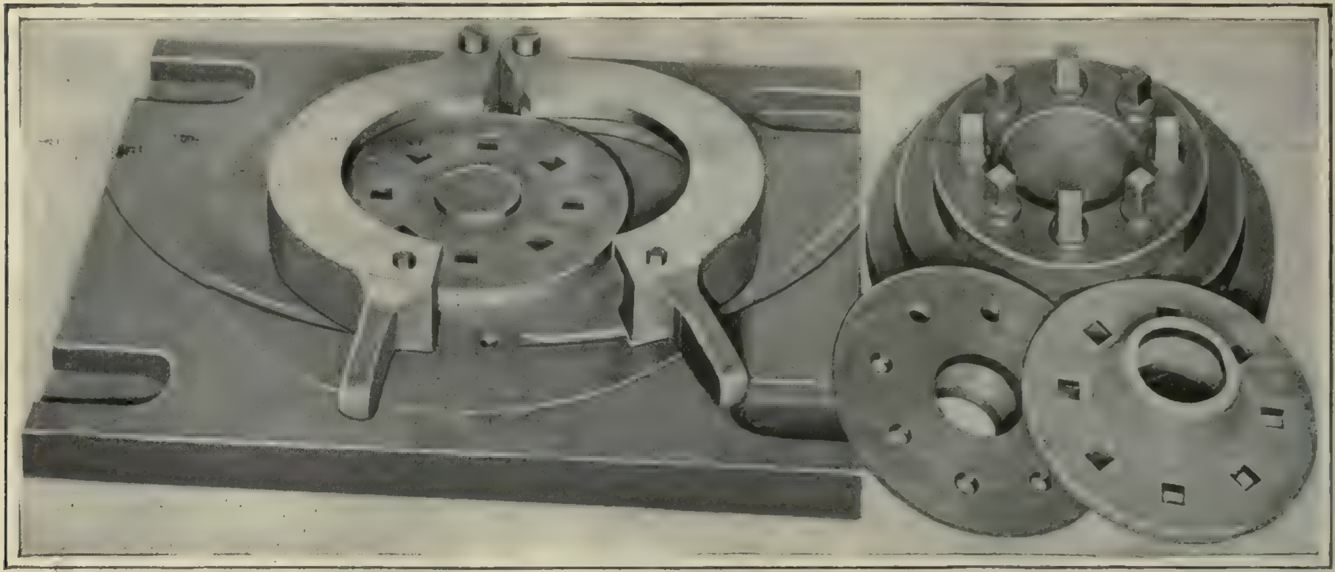
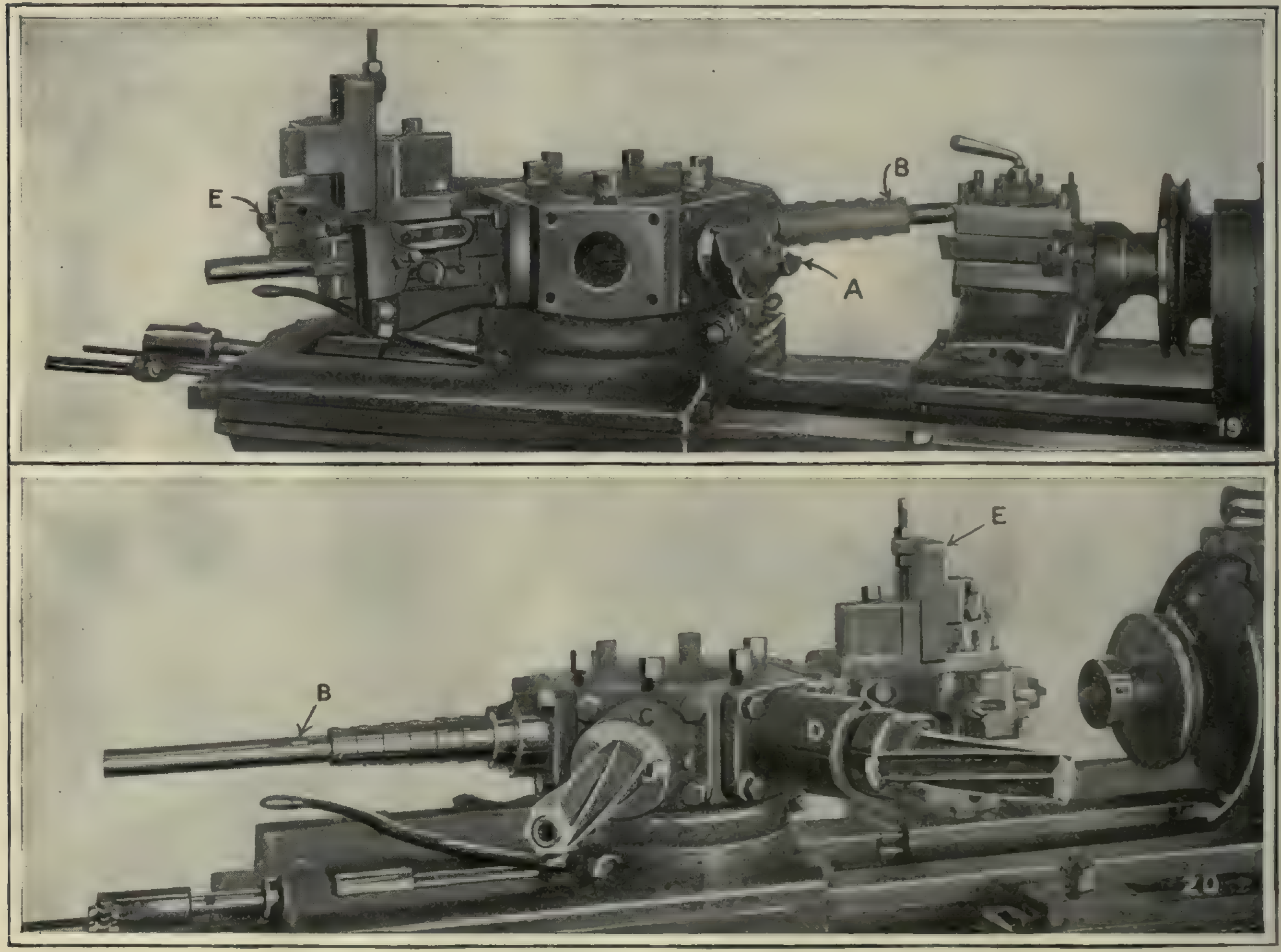


FIG. 18. HUB RINGS AND SPECIAL DIES



FIGS. 19 AND 20. TURRET LATHE AND TOOLS FOR BUB BOXES

bore hole, finish turn outside diameter of large ends, ⅜- and ¾-in. radii, and outside face of flange. The operations under (6) are all handled in the turret lathe with the special pot chuck and tools shown in Figs. 19 and 20. The cross-slide carries four tools for facing, etc. In Fig. 19, *A* is the first tool, ready to form the inside of the large end; *B* is the "step reamer," which roughs out the taper hole. In Fig. 20, *C* and *D* are roughing and finishing reamers, and *E* is the last tool, in position for finishing the inside of the bell. Operation 7 is to remove burrs and chase threads. In operation 8, bolt holes are drilled and counterbored, and sharp corners are broken. Operation 9 removes burrs and finishes for inspection.

The hub band is simple; and while some special tools and jigs are required, they are not of an unusual nature. A list of machining operations, together with the drawing, Fig. 9, is all that will be given. The machining operations are as follows: (1) Forge; (2) heat-treat; (3) pickle and neutralize; (4) do necessary grinding; (5) finish turn and face the 4¼-in. diameter end, and bore and thread, then face small end; (7) mill wrench slots; (8) drill holes to receive plunger; (9) remove burrs and finish for inspection.

OPERATIONS ON THE HUB CAP

The hub cap is a bronze casting, for which metal molds were tried, but were found more expensive to operate than sand molds. The operations on this piece are: (1) Make mold; (2) finish bore, turn, face and thread; (3) re-tap to fit gage; (4) finish face seat for oil valve (counterbore); (5) drill and ream hole that receives hub-latch plunger; (6) ream and burr hole; (7) finish mill top and radius on plunger lug; (8) broach hole for hub-latch plunger; (9) finish slot hole for oil-valve key; (10) finish bottom of hole that receives hub-latch plunger; (11) finish mill slots for spanner wrench; (12) file burrs and remove sand from inside. For the assembly the following steps are necessary: Fit and assemble hub-latch spring, hub-latch plunger and hub latch to hub cap; rivet and finish for inspection, then assemble oil-valve spring and washer in place on hub cap and lash with No. 20 wire (see Fig. 11).

On the wheel-fastening spring, operation 1 is to coil on a 0.226-in. mandrel, and in operation 2 seven coil lengths are cut off.

WHEEL-FASTENING PLUG

There are three operations on the wheel-fastening plug; namely: (1) Finish turn, bore, and cut off in ¾-in. lengths; (2) mill radius; (3) tumble pieces.

The hub-latch spring also requires three operations. The first is to coil on a 0.218-in. mandrel and cut off in 20 coil lengths. In the second operation the ends are heated and bent to touch the next coil. Then in the third operation the ends are ground. For the wheel-fastening plug, but one operation is necessary—to finish as indicated on the drawing.

The hub-latch plunger is finish turned and faced in the first operation. The second operation consists of straddle milling the end, while in the third operation the piece is drilled. The fourth operation is to file burrs and finish for inspection.

On the hub latch there are nine operations, as follows: (1) Forge and trim; (2) heat-treat; (3) pickle; (4) do necessary grinding; (5) straddle mill; (6) file burrs; (7) drill two $\frac{9}{64}$-in. holes for rivets; (8) finish slot 0.203 x 0.3-in. hole and plunger clearance; (9) file burrs and finish to receive end of plunger.

(To be continued)

Advantages and Disadvantages of Skeleton or Built-Up Core Boxes

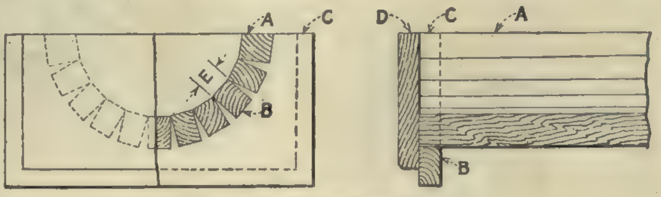
BY M. E. DUGGAN

A core box was required for a core 7 in. in diameter and 46 in. long. A skeleton core box would serve the purpose, but the coremaker does not take kindly to this kind of core box for the production of cores. "They are," he says, "a patternmaker's shortcut—a method intended for the purpose of eliminating labor and expense in the pattern shop and adding to the labors and difficulties of the molder and coremaker."

Few patternmakers are familiar enough with molding and coremaking to realize the problems that confront the molder and coremaker. Such knowledge is only acquired by frequent visits to the foundry and by observing the difficulties that the molder and coremaker must contend with because of improperly made patterns and core boxes.

Why make a skeleton for the production of a core? Because it is easily and quickly made and is least expensive as compared with the built-up core box. True, but much of the labor and time put in on the construction of a great many built-up core boxes is wasted.

The illustration shows a built-up core box that is easily, quickly and cheaply made and that answers the purpose as well as any built-up core box. It lacks beauty, style and finish, which, according to the artistic patternmakers' way of thinking, are most important. However, without a thorough knowledge of coremaking and molding, no patternmaker can realize to what extent he can go in the construction of patterns and boxes.



BUILT-UP CORE BOX

The core box shown was made as follows: From a board cut to the required length, strips 1 in. wide were cut on the circular saw. Three boards, one at each end and one at the middle, shown at *C*, were fastened together and cut on the circle *B* with a band-saw. Starting in the middle, the strips *A* were assembled in the circle *B* and fastened with glue and nails. The heads *D* were put on and securely fastened with glue and screws.

The box was made and finished with the stock as it came from the planer, band and rip saws, excepting the top strips *A*. These were hand dressed. No varnishing was done. The "flats," as at *E*, were made circling by the coremaker in less time than it takes to write about it.

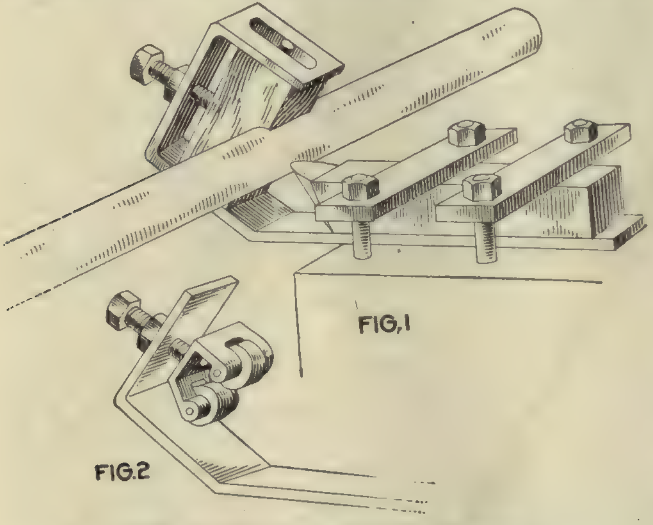
IDEAS FROM PRACTICAL MEN

Follower Rests

By Wm. Forray

The man who invented the name "follower rest" may have had the best intentions, but every time I look for such a tool I fail to see where the word "follower" comes in. These appliances have a peculiar way of making themselves rare. Some of our lathes had follower rests; others used to have them before the last "moving," at which time they failed to follow. And now the only one left, we preserve like the "last rose of summer"—liable to fade away at any moment.

I do not claim that the two makeshifts shown in Figs. 1 and 2 will do more "following" than any others, but they will do better "following" in many cases, especially for light work, where they have proved to be efficient. Their construction is self-explanatory. When in use, they are clamped under the tool in the cross-slide, as shown.



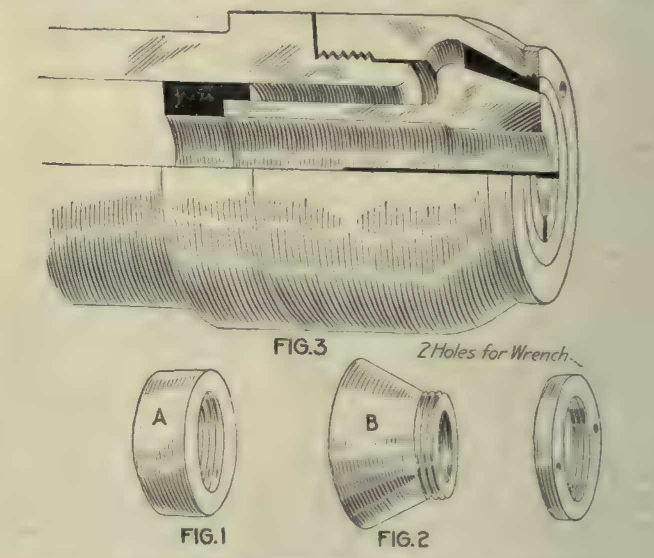
FIGS. 1 AND 2. FOLLOWER RESTS

Spring Chuck Adapter

By Raymond Grant

An old worn-out hand screw machine of 1¼-in. capacity was replaced with a modern machine of 1½-in. capacity. A large number of standard and special chucks had been supplied for the old machine, and not very long after it was discarded a job came in that necessitated the use of one of the special chucks.

Investigation showed that the old chucks were about ¼ in. smaller in diameter on the taper end, ⅛ in. smaller in diameter on the back end and about 1 in. shorter over all than the chucks for the new machine, so by making the parts shown by Figs. 1 and 2 our whole equipment of old-style chucks became available for the new machine. This idea might be valuable in many cases where there is enough difference between the chucks of different machines to allow adapters of sufficient thickness to be made.



FIGS. 1 TO 3. ADAPTERS AND THEIR APPLICATION

The part *A* is made of machine steel and casehardened, but *B* is of tool steel and tempered. The outside taper is first ground to fit the nosepiece of the new machine. Then putting the adapter and nosepiece in place in the machine, the inside taper is ground out, with a toolpost grinder, to suit the old chucks. In Fig. 3 the adapters are shown assembled in the large spindle.

A Roller Thrust Bearing

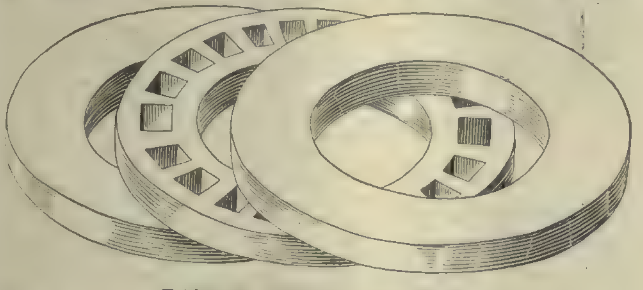
By Bryan T. Hawley

Drilling $1\frac{15}{16}$-in. holes through 2 in. of nickel steel with a feed of 0.22 ft. per min. may fairly be considered real work. A heavy-duty drilling machine having a spindle diameter of $2\frac{13}{16}$ in. and using a steady support fitted to the column for the drill and sweep fixture is used for this work.

The spindle ball thrust bearing gave out in less than three weeks. The bearing was replaced and a kick registered with the manufacturer, but without avail. The second bearing held up no better.

The repairman proposed roller bearings, but the Old Man said, "No," taking the stand that roller bearings were theoretically wrong for a thrust bearing and that the machine builder should know best what kind of thrust bearing to use. Another set of ball bearings was worn out in about the same length of time.

Pulling heavy-duty drilling machines apart every three or four weeks did not appeal to the repairman, so he said nothing, but turned up three washers $\frac{11}{32}$ in. thick. Holes were squared out in one of them to give a free fit for $\frac{3}{8}$-in. rollers $\frac{3}{8}$ in. long, as shown in the sketch. A sufficient number of rollers were cut off from $\frac{3}{8}$-in. Stubbs steel, and the whole works were pack hardened. The face and bore of the washers were ground, the rollers polished by hand, and the completed thrust bearings were put into the machine, having cost no more to make than the ball thrust bearings cost to buy.


ROLLER THRUST BEARING

The Old Man kicked some at first, but now he is pleased. This machine has run over a year without spindle repairs.

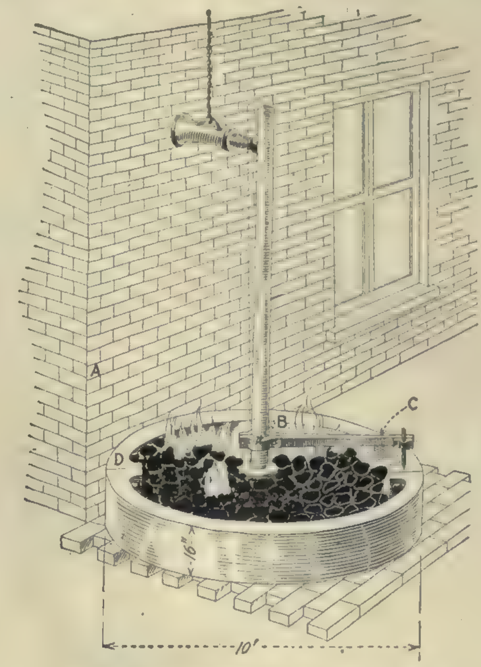
Straightening a Warped Flywheel

By George F. Wheeler

A few years ago a general repair shop took a contract to overhaul a 13 x 38-in. Jerome Wheelock steam engine that had passed through a fire and had been very badly scorched. Everything went well as far as cylinder, guides and bearings were concerned and the shop had broken about even on the contract price when the wheel was put on. This flywheel was 10 ft. in diameter by 16-in. face.

On the first revolution it was noticed that the wheel ran out sidewise about $3\frac{1}{2}$ in. A price of $600 was offered on a new one, which would mean a dead loss. Immediately, some expert molders and patternmakers were appealed to for their opinion as to whether it would be practical to heat the wheel and straighten the rim, but in every instance disappointment was encountered. Not one of the best men in the business thought there was a chance to get over it without causing a fracture in spokes.

The conclusion was reached that as the wheel was scrap, it could not be harmed any more, so as a last chance, it was treated as follows: As the wheel was bolted on the hub and the rim, we removed the crankshaft and the wheel was laid down on its flat as close as possible to the wall *A*. A groove 2 in. by $\frac{1}{2}$ in. deep was turned in an old shaft at *B*. The flywheel was bolted up tight on the shaft, the groove *B* being up about 3 in. over the hub. A trammel arm *C* was made to fit snug, and the extending end was revolved on the rim *D*. Here, an adjustable pointer was set so as to touch the rim. The wheel was turned around so that the shaft would lean its maximum toward the wall *A*. A jackscrew was suspended from the roof, and pressure was put on the end of the shaft. Thirty bags of charcoal were used to heat the wheel; and when the spokes were red, a slight pressure on the jackscrew forced the hub over till the trammel point touched all around the rim. The latter was then packed with bricks and wedges, covered over and allowed to cool gradually. When the wheel was put on the shaft, it was out less than $\frac{1}{8}$ in.; this was removed with a tool.



HOW A FLYWHEEL WAS TRUED

The wheel has been running now for over four years, is perfectly true, and there is not the least sign of a flaw. This stunt cost $45, saving $555. It is hoped that this description may be of some benefit to small-shop men similarly situated.

Blueprint Machine

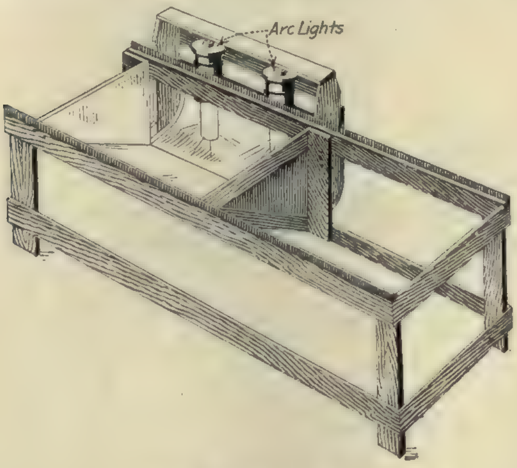
By G. F. Wetzel

Where blueprints are needed frequently, but there is not sufficient work to pay for an automatic printing machine, the one here described will do very well. Any carpenter can put it together, and the material needed is inexpensive and easy to obtain.

The machine frame is made of $\frac{3}{4}$ x 4-in. boards and is about 6 ft. 6 in. long, 27 in. wide and 36 in. high. On the upper edge of both front and back top strips is screwed a 1 x 1 x $\frac{1}{8}$-in. angle, with vertical flange outward. This serves as a track for the printing frame, which has a small grooved pulley and shaft fastened on each side near the corner. A standard 24 x 36-in. printing frame is used.

One end of the machine frame contains the light well, which is 3 in. long and bounded on each end by a triangular sheet of aluminum, polished on one side, of about No. 16 gage, B. & S. A plate-glass mirror, approximately 30 x 32 in., slants down at 30 deg. from the top front member, and at the back is a sheet of aluminum. The light is furnished by two arc lamps, spaced about 15 in. on centers and in front of the rear reflector sheet. The lamps are supported by wooden braces, as shown in the figure. The rear reflector is bent at the bottom to come around and meet the lower edge of the mirror, where two pins in the frame engage in holes in the sheet. At the upper edge of the sheet two round holes, with radial short slots at the top, slip over two wood screws with round heads. Thus by raising the sheet it can be removed for access to the arc lamps. About an inch space is left around the rear sheet for ventilation.

In using the outfit, the printing frame is in a horizontal position, with the glass side down, on the tracks. The felt pad and back are heavy enough to hold the tracing and paper flat. Ordinarily, the frame is left over the light well; but for wiping dust off the mirror or inspecting the lamps, it is pushed to one side. As the field of illumination is only 30 in. wide, when a longer print is desired expose only one half and then the other one by rolling the frame along. If larger prints than 30 in. are standard, three lamps will be needed.



A BLUEPRINT MACHINE

Good, evenly colored prints can be made in about 5 min., using electric rapid blueprint paper, without moving the frame. In shops where this machine would fit in, ordinarily the draftsman can stop long enough to start the print, go back to his desk and then remove the print without interfering appreciably with his work.

Another way in which the machine can be used is tracing through sketches or prints. By removing the pad and back of the printing frame, the light will show through a heavy print or sketch made on drawing paper, so that it can be easily traced.

Pressure Ring for Limited Die Space

By H. W. Johnson

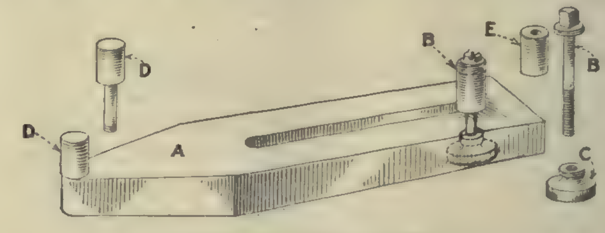
While designing a drawing die for a sheet-steel cup about 2½ in. deep, it became evident that the press we had did not afford enough height to house the springs for the pressure ring. As ordinarily made, this ring is attached to the punch holder and the springs have to compress a little more than the depths of the draw, in this case 2¾ in.

I suggested to the draftsman that he reverse the usual order of things and put the ring on the die holder, held down by short heavy springs in pockets counterbored in the lower side of the die holder. He did this and arranged a pair of links between the pressure ring and the punch holder to lift the pressure ring about ¼ in. when the press ram was clear up. As the press came down, the ring was lowered onto the blank, and inasmuch as there was no further connection between the press ram and the ring, the ring held the blank with uniform pressure all through the drawing stroke. By this method the springs had only ¼ in. of movement to allow the operator to slide the blank in, and we had plenty of room to house a short spring, where a long one would have been out of the question.

Sine Bar for Toolmakers

By Burt Binge

The illustration shows a small tool that toolmakers on gage and die work will find very handy for measuring angles. The measuring bar *A* is made of tool steel, hardened and ground; the adjusting screw *B* of machine steel, pack hardened; the adjusting nut *C* of machine steel. The measuring plug *D* is of tool steel, hardened and ground, as is also true in regard to the measuring button *E*.

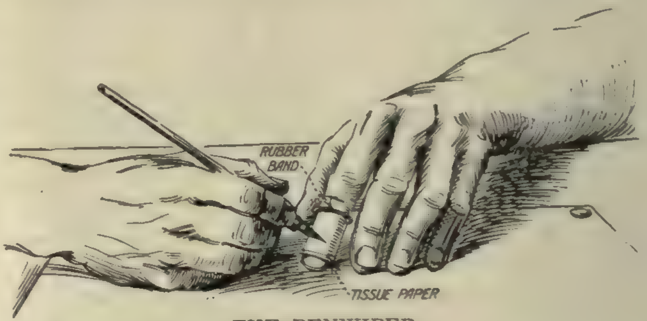


SINE BAR AND PARTS

A Handy Penwiper

By S. Newman

Draftsmen and users of fine pens with heavy india ink are bothered by dirt and eraser residue getting on the pen. Penwipers are unhandy to use, as both hands are engaged at the moment, so the unsightly habit is formed of wiping the pen on clothing, board or the finger nails of the left hand.



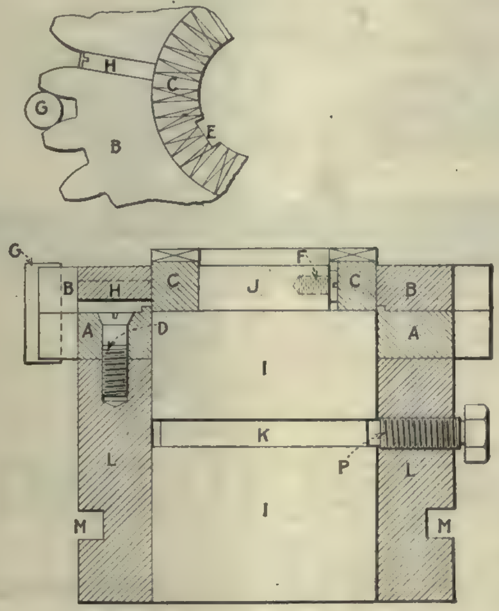
THE PENWIPER

To provide a really good penwiper, the writer has adopted the method illustrated. A piece of tissue paper is wrapped around the second finger of the left hand and held in place by the thumb or a rubber. It is a most handy device and preserves the cleanliness of the draftsman as well as of his pen.

Clutch Indexing Fixture

By Carl Klaiber

The illustration shows an indexing device that is used for cutting clutch teeth. It may be described as follows: The cylinder *I* has a shoulder *J* and a groove *K* machined on it, fits into the hollow cylinder *L*, and is free to turn in this cylinder, which is fastened rigidly to the table of the shaper by clamps in the groove *M*.



CLUTCH INDEXING FIXTURE

The gear *A* is fastened to *L* by the machine screw *D*, so that the two parts act as one piece.

The piece *C*, on which the clutch teeth are to be cut, is keyed to the shoulder *J* by means of the setscrew *F*, the head of which acts as a key and fits into the groove *E*. The whole fixture is set on the shaper table so that the clutch teeth in *C* will be cut radial by the tool.

To index, the setscrew *P* is loosened, the gear *B* is moved as many teeth as required and is accurately set by placing the pin *G* between the teeth of the gears *A* and *B* before retightening the setscrew *P*.

This device is used in the shop of the Maag Gear Co., Yonkers, N. Y., and has proved very accurate with this company's gears.

Variable-Speed Mechanism

By M. Jacker

On page 1131, Vol. 46, C. F. Meyer shows a variable-speed drive on a certain kind of textile machinery. This principle of variable speed, with the wheels differently positioned, has been used on the Acme automatic screw machine for a number of years and is shown in Fig. 1. The gear *A* and the pulley *A′* are keyed to the shaft, while the pinion *B* and the pulley *B′*, fastened to each other, are loose on this shaft. The pinion *C* and the gear *D* are both keyed on their shaft. In this case there is no loose pulley, but one could be inserted between the pulleys *A* and *B*, if required.

In Fig. 2, I have telescoped a couple more gears and pulleys over the sleeve *S*, shown in Fig. 1, to show how readily this principle can be extended to give a greater number of speed variations.

The similarly lettered parts in Fig. 2 are fastened to each other. The gear *A* and the pulley *A′* are keyed to the shaft; the others are keyed to their respective sleeves, revolving upon each other and the shaft. The gears *E*, *F*, *G*, *H* are keyed to the shaft *X*, which is the one having the varying speeds imparted to it by means of a driving belt running on either one of the pulleys at a constant speed. In this case, also, a loose pulley might be inserted between each of the others.

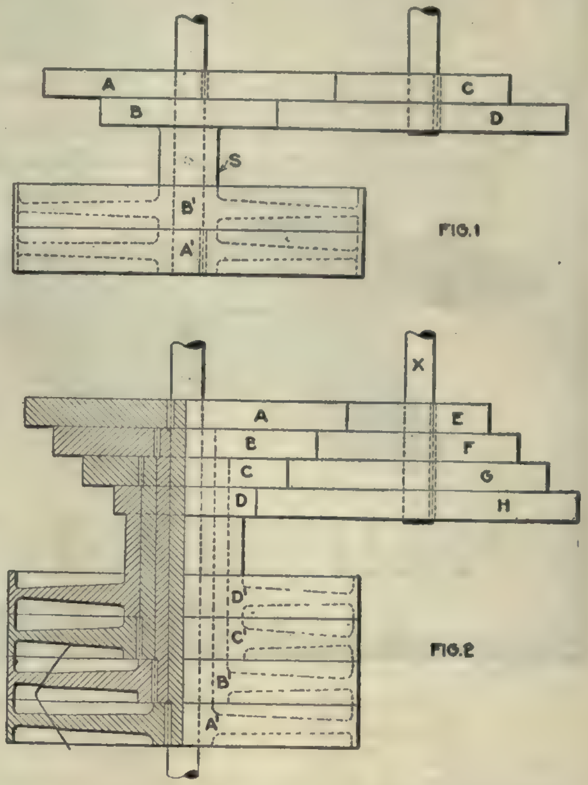


FIG. 1

FIG. 2

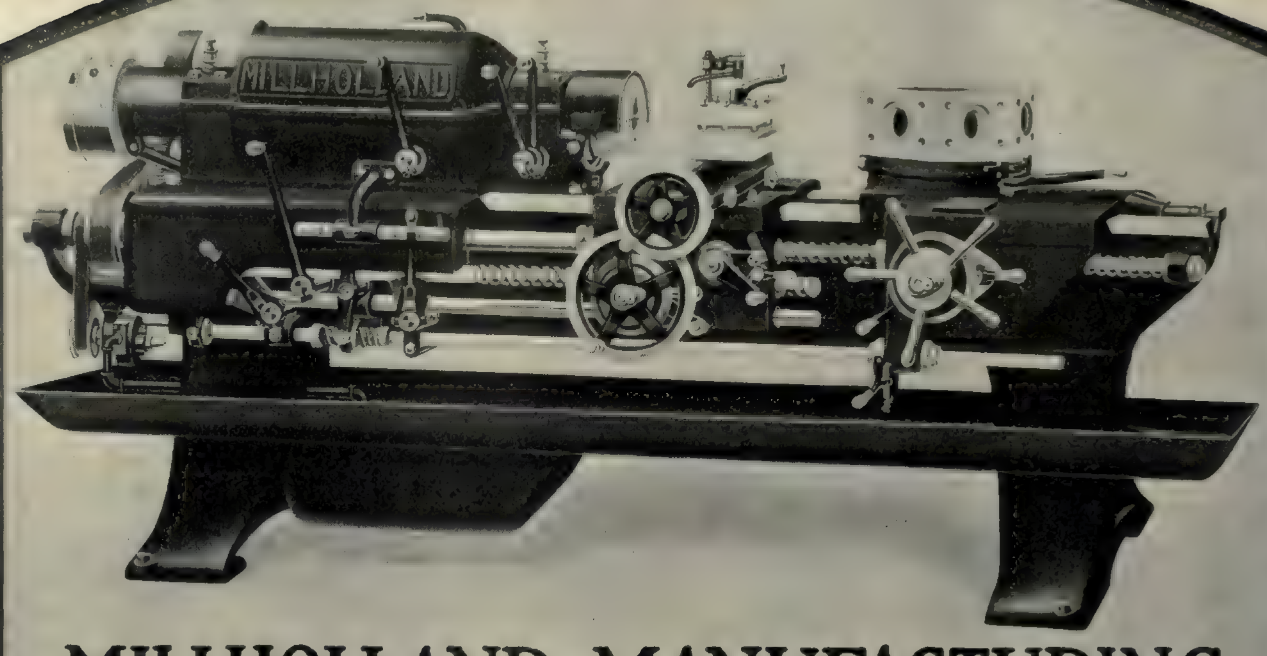
FIGS. 1 AND 2. VARIABLE-SPEED MECHANISM

In some cases, instead of this Fig. 2 arrangement it might be advisable to connect up the required gear by the good old way of a sliding feather in the driving shaft and have one driving pulley and one loose pulley only.

Formula for Obtaining Cutting Angle of Helical Gears

By C. Hecker

It is often required to replace spur gears with helical gears where the pitch diameter and number of teeth cannot be changed, as in speed boxes, etc. In this case a finer pitch cutter must be used, and the cutting angle made such as to give the correct proportion of tooth and space. While working out a problem of this kind it occurred to me that a shorter way than by circumferential pitch could be used. For example, given a change speed box with 6 diametral pitch spur gears, to replace them with helical gears of $6\frac{1}{2}$ diametral pitch. $6 \div 6.5 = 0.9230 = \cos 22^\circ\ 30'$, which is the cutting angle. The formula is $\frac{A}{B} = \cos C$; where *A* is the diametral pitch of the spur gear, *B* is the diametral pitch of the helical gear and *C* is the cutting angle of the helical gear.



MILLHOLLAND MANUFACTURING TURRET LATHE

APPROXIMATE diameter of hole in spindle, 2¾ in.; capacity of automatic chuck, 2½ in. rounds, 1⅝ in. squares, 2 in. hexagons; capacity of scroll chuck, 12 in.; swing over ways, 19½ in.; swing over carriage, 15 in.; travel of turret saddle, 30 in.; turret diameter across faces, 16 in.; feeds, eight $\frac{1}{512}$ to ¼ in. per spindle revolution; cross travel of carriage, 9 in.; longitudinal travel of carriage, 26 in.; cross feeds approximately one-half the longitudinal feeds; drive, by single pulley 14 in. diameter for 4 in. belt with speed of 400 r.p.m.; spindle speeds, eight, 18 to 240 r.p.m.; threading capacity, 2½ in.; weight, 5500 lb.; constant speed, 5-hp. motor may be attached by means of a floor base to the rear of the head end leg, being mounted upon slide rails to allow for belt adjustment. Bar equipment includes: An automatic chuck with master jaws and complete set of bushings for round, square and hexagonal stock as follows: Rounds, ¾ to 2½ in. by eights; squares, ¾, ⅞, 1$\frac{1}{16}$, 1¼, 1½ and 1⅝ in.; hexagons, 2 in. Outer stock support, one roll feed for round, square and hexagonal stock; three universal turners with roller back rests adjustable from 3¼ to ⅝ in.; pointing tool; automatic opening die with chasers for ½, $\frac{9}{16}$, ⅝, $\frac{11}{16}$, ¾, ⅞, 1⅛ and 1¼ U. S. S. threads; automatic opening die with chasers for 1⅜, 1½, 1⅝, 1¾, 1⅞ and 2 in. U. S. S. threads, and toolholders. Chucking equipment includes three-jaw scroll chuck with reversible jaws; plain turning and facing heads, one with straight and one with angle cutter holder; slide tools with graduated adjusting screws, boring bars, cutter heads and cutters; plain toolholders, spindle bushing and pilots. Supplementary equipment includes change gears for cutting threads of any pitch from 4 to 48; universal turning and facing gear, including two adjustable slide arms and one plain turning holder arm with angle cutter holder; taper attachment for turning tapers up to 1½ in. taper per foot with a limit of length of 12 in.; drill chuck, with capacity up to 1 in.; combined cutting-off and forming tool for turret.

THE Millholland 2½ x 30 in. manufacturing turret lathe, made by the W. K. Milholland Machine Co., Indianapolis, Ind., has been designed to take care of the latest requirements in manufacturing where unskilled help has largely taken the place of skilled labor. All unnecessary parts have been eliminated and the operation of the machine simplified so that the fewest possible movements are required by the operator. Parts are of substantial design and the mechanism has been simplified and made foolproof so that the machine is practically indestructible. Very few levers are required in the operation and these are placed in position most accessible for the operator. The lathe is complete with all-geared head, geared automatic feed and power rapid traverse for turret carriage, toolpost carriage with power cross and longitudinal feeds; independent adjustable stops for turret and toolpost carriage, stock stop, oil pump and pan and tool stand.

The machine is designed for rough and finished boring and turning and is of massive construction with large bearing surfaces. All gears of the head run in oil, and in addition are entirely enclosed and splash lubricated. The headstock is low, well balanced and designed to prevent the transmission of vibration. Speed changes are 8 in number, secured by means of 3 friction clutches, and the gears are of either steel or semi-steel. The turret lathe is furnished with a device for starting, stopping or reversing; controlled by a single lever which may be locked to prevent accidental starting. The friction clutches are of large size with proper adjustments provided and readily accessible by removing the headstock cover.

The head is designed to resist wear or vibration and all parts subject to wear are provided with adjustment. The carriage is designed for rigidity, absence of vibration and large productive capacity. Special attention is given to safeguarding the operator in every way as well as to relieve him of any extra work in operating the machine.

The main drive of the spindle is through a large friction on the spindle itself. Speeds and feeds are in geometric ratio with a factor of about 1.45 for spindle and 2.0 for feeds. The spindle is a 50-point carbon steel forging ground to size and scraped into its bearings, and has a large end thrust bearing. The spindle nose is especially designed to take the automatic chuck or a three-jaw geared scroll chuck. The square-turret carriage is arranged for screw cutting by means of lead screw and change gears. Spindle bearings are of phosphor bronze.

CARRIAGE CONSTRUCTION

The carriage spans the bed, and is arranged so that it can be brought close to the head of the machine, permitting the use of short, sturdy tools on the hexagon turret. The square-turret carriage and the hexagon-turret carriage are both operated by separate feed screws of coarse pitch, and the square-turret carriage has a separate feed shaft for cross feed with cross-feed reverse in apron. The both carriages have separate feeds so they can be operated independently. The feeds are changed by levers on headstock end of lathe. The square-turret carriage has power cross-feed with knock-out and micrometer index dial reading to 0.001 in. Four adjustable stops are provided for the power longitudinal feed. The square-turret toolpost accommodates four tools, anyone of which may be instantly brought into cutting position. The toolpost is indexed by a hardened stud, working in hardened bushings and clamped and unclamped by a binder lever which raises and lowers the toolpost with regard to its seat. Each cutter in the square turret is independently adjustable for height. Taper attachment is arranged for, so that both cylindrical and taper parts may be turned.

The main tool carriage carries the hollow hexagon turret, each face of which has one large diameter center hole, together with four holes for attaching tools. Independent adjustable stops are provided for each face of the turret. The stop roll indexes automatically with the turret. A large clamp ring encircles the turret base and serves to clamp the hexagon turret to its seat on the carriage. A large lock bolt working in hardened and ground lock bolt bushings is provided for indexing. The hexagon turret carriage has a power rapid traverse operating at 30 ft. per minute.

The bed is of box section with flat ways. Both carriages have a long narrow guide on front way, and are provided with taper gibs to take up wear and to make adjustments.

For motor drive, a motor base can be attached to rear side of front leg and a constant speed motor of 1200 r.p.m. mounted thereon and belted to drive pulley, adjustment being provided to tighten motor belt.

Kiln Drying Woods for Airplanes

When the United States entered the war, says a report of the Forest Service, the need for wood to build airplanes quickly created a difficult problem. Most of the air-seasoned wood available had been bought for the Allied nations abroad. Thorough air-seasoning of such stock requires from one to three years, according to the size and kind of wood. Kiln-dried stock under the methods ordinarily used has frequently proved unsatisfactory and, for that reason, airplane manufacturers have been reluctant to use it. If the needs of the fighting forces were to be met adequately and without prolonged delay, it was essential that methods of conditioning should be available in which full confidence could be placed.

Long before this situation developed the Forest Products Laboratory of the Forest Service, at Madison, Wis., had been making a scientific study of the drying of wood, and had developed a method of drying which has been very successful with all the woods tried. Several kilns had been built at the laboratory for experimental purposes and a number of demonstrations made in commercial kilns. Ash and spruce are the woods most in demand for airplane construction and the Forest Service secured a shipment of partially air-seasoned ash and spruce plank for preliminary tests. This material was kiln dried without injury.

Later thoroughly green Sitka spruce, white ash (northern and southern), white oak, Douglas fir, western white pine and mahogany were secured in the log for testing. The spruce and ash logs were cut up and the green material from each species divided into three matched groups. One group of each species was tested green, another has been set aside to be tested when it has air-dried, and the third group was kiln-dried, trying several methods, and then tested. Only the results of tests on the spruce have so far been analyzed. Comparison with standard tests which had already been made shows that Sitka spruce can be kiln-dried from the green condition with no more, perhaps less, injury to its mechanical properties than by air seasoning. Definite specifications have been prepared for kiln-drying spruce green from the saw for airplane construction and, if rigidly enforced, they will insure kiln-dried stock of this species equal to air-dried stock.

A preliminary study of propeller construction has shown the need of such information on propeller woods. The testing of the ash and other species now on hand, which include several propeller woods, is being pushed.

Courses in Naval Architecture and Marine Engineering

The United States has entered upon a shipbuilding policy that will make it the greatest shipbuilding nation in the world and there is already a great demand for professionally trained men in this work. To meet this demand in part the Polytechnic Institute, Brooklyn, N. Y., offers special courses in naval architecture and marine engineering. These courses aim to give the students such a comprehensive training that, when they enter a shipyard or a ship-drawing office, they will understand what is wanted of them and how to proceed in accomplishing it.

Editorials

How Tools Are Winning the War

WE SELDOM think of the twist drill as one of the important sinews of war; and yet when we consider that no sort of gun or ammunition, no motor truck or airplane can be made without the use of the drill, the more we realize its importance. How great a part this tool actually plays is brought out very clearly by the Cleveland Twist Drill Co. in one of its interesting publications.

Summed up in a table, the figures, as compiled by good authorities on a conservative basis, show the approximate number of holes to be about as follows:

Shrapnel shell (3-inch, forged)	70
Springfield rifle	94
Torpedo	3,466
Machine gun	350
Airplane (biplane)	4,089
Motor truck (3-ton)	5,946
Ambulance (light)	1,500
Field gun (3-in.)	1,280
Gun caisson	594
Anti-aircraft gun	1,200
Self-binder	500
Thresher	420
Motorcycle	1,160

Multiply these figures by the number of shells or rifles or field guns, etc., and you get some idea of the immense importance of the drilled hole.

Expressed in a different way, over 300 miles of drilled holes are blown away with the firing of every million shells. The machine guns on the Allied firing lines represent over 100,000,000 drilled holes. Four hundred million drilled holes are flying in France today; when our 23,000 machines are added to the list, each having over 4000 drilled holes, some 92,000,000 more holes will be added to the list. According to the same authority, about 12 per cent. of the machine work involved in our whole task of preparation is embodied in the drilled hole.

To supply only a million rifles means 94,000,000 drilled holes, and probably four times this number is necessary. Then, too, we must remember that the drill is only one of the tools used, the estimate being that 997 cutting tools are required in manufacturing the modern rifle.

Realizing the importance of the drilled hole, we can see good reasons for the embargo on twist drills and other tools and machines that go to make up our modern shop equipment. This embargo is very rigidly enforced and practically no machinery is exported to neutral countries, it being our first duty to supply ourselves and our allies.

Bearing the importance of the tool in mind, any shop man or shop manager who is turning out tools, jigs, fixtures or machines that are used in manufacturing either munitions or the machines which make them (and we can almost include forming and similar implements among the munitions) should not fret because he is not making actual fighting material. We cannot all do the spectacular or the heroic things, but our work in obscure corners is absolutely necessary in order to win trenches, to drive the enemy from the air and to do our share of the great work that still remains to be done.

Licensing of Enemy Patents

THE Federal Trades Commission, which has been designated by the President to carry into effect the recently enacted law that authorizes the granting of licenses to American citizens permitting them to manufacture under enemy-owned patents, has issued its regulations under which these licenses will be granted, but no such authorization to manufacture will be issued unless the interests of the public demand it.

It is the intent of the law to safeguard and protect the alien-enemy owner in his rights, and it also provides that the owner be adequately reimbursed for any invasion thereof, as soon as possible after the termination of the war.

While this law will, undoubtedly, prove of the greatest possible benefit to the manufacturers of drugs and dye-stuffs in particular, it will not have any appreciable effect on the machinery industry, as the "interests of the country" will not require anything in this line of foreign origin, when it is so adequately and satisfactorily supplied by our own manufacturers, and it is safe to assume that very few applications will be presented for rights in this particular line of industry.

It is a well-known fact, that for a considerable number of years, Germany has been the purchaser of machine tools in considerable quantities, and also that a large percentage of her products of these goods has been based on American design; sample tools being purchased that they might be copied, or adapted with only minor changes.

It is possible, and will in all probability prove true, that there are a number of patents granted to German inventors on guns, munitions, and kindred devices of warfare, also patents on various optical or scientific instruments which may be utilized to advantage. Undoubtedly manufacturers in all the different industries are thoroughly familiar with what might prove of benefit to them, and will be quick to avail themselves of anything possessing merit and promising to be of value.

The question of compensatory damages for what might be termed equivalent to infringement is apt to prove complex and perplexing in a considerable degree. Its solution would seem to lie in the appointment of boards whose members would be made up of those skilled in the art to which the invention pertains.

Testimony would necessarily have to be submitted on a number of different questions, principally on the cost of production, output, and net profit obtained, as a means of equitable renumeration to those whose property has been temporarily confiscated.

Another problem necessary of solution would be the validity or invalidity of the patent operated under, and a search into the prior state of the art and requiring competent patent counsel would be essential, in order that even an opinion on this point might be reached. It would manifestly be highly improper to compensate the owner of an invalid, and therefore worthless patent.

Testimony would undoubtedly be adduced by enemy patent owners to uphold their claims and which claims might be decided by a board constituted preferably of competent patent lawyers.

The enemy-patent owner while possibly thinking he has been maltreated is in reality greatly benefited, in as much as the invention forming the subject matter of his patent is exploited, and a market found for it which may continue. This all without any effort or expense whatever on his part.

Educate Men Now

IN SPITE of all our hurry and the bustle of war preparation (and it is still too largely merely preparation after seven months have elapsed), let us not make the grave mistake of overlooking the vital question of education and training. Skilled men and women are scarce at the present time, or we would be farther along in our war work. If every shop in the country had turned out trained mechanics during the past ten years, we would be in a much better position today.

Every city in the country should be training mechanics today, either in its shops or in vocational schools, or both. A part of the education of every boy and girl should be along the line of practical work with the hands as well as the head. And every mechanic, young or old, should be encouraged to become skilled in his particular line of work.

War work, no matter how urgent, should not blind us to the necessity of training mechanics for the future; for we shall need to be well provided with skilled mechanics to meet the competition of the years of reconstruction after the war ends.

While it is undoubtedly true that the foundations for mechanical training can be laid in the school, and a real vocational school can go a long way in the proper education, the final training must be done in the shop. And this should be a part of the routine of every shop. Even if it is considered as an expense, it should be a part of the overhead of the business; a tax on the industry if necessary. But, whatever it is, it must be done if we are to be well prepared for economical production in the future.

As an example of what can be done, even in a shop which is no larger than hundreds of others, we are pleased to cite the work of the Shepard Technical Night School, conducted by the employees of the Shepard Electric Crane and Hoist Co., of Montour Falls, N. Y., which is now in its second year. The management reports that the direct tangible results were very gratifying and that the spirit of coöperation has been of direct benefit to both sides. Those who wish to see what a moderate sized shop can do, and how it does it, will do well to write the Shepard school for details of its work.

It should be remembered that educational matters are not confined to the shops, but that technical books and papers also play an important part in the education of mechanics. Anything which tends to discourage the education of mechanics is a distinct loss to the country; a loss which will be sadly felt in the years to come. This makes the new postal law particularly harmful at this time, adding as it does several dollars a year to the cost of papers like the *American Machinist* to readers in the Far West.

There never was a time when the interchange of ideas was as necessary as at present, this being one of the best means of education, and the means for securing this should not be handicapped by unwise taxation. Every employer should give particular attention to the education of his men, as it has an important bearing on the future of the industry.

Making the Draft Selective

IT IS gratifying to note that an earnest attempt is being made to make the next calling for the drafted men more nearly selective than was the case at first. The failure to exempt men who were clearly of more service in industry, or to transfer drafted men to duties in the war department for which they were especially fitted, has caused much criticism, both inside the army and out of it, and with good reason.

By the new ruling every registered man will be completely catalogued by the local board so as to enable the board to determine the service for which he is best fitted. There will be five separate classes, running from those who have no dependents to those who are physically or otherwise incapacitated for active service.

Class 1 will be men of draft age, who are physically fit, unskilled, and who have no dependents. These men will be called first, and until this entire class is exhausted, no others will be called. Class 2 takes in men with few dependents, or men partially skilled. Class 3 will include highly skilled, or those with aged dependents. Class 4 takes those with large families. The last class, 5, will include all the "discards," or men not fit for active service.

It is hoped and believed that the new system, which, as has been stated, starts with a very complete life history of each man; of his work and of his responsibilities; will be much more equitable in every way. The new system fixes a man's class, and does not call him until the classes ahead have been drawn for active service.

This system should secure for the nation the services of all classes of men where they are most needed.

Resignation of Frank A. Scott

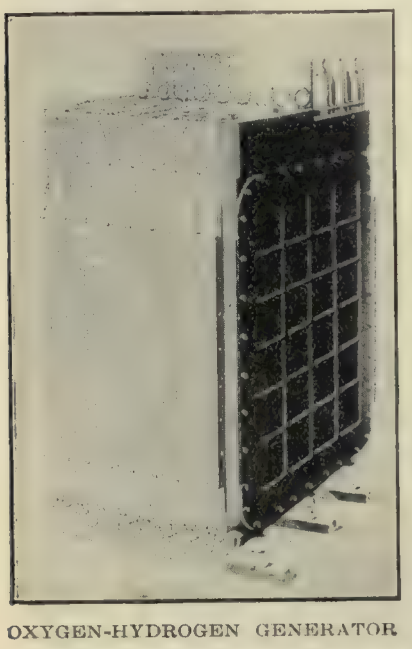
IT IS with genuine regret that we note the resignation of Frank A. Scott from the Chairmanship of the War Industries Board, and more especially as his resignation is due to ill health, caused by his long and arduous work on the Council of National Defense. Coming into the vortex of the war work fresh from a thoroughly practical and successful business training, he took hold of the work in a systematic manner which won the admiration of all who had dealings with him. His knowledge of machine production, and also his familiarity with small arms, which has been a hobby of his for many years, made him invaluable to the Ordnance Board, and to other departments involving machinery of various kinds.

We, and we speak for thousands who have had dealings with him during the past few months when he was under terrific pressure from every side, hope most heartily for a full and speedy recovery. The country can ill afford to spare him at such a time, and we trust that he may soon be in condition to carry on other and equally important work for us all.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

International Oxygen-Hydrogen Generator

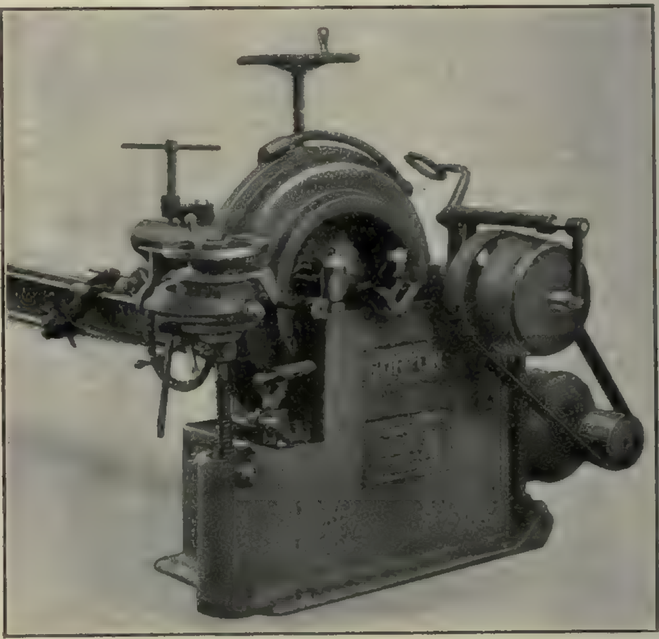
The illustration shows a new electrolytic generator that has been placed on the market by the International Oxygen Co., 115 Broadway, New York City, for generating oxygen and hydrogen gas. The generator is quite compact, the dimensions of one unit being 3½ in. thick, 3½ ft. wide and 6 ft. high. The capacity of this cell with a current of 1000 amperes is approximately 200 cu.ft. of oxygen and 400 cu.ft. of hydrogen in twenty-four hours. The units are so arranged that they may be assembled in a battery as indicated by the dash lines in the illustration. The generator operates on any current from 200 to 1000 amperes. The normal rating of 600 amperes is the point at which the most economical production is secured, figuring both first cost and operating cost. It is claimed that the oxygen produced is at least 99 per cent. pure while the hydrogen is at least 99.5 per cent. pure. It is also claimed that the construction is such that there are no parts to wear out.



OXYGEN-HYDROGEN GENERATOR

Gorton Cutting-Off Machine

The cutting-off machine illustrated is manufactured by the George Gorton Machine Co., Racine, Wis., and is known as their No. 2-D. Ten cutters are used which are held in blocks driven into the pockets in the bore of the blade One edge of each block is tapered and fits a corresponding taper in the pocket. The cutters and the blocks are located centrally by means of a tongue and groove construction. It is claimed that this type of construction allows very heavy feeds to be taken. The blade is made of chrome vanadium manganese steel, heat treated and ground on both sides; the cutter pockets are milled. Cutters are of high-speed steel being alternately wide and narrow, the narrow cutters projecting a slightly greater distance toward the center of the blade than the wide cutter. An automatic adjustable power-feed mechanism is incorporated which obviates necessity of the operator reversing any clutches when ready to raise the cutter head to position after finishing a cut. A handwheel is used to adjust the cutterhead, either up or down, and it automatically disengages the feeding pawls when raising the cutter head, thus allowing the screw to be turned in the opposite direction. A spring is used to counterbalance the cutterhead. All bearings, except those of the lubricant pump run in oil. The machines may be arranged for either belt or motor drive; the motor recommended for use being a 3-hp. variable-speed machine. A belt-driven cutter grinder is furnished as well as a supporting rack for long stock, also a single roller stand for use where only a few cuts are to be made from each bar.

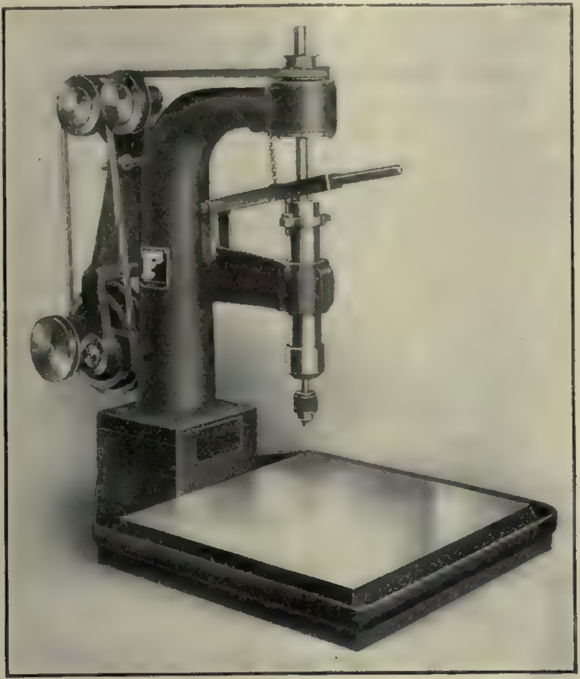


GORTON CUTTING-OFF MACHINE

Capacity, 4½ in. rounds, 3¼ in. squares, or any other size or shape that can be contained within a 4½-in. circle; net weight, 1900 lb.; floor space, 48 x 66 in.; height, 60 in.

Fenn High-Speed Drilling Machine

The high-speed drilling machine illustrated is one that has recently made its appearance on the market. It is of the sensitive type, but it will be noticed that the rack and pinion feed mechanism is not used. The feed is accomplished by means of a lever connected directly to the spindle sleeve, the weight of the lever sleeve spindle and chuck being counterbalanced. SKF ball bearings are used and the maximum spindle speed is 15,000 r.p.m. The Fenn Mfg. Co., Hartford, Conn., is the manufacturer.



SENSITIVE DRILLING MACHINE

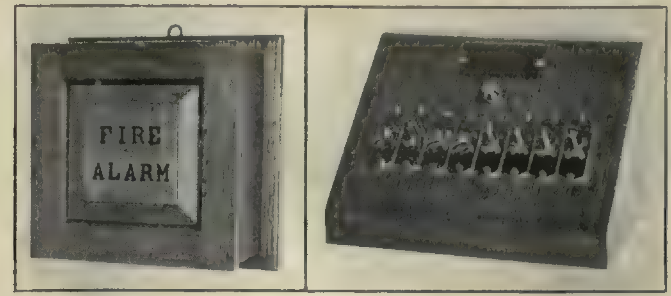
Bearings, SKF ball; maximum distance from chuck to table, 5¼ in.; distance from upright to center of spindle, 6½ in.; working surface of table, 13½ x 13½ in.; length of feed, 3 in.; speeds, four, 7735 to 15,000 r.p.m.; diameter of tight and loose pulleys, 4½ in.; net weight of bench machine, 140 lb.

Standard Call and Fire Alarm Systems

The Standard Electric Time Co., Springfield, Mass., is now marketing two new types of electric specialties; namely, a fire alarm system and a calling system.

Fig. 2 shows the operating board of the calling system. The selector fingers are of the type used on telephone boards and are arranged on a wood case. The operation is accomplished by pressing down the proper keys to secure any desired code number, and starting the instrument by depressing the key at the extreme right. This key has a red handle while the code keys are black. A small telltale lamp flashes the code signal to the operator at the same time the signal is rung. The system is supplied for various voltages and types of current. The mechanism is absolutely silent in operation.

The fire alarm system, one of the units for which is shown in Fig. 1, consists of a master selector which will ring any desired code either three rounds or indefinitely as desired. It is designed for use with either a regular break glass fire alarm station, or for push button operation. It is furnished for various voltages and currents. The selectors for both systems are very similar; the mechanism being operated by a strong spring, wound by means of an electric magnet, operating through a rack and pinion and suitable gearing. The main difference in the selectors is that in the calling instrument a series of contacts are used which come into alternate contact with a revolving flat spring, while the fire alarm selector has a definite code actuated by teeth cut on a cam. The time element feature is obtained by means of an escape wheel and a weighted pendulum which provide different ringing speeds. The contacts are of silver and all gearing is of cut brass.

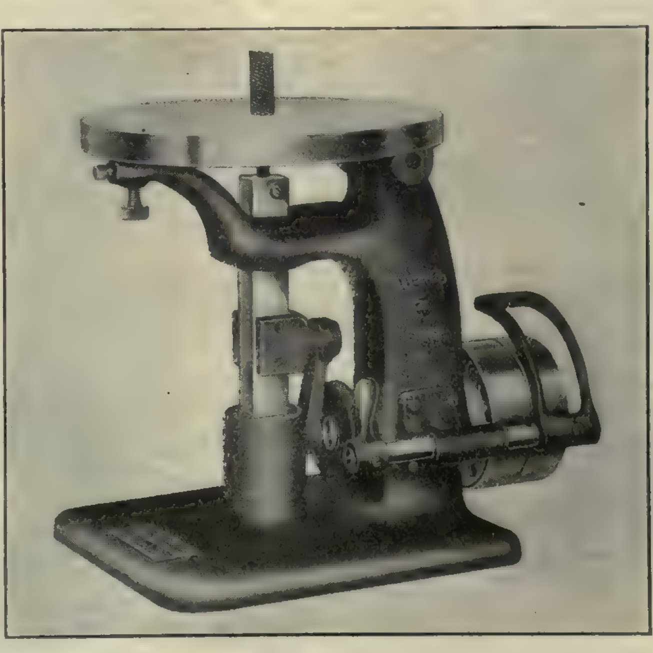


FIGS. 1 AND 2. FIRE ALARM AND CALLING SYSTEMS

Fig. 1—One of the units used in the fire-alarm system. Fig. 2—Operating instrument for the factory calling system.

"Nerco" Filing Machine

The Newark Engineering and Refrigerating Co., 476-482 18th Ave., Newark, N. J., has placed on the market the filing machine illustrated. The machine is driven by a simple crank and connecting rod motion, the features claimed being efficiency, rigidity and simplicity of construction. The file is carried by a square shaft supported in two babbitt bearings. Other bearings are of bronze. The angle of the platen is adjustable by means of locking and adjusting screws.

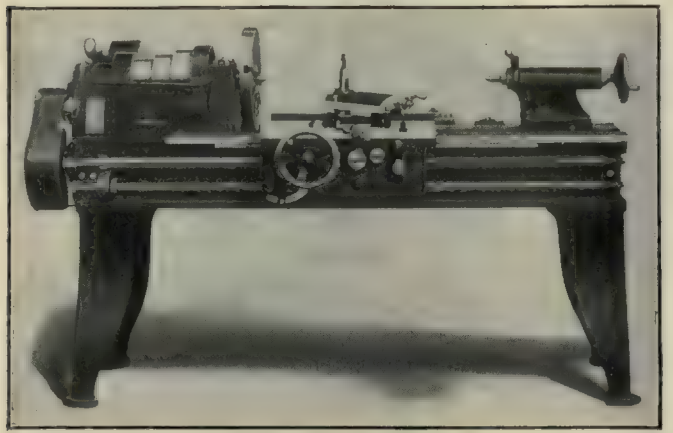


FILING MACHINE

Diameter of platen, 8 in.; height from bench, 10 in.; width, 8 in.; length, 12 in.; diameter of pulleys, 3½ in.; width of belt, 1 in.; weight, 22 lb.

"Amtew" 14-Inch Lathe

The American Machine Tool Engineering Works, Chicago, Ill., are now manufacturing the toolroom, or manufacturing lathe shown in the illustration with either a 6-, 7- or 8-ft. bed. The headstock is of the bowl-type, while the spindle is made of 60-point carbon crucible steel, running in bronze bearings. The carriage is said to be of extremely generous proportions, and the compound rest to be unusually large and rigid. The apron is cast in one piece, and has a safety device to prevent throwing in the half nuts when either feed is connected, thus preventing breakage. The feed rod is driven by gears through an overload friction cone.



"AMTEW" 14-INCH LATHE

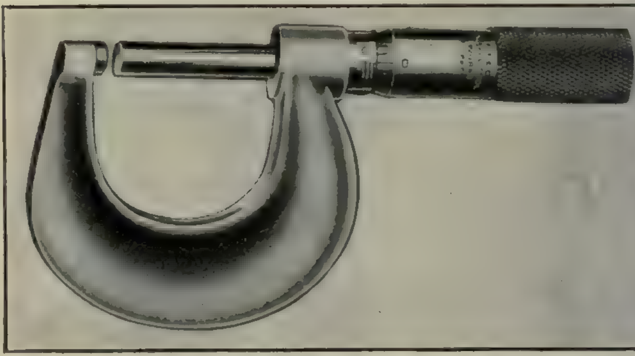
Swing over bed, 14⅝ in.; swing over carriage, 7 in.; distance between setters with 6-ft. bed, 36 in.; travel of tailstock spindle, 1⅞ x 3 in.; diameter of hole through spindle, $1\frac{5}{16}$ in.; spindle nose, 8 in.; diameter of tailstock spindle, 1¾ in.; taper of centers, No. 3 Morse; front spindle bearing, 2⅜ x 4 in.; rear spindle bearing, threaded, 2⅛ x 7 in.; threads cut, 1 to 48 per in.; threads cut with metric lead screw, 1 to 7 mm.; diameters of cone pulley, 5½, 6¼ and 8 in.; width of belt, 2½ in.; first back gear ratio, 3 to 1; second back gear ratio, 8 to 1; number of spindle speeds, eighteen, 30 to 655 r.p.m.; weight with a 6-ft. bed, 1600 lb.

Newton Thread Milling Machine

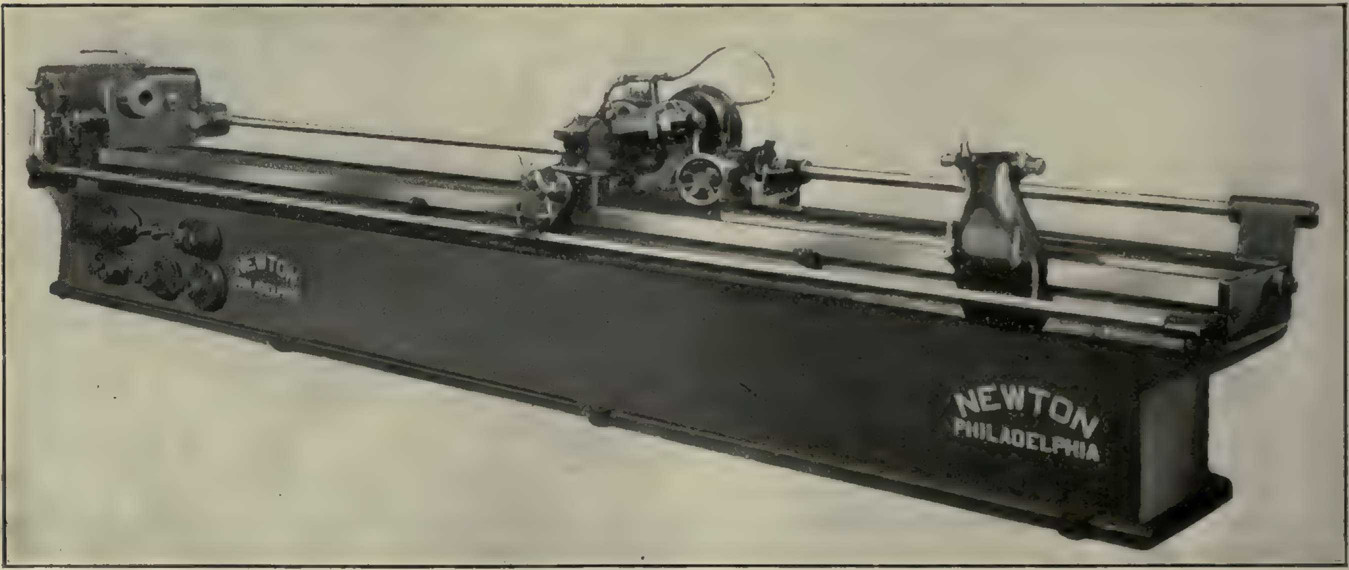
The machine illustrated is the product of the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Penn. This machine is used for worms and screws up to 6 in. in diameter and 16 ft. in length. In operation the worm blanks are placed on a mandrel, the end of which is inserted in a taper draw chuck in the hollow spindle. The mandrel is not released until the work is entirely completed, as the adjustment to the division for the successive leads is controlled by a tooth clutch. In the machine illustrated the three common leads are 1 to 3 inclusive, and the pitch is from ¼ to 9¾ in. The leads are secured by various combinations of lever-controlled gears. The pitches are obtained through change gears. When not in use the change gears are stored on a rack mounted at the front of the machine. In order to prevent the possibility of putting the brackets on the shafts in other than the correct manner the bores are made with different diameters at the two ends.

Reed Micrometer

The Reed Small Tool Works, Worcester, Mass., have placed on the market the micrometer illustrated. The frame is a drop forging, the web being concave to insure a good finger hole. All unnecessary finish has been excluded, the idea being to make the tools as simple as possible commensurate with long life and accurate measurement. The frame is finished in dull nickel to avoid enamel. A feature of the micrometer is a 2-part thimble which allows instant adjustment for wear. By



REED MICROMETER



NEWTON THREAD MILLING MACHINE

Capacity for work, 6 in. in diameter by 12 in. long; diameter of hole through draw chuck, 3 in.; leads, three, 1 to 3 inclusive; pitches, 1¼ to 9¾ in.

making the anvil stationary the width of the frame has been reduced allowing work to be done in close quarters. The micrometers are made in six styles measuring from 1 to 6 in. in steps of 1 in., and from 25 to 150 mm. in steps of 25 mm.

Are Ambitious Young Men Really Wanted?

By H. Maplethorpe

In answer to Mr. Baker's query, page 602, vol. 46, which also applies to hundreds of other fellows, ambition is a measurable faculty and may be calculated by degrees. If a man possesses the right degree of ambition there should be no difficulty in getting the right job.

Of course, Mr. Baker knows as well as anybody else, that some men have ambition for big wages and others for notoriety only, irrespective of what it costs them, but the ambitious young man the employer is in need of is the steady plodder, the constant reader of technical journals and books, who's constant thought is upon hard work, solving problems and surmounting difficulties which have often been left undone by others. Such ambition usually shows itself as early as the "teens" and will receive acceleration at evening technical classes and in studying rules, formulas, short cuts, and costs in the shop. Such ambitious men are very few and far between, hence the constant call for them.

I may say for Mr. Baker's information it is not the ambitious young man who is willing to just make a start in night school, or to otherwise educate himself, that will secure the desired place, but rather the other man who is already educated and proved beyond doubt his capabilities and degree of ambition by thorough perseverance and hard work in competition with his fellow workmen.

In conclusion I would advise Mr. Baker not to give up but try again. Try and learn by others' failures, constant thought and constant reading and study; for patience and hard work will, in time, attract attention.

Is Democracy Safe from Itself?

By Entropy

In those days when the lines between the two political parties were more closely drawn than in the present day there were certain sections of the country, which were so closely matched that it was a foregone conclusion that if election day was fair and bright, one side would win, if it stormed the other was absolutely sure of victory. This certainty was so pronounced that certain fair-weather voters declared that it would be sacrilege for them to venture forth in a storm as it would upset the manifest designs of the Diety.

This is not only confined to politics. It applies equally well in every organization whether social, economic or political. The members voting are absolutely sure to be a much smaller number than those who have the right. We complain that labor unions do not represent their members because the most skilled of their members leave the direction of things to those with the smoothest tongues, but exactly the same things apply to organizations of employers and to every other organization.

Where democracy falls down is in its willingness to let things go as they may happen unless they are too bad to endure, and then to get up and turn the rascals out, and put in another set of near-rascals in their places.

In this method, the most complete of all democracies, we can all see every day instances of our own mistakes, and without giving them any consideration, we never hesitate to criticize our neighbor for the mistakes he makes. We are inclined to stay away from meetings where our voices should be heard, and then blame those who were there for not knowing what we wanted them to say.

This is particularly true of our disposition to cut each others throats in a business way. We have to some extent thrown away the old motto, "Caveat Emptor," but we are a long way from having the consideration for the other fellow who happens to be dependent on us, for the sale of his product, his services, or his accumulated savings, that we would appreciate from him. In other words we are tolerant of other direct competitors because we realize that they have it in their power to force us into costly rivalry, and yet are intolerant of others because they have not yet forced us to fight them.

It seems a pity that we cannot be appealed to through reason, or by a view of the opponent's forces, but we have to come to actual blows before we recognize the truth which someone else holds. If we are to derive the full possible benefits of democracy everyone must state his case fully and in such a way that it will be heard. Moreover, everyone must hear with an open mind. Everyone must be ready to live and let live. Because a man belongs to an organization, which has done something wrong, which has affected our pocketbooks, is no sign that the man is wrong. It merely means that the right view (our view, of course) has not been presented to him in logical and understandable language. He is not at fault for not understanding us. We are at fault for not expressing ourselves correctly, or possibly for entertaining wrong ideas.

Almost every great movement has had its beginning in the mouth of some fanatic. He saw a light, and his imagination added a great fire. He was ridiculed, derided and finally figuratively, if not literally, crucified. Others followed him with milder ideas, presented to a more kindly world, until finally a point was reached where the world and the bearers of the new truth could agree. If only everyone could be persuaded to take his part in every new movement, as he sees it, or in every retarding action, if he sees the need of that, we might clear the field in much less time than is required at present.

Much of what passes for democracy now is really autocracy. A man convinces a number of men that he is the one who can lead them to what they want. Once elevated to the post of leader he uses his power in the most autocratic way to retain his position. Why? Because history of all our organizations, from big to little, shows him that the chances are a long way in favor of his success. We are always in need of consistent leaders, but we need leaders with their ears to the ground, leaders who have been followers, and know how it feels, leaders who can drop the reins of government and not reel with the drunkenness of past power.

This applies equally to every form of organization, big and little, whose membership includes nonactive members. The solution is easy in theory, but it involves the making over of many of our American ideals of an easy life. It has been said that "Eternal Vigilance is the Price of Liberty" and that applies to all of us. If we want a true and safe democracy, every individual one of us must take his full part in every subject of discussion, great or small, and must realize, without being forced, that every other individual, and every other organization has a right to a full, fair and lucid explanation of his position, and that if agreement cannot be reached on a basis of reason that there is something wrong with the presentation of the case or else with the case itself.

Personals

Roy B. Woolley, formerly sales and advertising manager for the Standard Electric Stove Co., Toledo, Ohio, and late with the American Ambulance Field Service in France, has returned to this country and is now in the advertising department of the Society for Electrical Development, New York City.

J. F. Sells, of the engineering staff of the National X-Ray Reflector Co., has been appointed consulting illuminating engineer for the new business departments of the Henry L. Doherty Co. Mr. Sells is at present located at Mansfield, Ohio, where the Doherty Co. operates the Mansfield Electric Light and Power Co.

W. S. Watson, formerly connected with the sales department of the Bogue-Wensley Lead Co., Denver, Colo., has accepted a similar position with the Advanced Machinery and Supply Co. The latter concern is district representative for the Duryea Mfg. Co., Fisher Governor Co., Cling Surface Co., Yarnall-Waring Co., Nelson Valve Co., Flexible Steel Lacing Co., Richardson-Phenix Co., Betson Plastic Fire Brick Co., and the Peerless Alloy Co.

Obituary

William R. Griswold, mechanical engineer of the Standard Tool Co., Cleveland, Ohio, died Oct. 6, aged 49 years. Mr. Griswold had been with this company for the past 15 years. He was a frequent contributor to the "American Machinist" in past years under the name of W. R. Green. His early apprenticeship was served with the Warner & Swasey Co.

Business Items

The Holyoke Truck Co., 128 Race St., Holyoke, Mass., has just moved into a larger plant at the above address.

J. M. Betton has removed his office to Room 1308, 59 Pearl St., New York City. Mr. Betton deals in injector sand blasts, repair parts, helmets, nozzles, cleaning rooms, etc.

The Pacific Derrick and Hoist Co. is the new name of the Verbank Machinery Co., 3223 First Ave., S., Seattle, Wash. No change will be made in the personnel of the company or its line of business.

Trade Catalogs

Precision Lathe and Grinder. Ideal Machine and Tool Co., 128-130 Opera Place, Cincinnati, Ohio. Circular. Illustrated.

Brass Foundry Equipment. Whiting Foundry Equipment Co., Harvey, Ill. Catalog No. 128. Pp. 8; 6 x 9 in.; illustrated.

"The Holyoke" Transfer Truck. Holyoke Truck Co., 88 Sargent St., Holyoke, Mass. Bulletin A. M.-1. Pp. 4; 8½ x 11 in.; illustrated.

Precision Bench Lathes, Attachments, Drilling and Tapping Machines, etc. The Elgin Tool Works, Elgin, Ill. Catalog No. 5. Pp. 94; 6 x 9 in.; illustrated.

Portable Electric Drills, Grinders, Flexible Shaft Machines. R. G. Haskins, 541 West Washington Boulevard, Chicago, Ill. Catalog. Pp. 22; 6 x 9 in.; illustrated.

"Little Journeys of the Flint Shot Man" is the title of a pamphlet issued by the United States Silica Co., 122 South Michigan Ave., Chicago, Ill., which gives the experiences of sandblasting with flint shot in different plants.

New Publications

An Aneroid Calorimeter for Specific and Latent Heats—By Nathan S. Osborne, Associate Physicist, Bureau of Standards, Washington, D. C. Bulletin No. 301. Twenty-five pages; eight illustrations and tables. Price, 10c.

Hendricks' Commercial Register—Issued by the S. E. Hendricks Co., 2 West 13th St., New York City. Two thousand two hundred twenty-nine 7¼ x 10-in. pages. Price, $10.

This is the 26th annual edition (1917-18) of the well-known commercial register of the United States and is especially devoted to the interests of the architectural, contracting, electrical, engineering, hardware, iron, mechanical, mill, mining, quarrying, railroad, steel and kindred industries. It is a very complete list of producers, manufacturers, dealers and consumers connected with the industries mentioned. In addition to the main body of the work, and the list of trade names, a very important alphabetical section has been added covering in itself approximately 450 pages. The latter section will prove of immense value for reference purposes.

Handbook of Chemistry and Physics—Fifth edition, 390 4¼ x 6⅜-in. pages, plus a 20-page index. Issued by the Chemical Rubber Co., Cleveland, Ohio. Price, $2.

This is a very convenient little handbook that will fit the pocket; and it consists of a large number of tables, formulas, and receipts of use to chemists and physicists in general. These tables and other data have been gathered from various sources, and carefully checked from time to time, by members of the Department of Chemistry at the Case School of Applied Science. Additions have been made in each of the succeeding editions, and the present edition contains considerable valuable matter not included in former ones. The table of contents; the complete index; a bibliography of textbooks, manuals, and reference books on chemical subjects add greatly to the usefulness of the book.

Locomotive Handbook—Compiled and published by the American Locomotive Co., New York, 195 pages, 3½ x 6 in. Price, 75c.

This little handbook contains the latest available information on the various subjects which have to do with steam motive power, and, of course, such questions as drawbar pull and grade resistance are equally applicable in the case of electric power. It includes the burning of fuel oil, valve setting, bearing pressures, boiler capacity, classification of locomotives, counter-balancing, engine friction, air resistance, horsepower, Interstate Commerce Commission rules, pressure for forcing insistent rods, axles and crankpins, speed factors, tire shrinkage, track resistance, tractive power of both compound and simple engines, valve settings for articulated engines, the Stevenson link motion and the Walschart gear. It is a very complete book of reference in a handy form, and containing an exceptional amount of the kind of information needed by railway shop foremen and executives.

The Composition of Technical Papers. By Homer Andrew Watt. 420 5 x 7½-in. pages, plus 11 pages of index. Published by the McGraw-Hill Book Co., New York. Price, $1.50.

As the author says in his preface, this book is the result of a teaching experience of several years at the University of Wisconsin, and embodies the methods employed there in a one-semester, three-hour course elective for juniors and seniors in the College of Engineering. All the students taking this course had already taken the freshman English course, and some had taken other university courses in English composition. The book, however, has been written with regard to possible use in a first course in college English. It has one aim and only one—to teach engineering students to write better technical papers. The author proceeds to build up his subject in a logical manner, and a student or reader will gain much by a careful perusal of this book. Numerous examples of professional work in the way of articles written by well-known authors are given as guides in the handling of various subjects, and these articles perhaps more than anything else, if carefully studied, will give the reader or would-be writer an idea of how to handle a certain theme so as to make it clear to his audience, whether this audience is reached directly or through the pages of some journal. Altogether, the author's viewpoint is that of the teacher of English rather than that of the editor of a technical journal, and as such the book should have a greater sale among students who have in mind the composition of engineering papers and reports, than among those intending to make writing a profession.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

The fifth annual Pennsylvania Welfare and Efficiency Conference will be held in the hall of the House of Representatives, Harrisburg, Penn., Nov. 21 and 22. The topics to be discussed at the conference this year, while centering mainly about accident prevention and workmen's compensation, include also such important subjects as women in industry, Americanization, and industrial education. The arrangements for this conference are being made by the Department of Labor and Industry, Harrisburg, Penn., which, on request, will furnish programs and other information desired.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Grinding Stand

St. Louis Machine Tool Co., St. Louis, Mo.

"American Machinist," Nov. 1, 1917

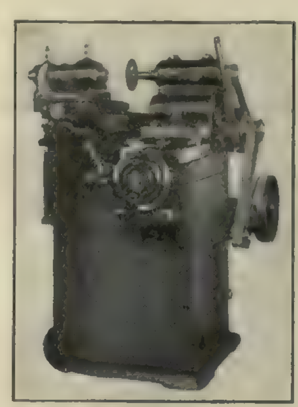
Made in a number of sizes Specifications for No. 7 machine are: Diameter of arbor in collars, $1\frac{3}{4}$ in.; diameter of arbor in bearings, $1\frac{1}{2}$ in.; length of arbor, 56 in.; distance between wheels, $45\frac{1}{2}$ in.; length of bearings, 14 in.; height to center of arbor, 38 in.; size of base, 23 x 24 in.; size of spindle pulley, $5\frac{1}{2}$ x $5\frac{1}{2}$ in.; weight, 700 lb.

Grinding Machine, Radial

Rivett Lathe & Grinder Co., Brighton, Boston, Mass.

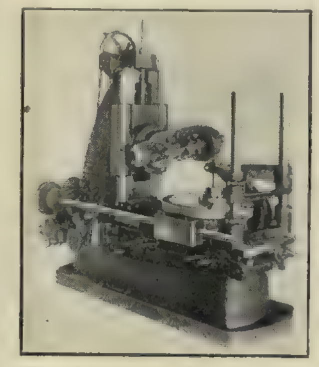
"American Machinist," Nov. 1, 1917

Swing over swivel post, $6\frac{1}{2}$ in.; maximum diameter, 10 in.; cross-slide movement, 4 in.; longitudinal travel of work-carrying head, 5 in.; cross-movement of work-carrying head, $4\frac{1}{2}$ in.; swivel of post each side of center, front, 60 deg., rear, 135 deg.; diameter of hole through spindle, $1\frac{5}{16}$ in.; maximum capacity of split chuck, 1 in.; speeds of oscillating post, 3; movement of grinding wheel bracket, 11 in. forward and 6 in. back of center line; speeds of large grinding wheel spindle, 3500, 6000 and 9000 r.p.m.; speeds of small grinding wheel spindle, 3; speeds of work spindle, 6



Gear Hobbing Machine

Goss Printing Press Co., Chicago, Ill.



"American Machinist," Nov. 1, 1917

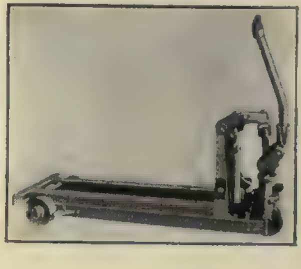
Rated diametral pitch capacity in cast iron or steel, $2\frac{1}{2}$; maximum pitch diameter without supports, 36 in.; with supports, 28 in.; maximum width of face, 12 in.; diameter of cutter arbor, $1\frac{1}{16}$ in.; diameter of work arbor, 2 in.; minimum distance between centers of work and cutter arbors, 2 in.; cone pulley speeds, 4; floor space, 48 x 72 in.; height, 71 in.; net weight, 4420 lb.

Truck, Elevating "Jacklift Master Type L"

Lewis Shepard Co., 48 Binford St., Boston, Mass.

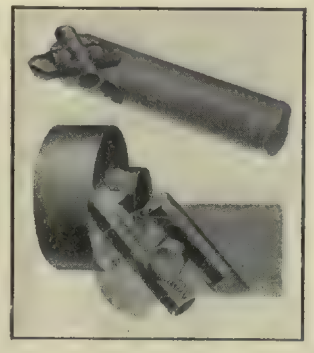
"American Machinist," Nov. 1, 1917

This is a lighter truck than previously manufactured by this company, but it incorporates the operating features of the heavier trucks, such as higher vertical lift and free lifting handle which permits the load to be elevated while the handle of the truck is turned to one side. This feature is claimed to permit operation in narrow aisles or other cramped or congested places. Six models are made. The lifting ratio is 40 to 1, which it is claimed allows the use of the truck by women or boys. The capacity is 2500 lb.



Tools, Inserted Cutter

Lovejoy Tool Co., Inc., Springfield, Vt.



"American Machinist," Nov. 1, 1917

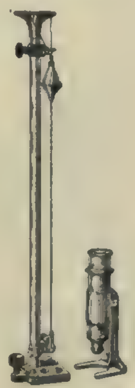
The cutter is in the form of a cylinder with one side flattened and toothed in a manner somewhat similar to a rack. When the tool has been adjusted to the proper position, a second toothed part is slipped into the holder engaging the teeth in the tool itself. A flat-sided taper pin is then driven into the holder, serving to secure the second toothed part, and consequently the tool itself in place. A number of sizes are made for boring or for lathe work

Hardness Tester "Waldo"

Palo Company, 90-94 Maiden Lane, New York City

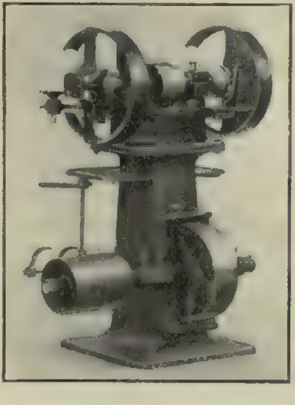
"American Machinist," Nov. 1, 1917

A portable machine for testing the hardness of metal that consists essentially of a plummet weighing $\frac{1}{10}$ lb., which is allowed to fall on the material being tested, a 60 deg. tempered point making an indentation on the work. The diameter of this circular indentation is measured with a small microscope, and from this measurement the hardness of the metal is determined. The base of the machine is fitted with levels and leveling screws



Grinding Stand

St. Louis Machine Tool Co., St. Louis, Mo.



"American Machinist," Nov. 1, 1917

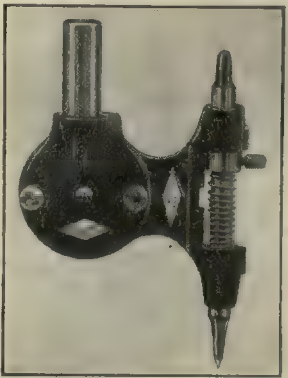
Made in a number of sizes. The following sizes are for the No. 6 self-contained grinding machine. Diameter of arbor in collars, $1\frac{1}{4}$ in.; diameter of arbor in bearings, $1\frac{1}{2}$ in.; length of arbor, 48 in.; distance between wheels, 38 in.; length of bearings, 6 in.; height from top of column casting to center of arbor, 11 in.; height to center of arbor, $41\frac{1}{2}$ in.; size of base of head, 10 x $19\frac{1}{2}$ in.; size of base of column, 18 x 25 in.; spindle pulley, 5 x 5 in.; weight, 550 lb.

Spoticator

Reliance Tool Co., Meriden, Conn.

"American Machinist," Nov. 1, 1917

The spoticator is intended to be attached to a milling machine for use in spotting holes, and in lining operations in connection with the jig, die or other like work. When used in this manner the instrument will spot holes on the work as accurately as the table of the milling machine can be moved by the screws. The plunger, or prick punch, is held in its upper position by a spring, but when set in proper position for spotting, it is pushed down against the work by the small knurled handle at the side, and tapped lightly with a hammer.



Patent Applied For

WEEKLY PRICE GUIDE O

IRON AND STEEL

The Government Schedule of steel prices, which went into effect Sept. 24, will have little effect on the general market for some time. Present warehouse stocks—bought at the old mill price—will probably be sold out before the present warehouse prices to ordinary consumers are reduced. The price of pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Nov. 9, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	....	$20.00
No. 2 Northern Foundry, Chicago	33.00	$33.60	26.00
*Bessemer, Pittsburgh	36.30	....	29.95
*Basic, Pittsburgh	33.00	36.30	25.95
No. 2X, Philadelphia	33.75	33.75	25.00
*No. 2, Valley	33.00	33.00	25.00
No. 2, Southern Cincinnati	35.00	....	22.90
Basic, Eastern Pennsylvania	45.00	45.00	26.00

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Nov. 9, 1917	One Month Ago	One Year Ago	Nov. 9, 1917	One Year Ago	Nov. 9, 1917	One Year Ago
Structural shapes	$5.25	$5.25	$3.50	$5.00	$3.60	$5.00	$3.35
Soft steel bars	5.00	5.00	3.50	4.50	3.60	4.50	3.35
Soft steel bar shapes	5.00	5.00	3.50	4.50	3.60	4.50	3.35
Plates, ¼ to 1 in. thick	10.00	10.00	4.25	7.00	4.10	7.00	4.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Nov. 9, 1917	One Year Ago
Pittsburgh, mill	$4.50–5.00	$2.75
Warehouse, New York	4.75	3.50
Warehouse, Cleveland	4.45	3.45
Warehouse, Chicago	4.50	3.35

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Nov. 9, 1917	One Month Ago	One Year Ago	Nov. 9, 1917	One Year Ago	Nov. 9, 1917	One Year Ago
*No. 28 black	5.00	9.00	10.50	4.50	6.75	3.90	8.50	4.10
*No. 26 black	4.90	8.90	10.40	4.40	6.65	3.80	8.40	4.00
*Nos. 22 and 24 black	4.85	8.85	10.35	4.35	6.60	3.75	8.35	3.95
Nos. 18 and 20 black	4.80	8.80	10.30	4.30	6.55	3.70	8.30	3.90
No. 16 blue annealed	4.45	8.20	10.20	4.45	6.20	3.95	8.20	4.00
No. 14 blue annealed	4.35	8.10	10.10	4.35	6.10	3.85	8.10	3.90
No. 12 blue annealed	4.30	8.05	10.05	4.30	6.05	3.80	8.05	3.85
No. 10 blue annealed	4.25	8.00	10.00	4.25	6.00	3.75	8.00	3.80
*No. 28 galvanized	6.25	10.50	12.00	6.50	8.25	5.50	9.50	5.60
*No. 26 galvanized	5.95	10.20	11.70	6.20	7.95	5.20	9.20	5.30
No. 24 galvanized	5.80	10.05	11.55	6.05	7.80	5.05	9.05	5.15

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Nov. 9, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Nov. 9, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	15.30	6.30
Chicago	14.00	5.75
Chicago	15.00	5.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Nov. 9, 1917	Cleveland Nov. 9, 1917	Chicago Nov. 9, 1917
Tire	5.00	5.00	4.50
Toe calk	5.70	5.50	4.75
Openhearth spring steel	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe; of July 2 for iron pipe:

	Steel			Iron	
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	37.9%	23.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	41.9%	26.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Nov. 9, 1917	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	35.00
Tin, in 5-ton lots	68.00	62.00	45.00
Lead	6.25	8.50	7.00
Spelter	7.88	8.50	12.50

*Government price.

ST. LOUIS

	Nov. 9, 1917	One Month Ago	One Year Ago
Lead	6.13	8.00	7.00
Spelter	7.63	8.25	12.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Nov. 9, 1917	One Month Ago	One Year Ago	Nov. 9, 1917	One Year Ago	Nov. 9, 1917	One Year Ago
Copper sheets, base	35.00–37.00	35.00	37.50	36.00	38.50	35–36	36.50
Copper wire (carload lots)	36.00	38.50	35.00	32.00	33.00	33.50	37.00
Brass pipe, base	41.00–43.00	43.00	47.50	42.00	46.00	42.00	46.00
Brass sheets	40.00	40.00	45.50	35.00	43.00	35.00	38.00
Solder ½ and ½ (case lots)	39.25	39.25	28.50	37.50	27.00	38.00	34.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Nov. 9, 1917	One Year Ago
Mill	$29.00	$42.00
New York	35.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

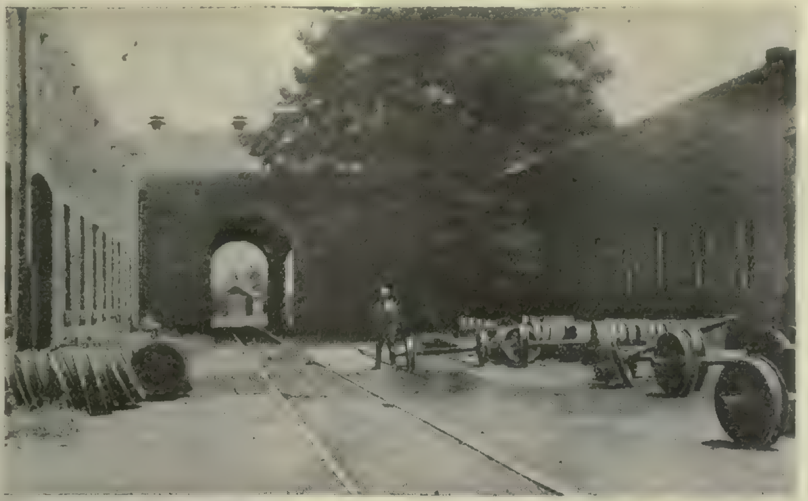
ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Nov. 9, 1917	One Year Ago	Nov. 9, 1917	One Year Ago
New York	20.00	18.00	20.50	19.00
Cleveland	21.00	16.75	21.25	17.50
Chicago	21.00	17.00	21.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Nov. 9, 1917	One Year Ago
New York	14.00	13.50
Cleveland	16.50	13.00
Chicago	16.00	13.50



Historic Railroad Shop in Nevada

By Frank A. Stanley

The author here gives a description of a pioneer railroad shop established in 1870 at Carson City. Many of the tools in this plant, although nearly a half-century old, are still in active use. Interesting comments are made by the author on the ingenious ways and means found here for accomplishing both usual and unusual jobs.

THE repair shop of the Virginia & Truckee R.R. at Carson City, Nev., is one of the most interesting machine plants in the Far West. It dates back to a period when railroad construction had not been carried out to any great extent in this section of the country, and the rolling stock that depended upon this plant for its upkeep was relied upon in the early days for the hauling of immense quantities of gold and silver bullion and ore from the numerous mines on the Comstock lode at Virginia City. Over the rails of this company was transported the output of what were at the time the most wonderful gold and silver mines of the world.

The United States mint was established in Carson City in 1868 shortly after the Comstock mines had become noted for their output of wealth, and the stories now heard of bullion and ore brought down over the 18 miles of track from Virginia to Carson City must seem unbelievable but for the authenticated record of the times referred to. In the sixties and seventies the operation of the mines were so extensive as to necessitate the running of 60 or 70 trains a day between the two cities. Today, a half-dozen trains take care of passenger and freight traffic, and out on the sage-brush desert south of Carson City, with the High Sierras for a background, stand long lines of disused ore-cars, which in former days were constantly in operation between the mines and Carson City.

The Virginia & Truckee shops are granite buildings consisting of two main structures erected parallel to one another and connected at the south end by the roundhouse, a 12-stall building that will be noticed at the center of the title illustration, with open archway through both walls of the building. The machine shop proper is at the right, and the foundry and coach shop at the left. The blacksmith and pattern shops are also housed in the two main buildings, but are not visible in the illustration. This view does show, however, a large number of wheels and axles in the yard between the shops, one department of the machine building being devoted to the overhauling of these units.

In this section of the state, there are comparatively few general jobbing shops and foundries, and necessarily the railroad plant with its diversified equipment is relied upon for a great variety of repair jobs, which in Eastern communities would be taken care of elsewhere than in an establishment devoted primarily to the upkeep of rolling stock. To this shop are sent automobiles, trucks, farm tractors, portable engines, sawmill machinery and a variety of other equipment that is repaired alongside of the locomotives and cars of the railroad company. The foundry likewise does a general business in the production of gray-iron and brass castings, and one of the most interesting features of this plant is its adaptability to the various purposes of a jobbing foundry, machine shop and forge shop.

Fig. 2 is presented at this point to illustrate the overhauling of a pleasure vehicle alongside the big standard locomotives. The car will be seen over a narrow-gage pit, for both standard- and narrow-gage rolling stock are regularly overhauled here. It will be observed that the locomotive pit is an exceedingly handy feature for the inspection and repair of automobiles as well.

The roundhouse, so called, although it is a rectangular shed with parallel tracks and pits, is of interest to the visitor, as here will be seen at any time along with the modern engines one or two examples of the old-time wood burners, whose funnel-topped stacks are equal in diameter almost to the boiler itself. One of these locomotives of early days is shown in the foreground of Fig. 3. In another part of the roundhouse a locomotive not quite so old as the wood burner was seen with smoke arch opened and with mechanics at work on the boiler shell. This locomotive also dates back quite a number of years, or to the period when brass-trimmed cylinders, steam chests, smoke-stacks and handrails were in vogue. A number of similar engines are still in service on this system.

A general view in the machine shop, showing something of the equipment, is reproduced in Fig. 4. The tools here illustrated were in the main installed when the plant was opened, about 1870, and are still employed regularly for the handling of all kinds of repair operations. They are very largely the product of the Sellers, Niles and Bement tool shops; although naturally of a construction now superseded by more recent designs of their builders, they are still kept regularly employed on a class of work that has not as yet become too heavy or too extensive to be readily taken care of with this equipment.

FIG. 2. A LOCOMOTIVE PIT IS HANDY FOR AN AUTOMOBILE

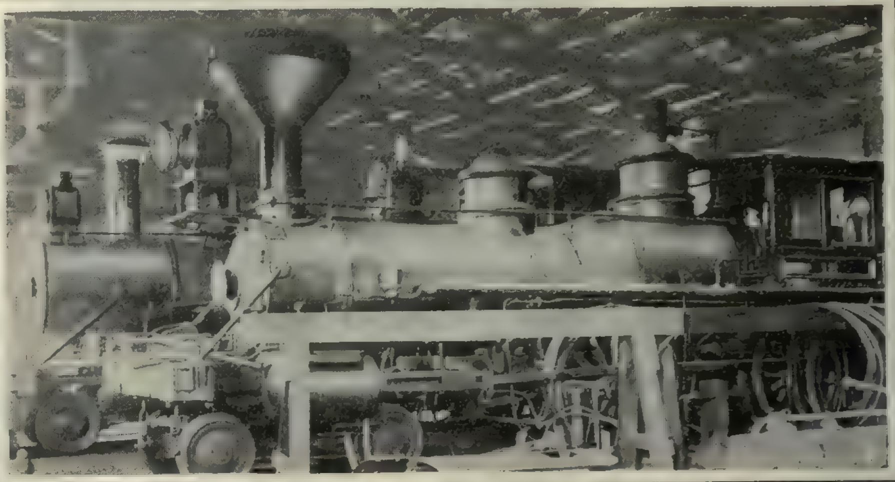


FIG. 3. ROUNDHOUSE WITH OLD WOOD BURNER IN FOREGROUND. THIS IS STILL IN SERVICE

In the way of special apparatus, there are a number of interesting examples, in connection with which Fig. 5 may here be referred to. This shows a special tool rack standing some 5 ft. in height, built up of steel angles in pyramid form. It has numerous projecting arms for holding socket and fork wrenches and other hand tools that are necessary in overhauling equipment on the pits. This tool rack holds several hundred wrenches and other articles, keeping them off the floor and in good condition for use.

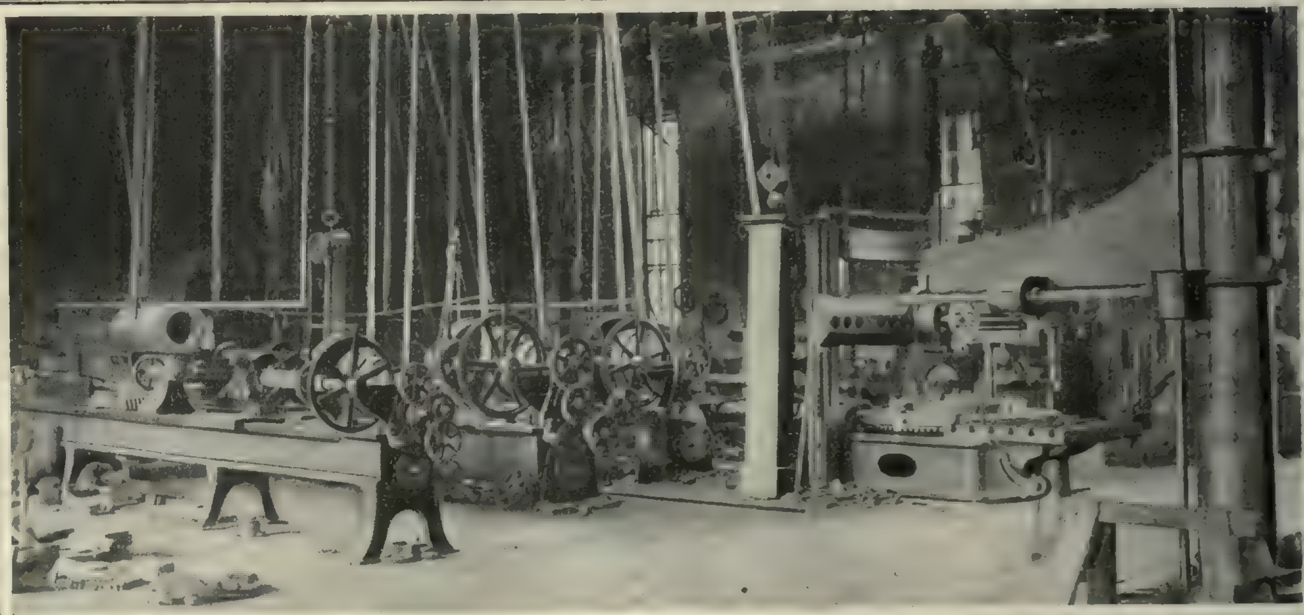


FIG. 4. THESE TOOLS WERE INSTALLED IN 1870 AND ARE STILL IN USE

Fig. 6 is a special machine for grinding the treads of wheels that are still on their axles. This machine is adapted to receive the axles between centers, and the work is rotated by a gear-driven head spindle that is actuated from a small pinion on the driving shaft at the left. The driving belt operates at high speed over a narrow-faced pulley about 2 ft. in diameter. The grinding wheels are approximately 16 in. in diameter by 2-in. face. Each is carried in a fork-shaped bracket that has a shank at the rear adapted to fit in a toolpost secured to a tool slide mounted upon a pedestal behind the centers. The slide for the wheel holder is adjusted to and from the work by crank handle and screw. Underneath this cross-slide, there is a lateral slide by which the wheel may be traversed to right and left. It permits angular adjustment in the horizontal plane, so that the tread of the wheel being ground may be finished to the desired taper or slope of bearing surface. Both wheels for grinding have, of course, independent adjustments and movements in all directions, so that each may be regulated and operated independently of the other.

Fig. 7 is an illustration of an open-air stock rack located between the two shops and adapted to hold bar material of all kinds and sizes. This rack is of skeleton construction and although the material is exposed to the weather, climatic conditions are such that there is little accumulation of moisture or rust, as would be the case in sections of the country where dampness universally prevails.

FIG. 5. SEVERAL HUNDRED WRENCHES

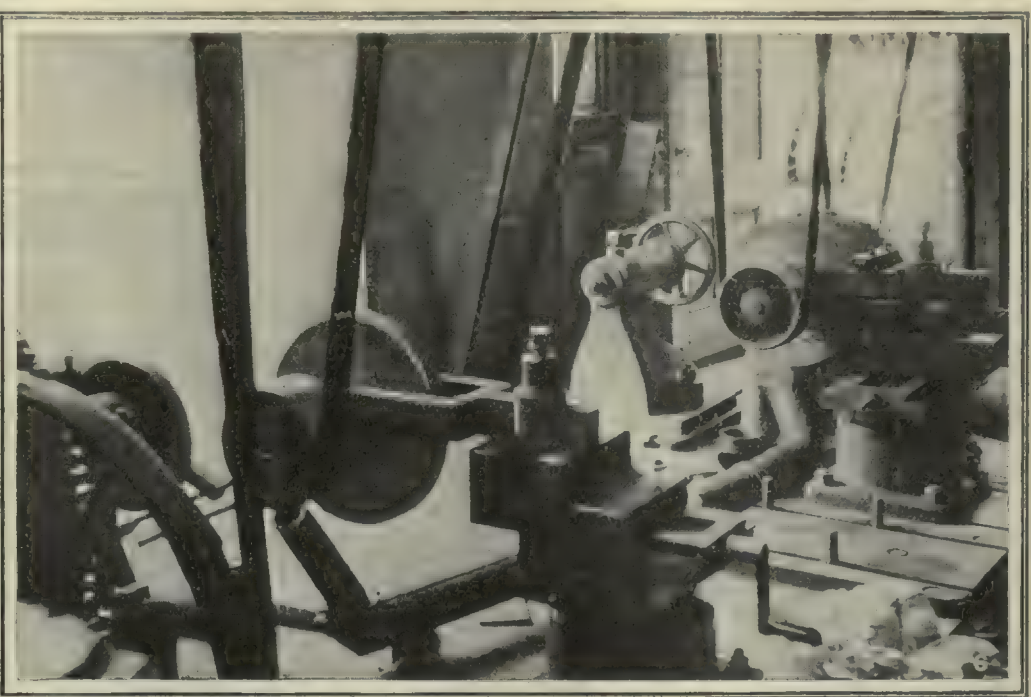


FIG. 6. SPECIAL MACHINE FOR GRINDING WHEEL TREADS

FIG. 7. ALTHOUGH EXPOSED TO THE WEATHER, THERE IS LITTLE TENDENCY TO RUST

FIG. 8. THE FOUNDRY PRODUCES A DIVERSITY OF CASTINGS

Fig. 8 shows the interior of the foundry with its big wood-framed jib crane near the center, while at the right is shown the cupolas for melting iron. The brass-melting apparatus is not included in this illustration. The flasks set up in the center of the floor are of the usual two-part form, made of wood with convenient projections for handling. The series of flasks shown are for molds for pouring long grate bars, which are a common product of this department. Like all jobbing foundries, a diversity of castings is made here, including pulleys of various kinds, gears, couplings, machine frames, drum heads and other items too numerous to detail.

While no illustrations are included to show the equipment and work of the forge shop, it may be stated that the department produces under its steam hammers and on its hand forges a variety of products as interesting as that turned out by the foundry.

Reference has already been made to the various kinds of outside repair jobs taken care of by the machine shop. A characteristic undertaking that should be of interest is the overhauling of farm tractors. Very often not only the shop proper but the foundry and the blacksmith shop are also called upon in the preparation of certain parts required to put the apparatus in condition for satisfactory service. One of these tractors will be seen under repair in Fig. 9, where it is represented standing outside the building, to be refitted with new parts and to receive a general overhauling.

Like various other Western railroads, this company has recently found it advantageous to adopt certain small-vehicle units for handling light traffic where it would be poor economy to utilize a standard train of locomotive and one or more cars. For this purpose a motor truck, or bus, has recently been added to the equipment. It is adapted to carry 25 or 30 passengers and is in appearance quite similar to the big motor busses used on many open highways. Fig. 10 is a view of the car taken in the coach shop. The general proportions are shown quite clearly. As will be seen, it differs chiefly from the usual road vehicle in its wheels and trucks, the wheels, of course, having the usual flanged form to conform to the rails, and the forward truck being of bogy type with a pilot of light construction.

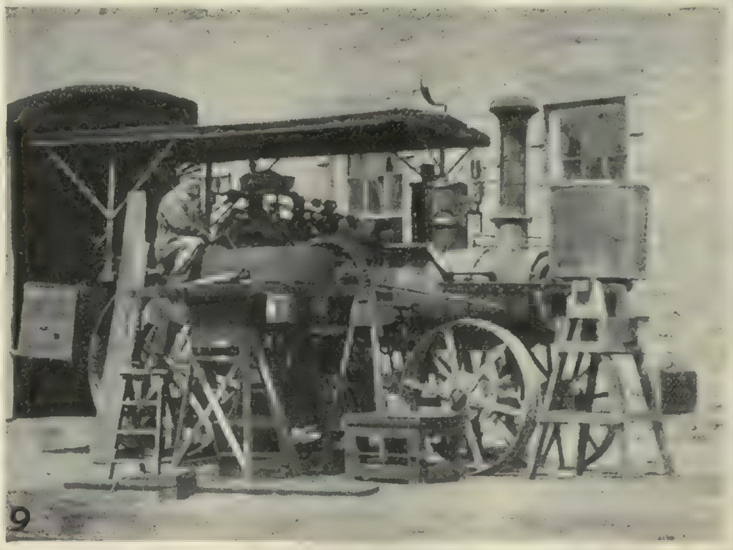


FIG. 9. FARM TRACTORS ARE FREQUENT VISITORS

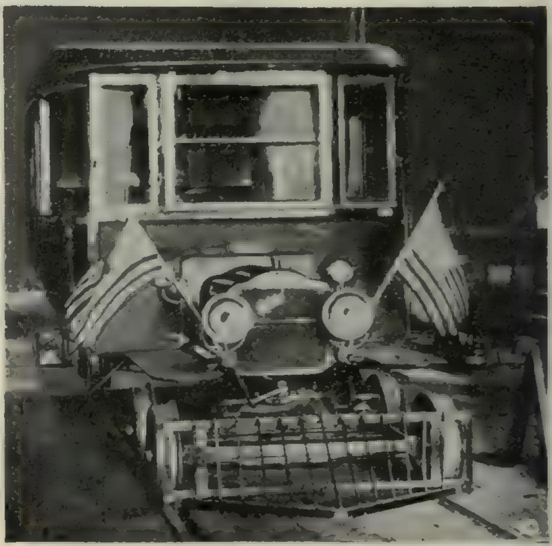


FIG. 10. SMALL VEHICLE UNITS ADOPTED

Appointing Agents for Belgium

BY URBAIN VAN WYMEERSCH

Readers of *American Machinist* will no doubt remember the discussion of the question as set forth on pages 256 and 257 regarding Belgian machine tool agents. George R. Woods points out that it is a great mistake to appoint Belgian agents. It seems to me the "native son," who is well understood and knows the field, the product he is selling, and has a general training in the machine tool line, is the best representative.

Mr. Woods says that the French government flatly turned down the proposal of an association of machine tool importers.

The French government would not trouble much about an organization of this kind, but one thing is certain, American and English dealers are represented in Europe, so why should a Belgian or French house place a large stock order and when this stock is sold perhaps not be able to secure an additional stock. Now the French government would not permit one dealer to buy from another one, for if so one must work for nothing, so under these circumstances the French or "native son" is unable to import machine tools.

Mr. Woods makes the further statement that Belgian agents before the war handled American machine tools, also German machine tools. There is not one machine dealer who imports only one kind of machine. A certain English dealer who before the war handled German, American and French machine tools now deals in English machine tools only.

Mr. Woods also asks whether any isolated "native son" machine tool house is going to be able to retain the technically trained machine tool men that an international house is obliged to have at its headquarters. Yes, there will be "native son" dealers able to get technical men at their headquarters, and who have a thorough training. Also, when a business man is represented in his own country he will be able to purchase stock advantageously.

The international house does not know where they want machine tools. With regard to this feature the "native son" knows every corner of the country; the machine shops, and finds out where they do business.

A machine tool could be sold by a "native son" before Mr. Woods could find out where it was wanted. After the war any "native son" house will have the advantage in selling machine tools in Belgium with the help of the government, or the Belgium shipping companies. The latter are now located in England ready for business.

I tell you that any "native son" salesman in trade in his country will be better at selling than any American salesman for the reason that some Flemish business men do not know a word of French.

Who then could sell the machine tools best, the American or the "native son"? Take Belgium in two parts, French and Flemish, then who would be the best salesman of the two. The one talking Flemish is the best for selling in the one part and the one speaking French in the other part. Belgium will give the profit to a "native son" before any American.

Reworking Electric Railway Truck Springs

BY J. V. HUNTER

The small railroad blacksmith repair shop receives considerable call these days to rework heavy truck springs, which usually, from faulty tempering when first made or from heavy overloading, have some of the leaves broken or all of the leaves permanently sprung out of form. These springs have seldom been thrown into the scrap in the past, and certainly to do so now would be the greatest folly, considering the present prices of material and the difficulty with which it may be obtained.

EVERY shop undoubtedly has its own methods of treating repair work on heavy truck springs, the larger shops using the greater amount of equipment and the smaller shops the less, but for any shop there are probably a few kinks and devices that others have that might be useful. The following description of some of these tools may show a few that others might find adaptable to their own needs.

The majority of railroad-car springs are made up with each individual set held together with an iron band; it is relatively seldom that these sets are drilled for a bolt to hold them together. Such drilling would manifestly tend to create a weakness in the center, with a greater chance for breakage at that point. Consequently, before any work of reforming can be undertaken upon the spring sets, these bands must be removed; but since they have been put on as a shrink fit, it is naturally to be expected that they will not slip off without forcing. The removal of the band is additionally complicated by the fact that all springs have "spring centers," which to the uninitiated can be explained as a small nub sticking out, possibly ⅛ in. in height, in the exact center of the convex side of the spring leaf. This center is made by driving in a large center punch or similar tool while the leaf is hot. As each teat so formed fits into the corresponding recess in the next leaf, the leaves are kept in place during the assembling operation; and also any one of them is prevented from working out, should the band not be tight.

These centers add somewhat to the difficulty of removing the bands, although it is obvious from the fact that they are shrunk on that they will not come off with ease; and any attempt to remove them cold is apt to cause breakage of the bands. The best practice for their removal is to heat the bands in a short, quick fire so that the band will come up to a red heat without the remainder of the spring becoming too hot for comfortable handling. The spring is then placed on a convenient anvil, as shown in Fig. 1, in a vertical position, with the bottom edge of the band resting on the upper corner of the anvil. A convenient tool for holding the spring in this position is shown at *X*. It fits down in the hardy hole and fairly tight around the band to prevent it from slipping from the anvil while this operation is being performed.

The blacksmith steadies the spring with one hand and with the other holds the flat-nosed chisel *C* on the first short leaf, while his helper strikes it with a sledge, driving it out and thus loosening all of the remaining leaves of the set.

Some time ago one shop had occasion to rework about a thousand sets of springs for light electric-railway trucks, the springs for which had been designed too light, so that they would not stand up in service. In order to stiffen the spring, it was decided to put in an additional leaf next to the master leaf. Practically every spring set was in first-class shape, so that if the band was removed without drawing the temper of any of the springs or otherwise injuring them, it would not be necessary to rework anything except the band, which would naturally have to be stretched. For this reason it was decided to remove the bands cold and run the risk of breaking a few of them.

In Fig. 2 is shown a special tool that was made for this purpose, so that a bull-dozer might be used for pressing off the bands. As can readily be seen, this tool has been very simply forged up from a piece of ⅝-in. stock, with vertical ears standing up on each side, so that the band is held on three sides. This device must be of sufficient length so that the spring may be pressed back through it until the shortest leaf is free of the band. The upper view of this illustration shows the spring as first placed in the tool device, while the lower view gives an idea of the manner in which it has been pressed free from the band. Of course, the center nub on the top leaf had to be crowded through the soft iron of the band in all cases. In some the banding operation had crowded the band pretty tightly between the leaves of the spring, making it a tight squeeze to get off many of the bands. To the credit of the method, however, it may be mentioned that the total breakage of bands in this operation, together with the subsequent ones amounted to approximately 2 per cent., certainly a remarkable record considering the severity of the treatment to which the bands were subjected. No spring leaves were broken.

MAKING NEW BANDS

In reworking miscellaneous lots of springs, many bands will be found to have broken in service. Or if not actually broken, cracks will be found in corners, which would probably develop into serious trouble during the rebanding operations. The next problem before the spring blacksmith will be to make up new bands to replace the broken ones. Spring bands must be made of wrought iron. Mild steel will not serve for this purpose, if any service is to be expected of the springs. Steel develops three main faults—greater trouble in getting a perfect weld; decided tendency toward cracking due to the sharp bends necessary for the corners; greater breakage in service, through the fatigue of the metal induced by vibration.

Good wrought iron, with its fibrous structure, is admirably suited for bands, as good corners can be formed without fear that faults will develop. After cutting to length, the next operation is that of scarfing one end for the weld. It will be noticed at *B*, Fig. 3, that only one end has been scarfed; to scarf the other as well is wasted labor.

The bending to U-form can be performed in a bulldozer die, as at *A*, Fig. 3, provided enough bands of a certain size are to be made to warrant the production of a cheap die of this type. From this stage the final bending, as at *B*, is performed on a "pull-around" stake. When only a limited number of the bands is required, all of these bends can be made on the same stake.

Few shops will have so many bands to make up that they will be repaid for the expense of making special hammer dies for this purpose. Their usual plan will be to weld the band over the heaviest mandrel that will readily pass through it. Afterward it will be "edged up" with the hand hammer or flatter and sledge.

The special hammer dies shown in the lower portion of Fig. 3 are for use in shops where a great many bands are regularly made up. The outline drawings *C* and *C′* show respectively the front and side views of these hammer dies, those for the upper and lower die blocks being shown together. The actual welding operation is performed upon the side horn *M*. The welding is also shown in perspective at *D*. Here a band is in the welding position upon the horn, and it will be noticed that the slanting face of the upper die will strike the scarfed weld an almost full blow as it descends. Sometimes the upper die has this face recessed so that it can only strike the iron until a certain specified thickness is obtained at this point. Naturally striking a hot weld in this manner spreads the metal, so the edging-up operation is shown being performed between the flat faces of the dies at the left. When there are good devices in the shop for squeezing the band smaller at the same time that it is put on the spring, as will be explained later, no great care is necessary toward welding up the band to an exact size. Indeed, sometimes the work is so roughly performed that the welded band will appear anything except square, and yet the final operations when the spring is finished will cause it to perform its functions perfectly.

Before starting the actual work of reforming the leaves of the spring, they should be cleaned to remove all the old scales of rust, if they have been long in use. This can be done either by scraping or by using the sandblast when that is available. Many people, among them blacksmiths, do not realize that an otherwise good spring will not be nearly so easy riding if it has not been well lubricated and if the spaces between the leaves have filled up with heavy rust, binding the leaves into a compact mass. The breakage of all types of springs is much greater when, after long service, the lubrication originally between the leaves has disappeared and rust has formed heavily. Automobile owners have begun to realize the need of spring lubrication, as evidenced by the increasing number of devices on the market for forcing oil between the leaves of springs.

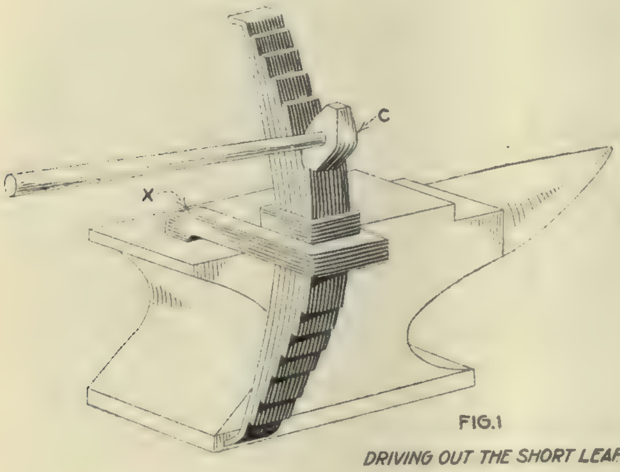
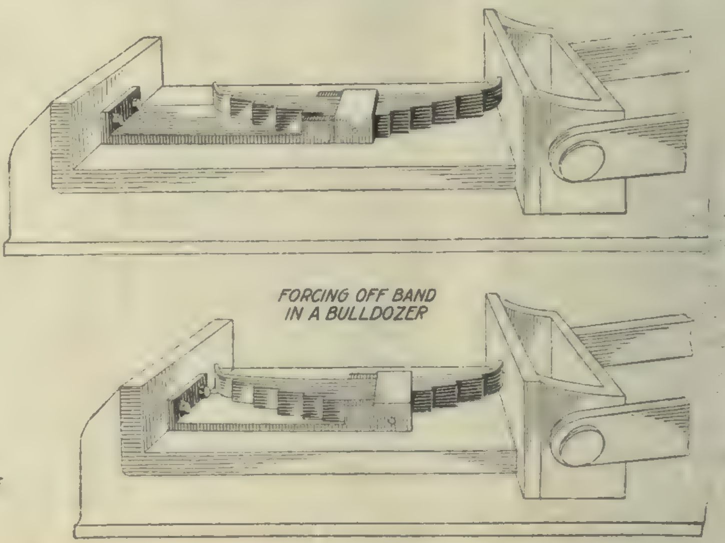


FIG.1
DRIVING OUT THE SHORT LEAF



FORCING OFF BAND IN A BULLDOZER

FIG.2

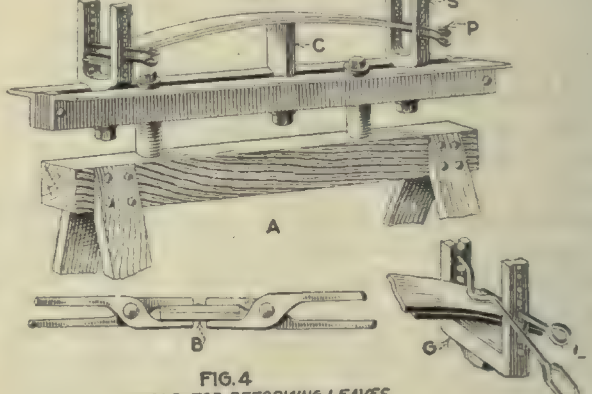


FIG.4
TOOLS FOR REFORMING LEAVES

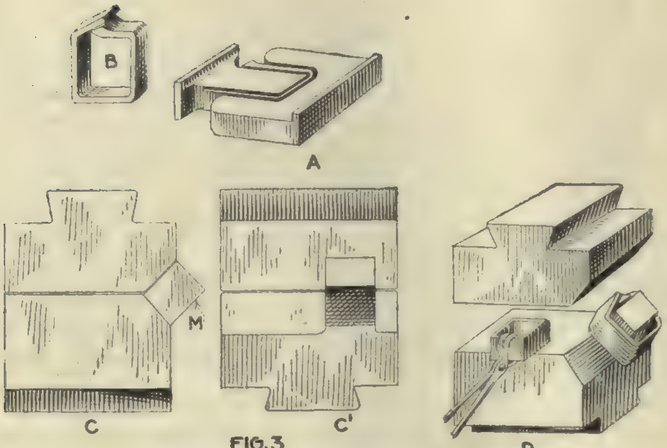


FIG.3
TOOLS FOR MAKING NEW BANDS

FIGS. 1 TO 4. VARIOUS OPERATIONS ON RAILWAY-TRUCK SPRINGS

For the small- or even medium-sized repair shop, it will be needless to consider any of the large manufactured spring-forming machines that are found in spring-manufacturing establishments. Such devices as the smith-shop foreman can rig up in his own shop and make with little outside help, will prove suitable for the average jobbing repair work. One of the simplest forms, and a remarkably good one for leaf forming in small quantities, is shown in Fig. 4 at *A*, all parts for which can be easily produced in any forge shop.

The frame for this device is made up of two angles, riveted together with spacers between. It is mounted upon a wooden trestle to give a convenient height. The two end stakes *S* and the center stake *C* are adjustable by loosening the clamping nuts at the bottom so that they will accommodate any length of leaf. As shown, there are two leaves lying in the device. The lower of these is the cold "master" leaf; the upper is the hot leaf, which is to be conformed to the radius of the master.

In operation, after the lower and upper leaves have been laid in the stakes in the general position shown, the upper and lower pins *P* are placed, one above and one below the leaves, as close to them as the holes in the stake will permit; this is at one end only. To force the hot leaf down to the master leaf at the other end, the arrangement shown at *G* is used. This is a light rod lever *L*, which will fit in the stake holes and has a small crook in it to press against the hot leaf. By forcing this leaf down with *L* in the manner shown, the pins at this end can be inserted to correspond to those at the opposite end.

To squeeze the hot leaf down and insure that it shall come in contact and conform to the master at all points, a rather peculiar method of forming is adopted, as illustrated at *B*. Two straight flat-nosed tongs are used. One is handled by the smith from one side of the frame and his helper squeezes with the other from the opposite side, taking care that the tongs are always working practically opposite to one another. In this manner the workmen quickly pass the full length of the leaf and it is then ready for removal to the quenching tank Of course, this is not a particularly quick operation for even the most rapid of workmen, and frequently the leaves need more attention later in the setting-up operations than do the roll-formed leaves; but, as explained, this is a very simple form of device to make up.

A Leaf-Forming Machine

As the amount of work going through the spring shop increases, the ambitious foreman will not be content with so simple a rigging for shaping the leaves. Then the device illustrated in Fig. 5 is to be recommended. It has been successfully used for a number of years in some of the large spring-repair shops. About a year ago we made up a set of patterns for building one for our present shops, and I feel safe in saying that it has halved the previous cost of spring-repair work.

The operation is as follows: A master leaf is first made up, from which all main or base leaves are to be shaped. These leaves will, of course, be shaped from the master; and after that, all successive leaves will be shaped from the preceding leaf, as is done in all practice, so that each leaf is naturally the master of the one that follows it. When each hot leaf is removed from the furnace, it is laid upon its cold master. The smith, holding each end of the pair with a light pair of tongs, inserts them in the rolls. To do so, he presses upon the foot lever *L*, Fig. 5, thus drawing down upon the rod *R*. This rod is directly connected with the sliding bracket that carries the lower roll *O* and so pulls it down far enough to permit the two leaves to be inserted between the leaves. Immediately he releases the lever, the spring *S* puts sufficient tension upon the leaves in accordance with its adjustment for the work, which has been taken care of by the adjusting screws *C*.

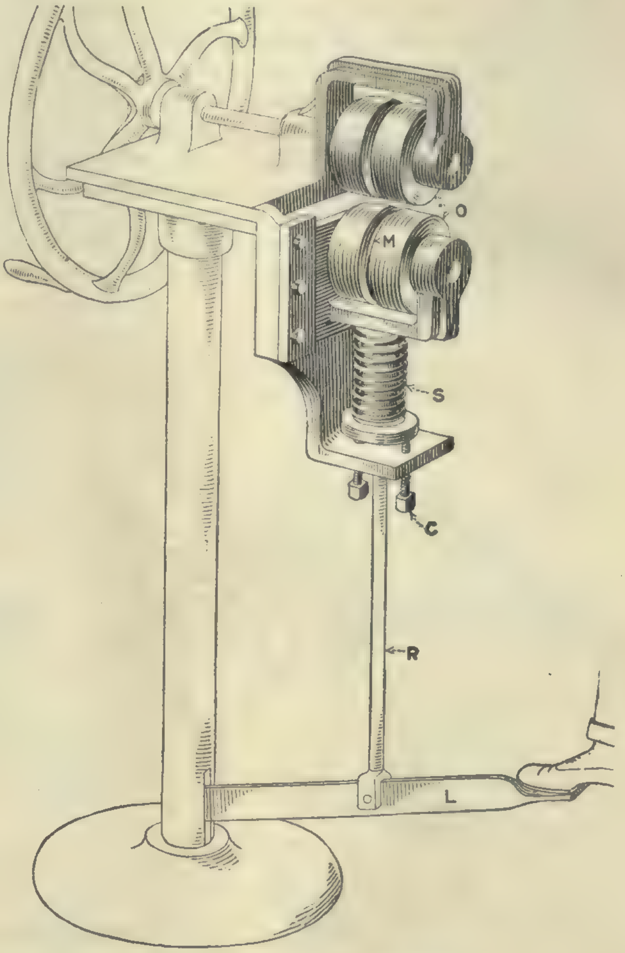


FIG. 5. LEAF SHAPING MACHINE

The position of the work is now as is illustrated in Fig. 6. The smith's helper, from the farther side of the machine, by the handwheel, quickly revolves the rolls back and forth several times, so that the leaves feed from one end to the other. During this time the smith continues to hold the work with his tongs in the manner shown, except as it may be necessary to release one end at a time to permit the rolls to come to the end of the leaf. The action of the rolls presses the hot leaf firmly at every point to the cold master, so that the set produced is an almost perfect fit. The grooves *M*, Fig. 5, will be noticed around the centers of each roll. They are about ½ in. wide by ¼ in. deep and are for the purpose of passing the spring centers without rolling them flat. The leaves are removed from the rolls by pressing the lever, just as they were entered.

The smith now puts the necessary "gather" into the hot leaf. This is so quick an operation that it will escape any but the trained eye of a spring expert. Watch your spring man. If he knows his business, you may think that he is merely knocking off a little hot scale; but not so, it is the gather he is making. To do this, still holding the two leaves together just as they came out of the rolls or from the other forming jig, he strikes them flatwise upon some solid object, so that it strikes a smart blow in the center of the concave side of the cold spring. The result of this blow is that it puts a momentary additional spring into the cold leaf. As the hot leaf is held to it by the tongs at each end, it naturally is sprung too, to the same amount. However, being hot, it does not spring back to its former curve, but takes on a little additional curve corresponding to the weight of the blow. This is the trick that gives the gather to each successive spring leaf.

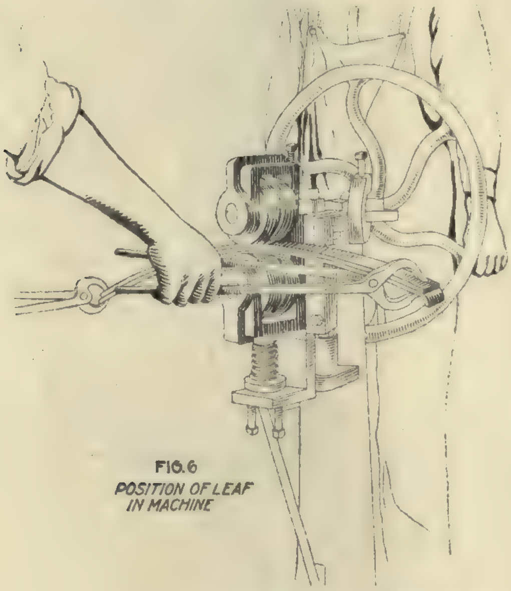


FIG.6
POSITION OF LEAF IN MACHINE

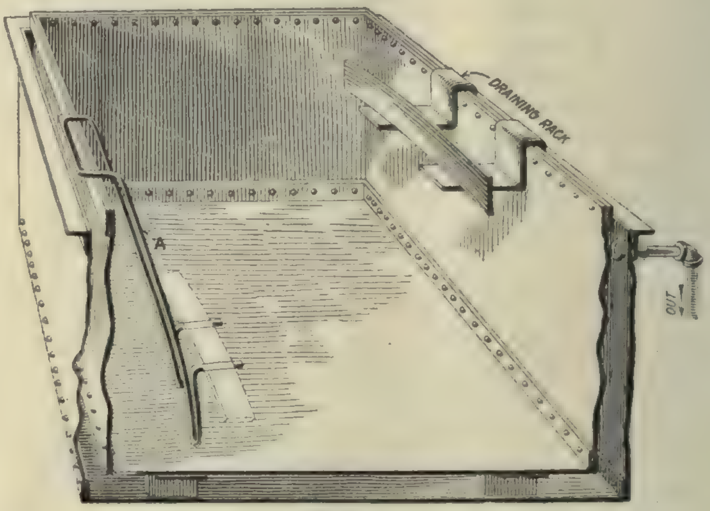


FIG.7
QUENCHING TANK AND LEAF HOLDER

FIGS. 6 AND 7. METHOD OF FORMING AND QUENCHING SPRING LEAVES

The spring leaf is now ready for immediate quenching. More than three-quarters of the spring makers do this in an oil bath. A few others quench by various water-cooling systems; but the latter usually require greater technical skill to insure as high a grade of spring, and without the most careful supervision they are hardly suitable for any shop. For oil hardening, cotton-seed or fish oils were the most common mediums employed in the past; these have been largely displaced by the various mineral or "mineralized" hardening oils now on the market, which are usually not only cheaper in first cost, but have a longer life as well and give more uniform results.

In any ordinary oil-quenching bath the volume of oil is not sufficient to keep on indefinitely, absorbing heat from the hot springs unless some means are provided for cooling the oil. Many shops have an oil tank with a volume of not more than a couple of barrels. Some of these small tanks are cooled by coils of pipe through which cold water is kept flowing. Another arrangement for cooling is shown in section in Fig. 7. In this case the oil tank is placed at one end of a large water-quenching tank, which is of sufficient size so that there is a complete circulation of water around all sides of the oil tank, thus insuring cooling by its relatively large radiating space.

The small device shown at *A* in this illustration is a shop kink worth having. It is a simple little frame quickly forged out of a piece of ½-in. round stock. When the smith is ready to immerse the spring leaf in the oil for quenching, he grasps this frame by its looped top and draws it up out of the oil. On the two prongs projecting outward he lays the hot leaf, in the position shown by the dotted lines, then immediately lowers all back into the oil again, the top remaining hanging from the side of the tank.

This frame is very convenient for withdrawing the quenched leaves from the oil. As it will hold from eight to ten at a time, the cold one need not be removed every time a hot one is laid on it. Its other purpose is even more important and bears mentioning. The coils of pipe carrying the cooling water through the oil may leak a little, or for an arrangement as shown in the illustration water may be accidentally splashed over into the oil. In either case a large or a small amount of water would eventually collect in the bottom of the tank; and if the hot steel were lowered to the bottom so that any portion came in contact with the water, the effect would be most disastrous to the even tempering of the spring. This frame holds the work far enough from the bottom so that long before the water can reach that point, its presence should be detected, and it can be siphoned off.

A smith usually handles the reworking of springs in sets of from 10 to 30, and all of one size of leaf are finished before the next is started. The frame just described will handle about 10 leaves. If there are more, he will need more frames or else will have to remove some of the cool leaves from the bath to make room. As soon as all of one size of leaf are finished, the final work of tempering these leaves begins. In nine out of ten shops this is done by "blazing off the oil." The tenth shop either does not temper at all, and hence has an inferior spring, or it has a heated bath of oil of known temperature, in which the leaves can be placed.

Blazing off the oil is the simplest method and one that will insure fair uniformity. It depends upon the well-known principle that nearly all tempering oils will flash at approximately the same temperature, which is close to the proper tempering heat for spring steel. To be sure, there will be some variation at this point, depending upon the nature of the oil; for instance, whether it is a mineral or an animal oil, the latter usually having a rather higher flashing temperature, although the extreme variation will probably not be more than 50 deg.

To blaze, the smith's helper places a leaf or two at a time in the furnace, turning each leaf over every few seconds so that it will be as uniformly heated as possible. He continues the heating until the flash point of the oil in which it has been quenched is reached. At this point the oil remaining upon the leaf begins to smoke and blaze and within a few seconds will have practically disappeared. The steel is then at just the right temper; and before the temperature can go any farther, the helper quickly removes the leaf from the furnace and hands it to the smith.

The smith now proceeds to put the "fit" into the leaf, which has probably warped a little during the hardening, so that its ends do not have a good bearing upon the leaf upon which it was rolled and consequently will not support their share of the load that will come upon the spring. To detect this warping, the leaf is laid on top of its master, exactly central, the two stood on edge and their centers clamped firmly together by a pair of tongs, as illustrated in Fig. 8, which shows a smith inspecting the leaves to see whether any space will show between the leaves at any point, denoting an improper fit.

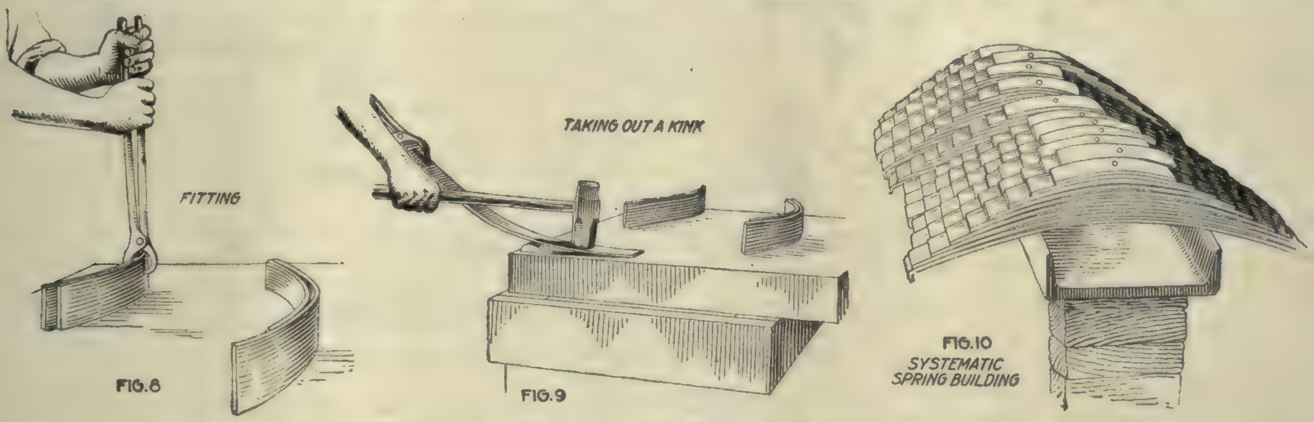


FIG. 8

FIG. 9

FIG. 10

FIGS. 8 TO 10. VARIOUS HANDLING METHODS

When an end is found to be sprung, he holds the spring on the fitting plate in the position shown in Fig. 9 and strikes its face a smart blow with a heavy hand hammer. Since the leaf is resting against the small block below it, more or less of a bend can thus be put into it. In this connection it must be mentioned that the leaf is still approximately at the tempering temperature, else it could not be treated in this manner without fear of snapping the steel. To get a perfect fit, the smith may have to work it back and forth a number of times between the two positions just shown, and finally turn it over and inspect the other side in the same manner.

It has been mentioned that the springs are worked through in sets of 10 or more. This is necessitated by the fitting operation, because every successive leaf must be kept on the leaf to which it was rolled or fitted, else a poorly constructed spring would result. The way that a smith will follow this system through is illustrated in Fig. 10, which shows the sets piled up before banding. In following this system he has first rolled up the main leaves all from one master leaf, the leaves after tempering having been laid side by side as a foundation for the piles to be built upon them. In starting to roll up the next leaves, he picks up the main leaves one at a time to roll upon, sometimes numbering them and the successive leaves with a piece of chalk so that there will be no chance for mixing. The following leaves, after tempering, have been piled back on the leaves upon which they were fitted.

There is another interesting point in this illustration. As the leaves are loosely piled without a band or clamp, it will be seen that, although resting upon each end, there is more or less space showing between each one and the one above; this space is the gather, of which we have previously spoken. Between the first two or three leaves the gather appears to be about the same amount; but farther down the scale it gradually disappears, until between the shortest leaves there is none at all. This is exactly as it should be in the best spring-building practice. This gather is not so great but that it will easily take up with the clamping of a light pair of tongs when the smith is fitting the pieces. It insures that, when the spring is finally built up and banded, the pressure of the band will not cause some of the ends to curl away and fail to carry their share of the load properly. Also, a shorter leaf will manifestly be stronger and stiffer for that very reason. If the small amount of gather should make it carry any greater part of the load, it will be amply strong to sustain it. This is one particular point that must be taken care of in any proper shop, because there are probably very few office-trained draftsmen who are acquainted with this fact.

In working through a large lot of old springs, the loss due to the breakage of leaves is made up the last thing, when the number of each size that will be required has been ascertained. Many shops prefer not to make up this loss at all, claiming that it does not pay to mix new steel with the old; but I have not found this to be a fact, because a carefully reworked spring may last the lifetime of a truck, and certainly one or two leaves of new steel that may have been put into it will not have been wasted.

Practically all spring leaves made today have tapered ends. In the manufacturing shops and the largest of the repair shops the production of these tapered ends is very simply accomplished by passing the parts through a taper-rolling machine. Most of our repair shops are not so equipped; and for the small output required, satisfactory results can be acquired by drawing down the tapers under a spring, trip or steam hammer.

Few springs made today outside of the automobile industry have rounded ends on these leaves, as this just adds one more item to the expense of manufacture. However, in reworking some of the old springs these may be found with rounded ends. The combination hot cutter, to fit in the hardy hole of the anvil for handwork, will serve admirably for cutting a round end. To get nice work, the shop should be equipped with one for each width of steel. This cutter is illustrated in Fig. 11.

The new leaves will also require punching of their centers. This can be accomplished when they are hot, by means of the little punching rig shown in Fig. 12. This is another case where one should be provided for each width of steel, since the guide hole in the upper portion is spaced to come in the center. A recess is drilled immediately below it and rounded out to the same shape as the end of the punch.

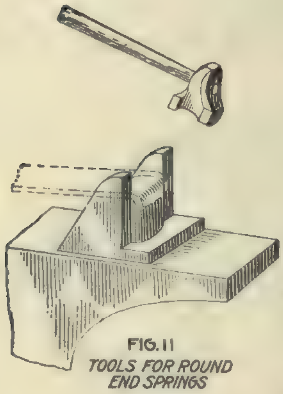


FIG. 11 TOOLS FOR ROUND END SPRINGS

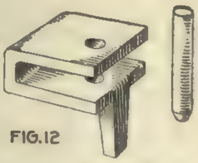


FIG. 12 PUNCHING FIXTURE

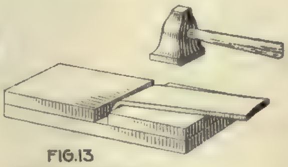


FIG. 13 GIB FORMING BLOCK

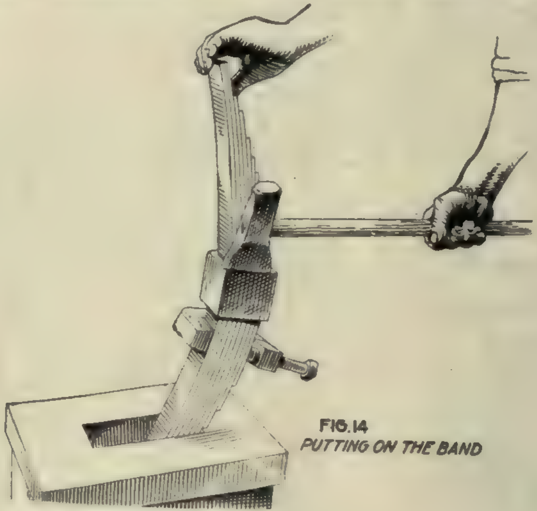


FIG. 14 PUTTING ON THE BAND

FIGS. 11 TO 14. A NUMBER OF DIFFERENT TOOLS

Many of the light springs were formerly made with a rolled eye on the end. This was formed in an eye-bending tool of one kind or another, and they had to be made up in pairs with the inner eye rolled up just large enough to pass a bolt that bound all together. The outer leaf only had its eye half-formed at the start. In many cases its ends had to be reheated during the assembling. With the hammer they were quickly worked around the inner leaf.

The round eye on the main leaf has given place to the gibbed end that fits into a small casting or forging now used to bind all sections together. This short gib is easily formed by hand with a grooved block, as shown in Fig. 13. In this case the end is heated and inserted in the groove, bent over and then flattened down square by a sledge and flatter.

When all the sets of springs have been made ready for banding, the smith's helper takes one set at a time and, starting with the main leaf, gives it a brush coat of a heavy viscous oil. Such an oil as common pinion grease is the best; otherwise, a heavy cylinder oil will do. This treatment is repeated with each leaf. It is the intention to have the oil remain between the leaves of the spring during service and have it act as a spring lubricant. It aids greatly toward making a spring more easy riding and probably prolongs the life of the spring somewhat by preventing the formation of heavy crusts of rust at this point, which tends to bind the leaves together. As the leaves are piled together, the blacksmith lines each one up with the preceding, carefully putting the centers above one another, so that they will not interfere in clamping up.

The smith now uses two C-shaped screw clamps. The largest is placed exactly in the center of the spring and drawn up, taking up the gather and holding all pieces firmly together. Sometimes he places a chalk mark on each side of the center at the distance of one-half of the width of the band, as a guide for slipping on the band.

The second clamp is placed just below one of the chalk marks; and after it has been drawn tight, the first clamp is removed. The set is then ready for the banding operation.

Before the band is finally heated for this last operation, it should be stretched over a mandrel, under a hammer, until it is somewhat larger than the completed size of the spring, say, in this case, almost $\frac{1}{8}$ in. This will make it very much easier to drive into place, and its increased size will be worked small again by the upsetting methods of the banding operation.

The spring is then placed in an upright position against any convenient support, as is shown in Fig. 14, and the band, which has been heated to a bright red heat, is slipped down over the upper end and worked down into place by the smith and his helper, who use a narrow-set hammer and sledge. In most shops the spring with its hot band is immediately placed in some clamping device, where heavy pressure may be exerted against the top and bottom of the hot band (the clamp being then removed if it is in the way). With the flatter and sledge the loose stock of the band is upset and worked down tight to the leaves, first on one side and then, the spring having been turned over, on the opposite side. This operation takes up any oversize of the band sufficiently so that the final shrinking of the band upon cooling puts as much stress upon it as it should be called upon to withstand.

While this is the general method of upsetting the band and the purpose for which it is done, there are any number of kinks and different methods of handling this work in the shops, a few of which may be useful to someone. The simplest that I have seen is the case where the smith places the band under a heavy steam hammer and uses its weight for the top and bottom pressure, working the band in by striking sidewise against the sides of the spring. That is a makeshift method, and little reliance can be placed upon its success, because of the chance for poor flatter work.

UPSETTING WITH POWER HAMMER

In Fig. 15 is another hammer method using two V-blocks, one inverted over the other. This will strike the band on all four sides at once and force the band to upset properly; but in this case three men will probably be required to handle the job, and it ties up a costly tool for a little piece of work.

The clamping jig illustrated in Fig. 16 is a simple and useful tool for all classes of spring work. The faceplate can be used for all of the previous operations that require a plate, and the clamping arrangement on the end is just the thing for handling the upsetting of the bands carefully and quickly. As can be readily seen, this jig consists of a large cast-iron frame, big enough for either large or small sets of springs, for which it can be arranged by changing the spacing blocks. The pressure on the band is exerted by an off-center cam that is forged on the end of a long lever. As little distance need be traveled in the "squeeze," the wedging pressure obtained in this way can be as great as is desired. The back or bottom of the jaw affords a firm base for the flatter and hammer work that is done upon the band.

Similar results can be accomplished in a shop that has an available bull-dozer or forging press that can be conveniently stopped at the end of its stroke. Although I have never seen it done, it would seem as if V-blocks could be so arranged that handwork on the band could be avoided, as in the method mentioned under the steam hammer.

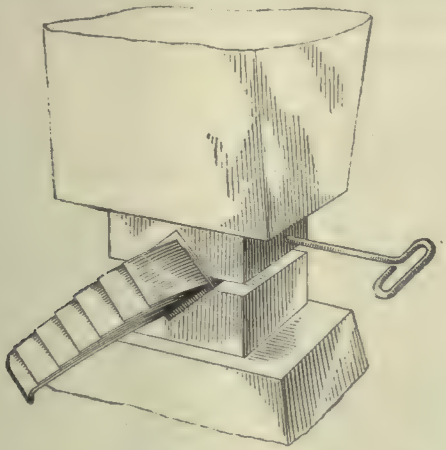


FIG. 15. UPSETTING HAMMER DIES

As soon as the upsetting of the band is accomplished, the spring is immediately placed in a water bath, to quench the hot band and so prevent it from drawing any of the temper from the spring leaves. The question has frequently been raised as to whether the hot band does draw the temper to any extent from the outside leaves, and I feel safe in answering in the negative. This can be judged by anyone, for it will be seen that if the work is done quickly the heat of the band will just start a slight smoking of the oil that has been smeared on the leaves, indicating a relatively low heat, whereas during the tempering operation it was actually burned from the leaves, requiring a much greater degree of heat.

A great many operations have been enumerated in rehandling these old sets of springs, but on a daywork basis and equipping the smith with the proper tools, a good man will handle about 10 sets of springs per day, of about the size and type shown in the illustrations. In this case each set contains nine leaves. This estimate covers all the operations from the start to the finish, but will not allow for the forging of any new bands or spring leaves, should these be necessary; but all other work will, or should be, of an excellent grade in that amount of time, for a 10-hour day.

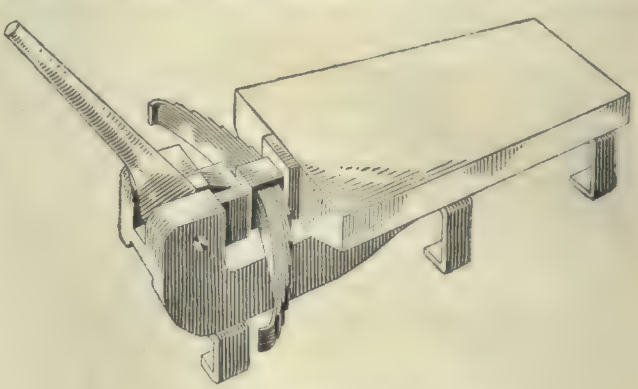


FIG. 16. AN UPSETTING FIXTURE

The larger spring-manufacturing and the largest repair shops have many short-cuts not available to the average railway repair shop. Among these are such items as the forging of the bands and the banding operations. For these operations some have used a regular forging machine. It is arranged with dies that permit the band to be welded right on the spring, making that and the banding operation all one.

A Countershaft Drive Problem

BY H. MAPLETHORPE

On page 484, Vol. 46, what Mr. Martindale complains of is a very common occurrence with the leather belts manufactured these days. In fact, I have had to adopt balata belts in preference to leather, although, I much prefer the leather for several reasons.

The real cause of leather belts jumping to the next cone pulley step, and in some cases twisting over is entirely due to the fact that some section of the belt is stretched more on one side than on the other. This is due to the fact that the strip of leather composing the belt has been cut too low down the side of the hide. The very best belts are always cut out of the center of the back of the hide as this part usually yields a leather about $\frac{3}{16}$ in. to $\frac{1}{4}$ in. thick, and the further you get from the center of the back, the thinner the leather obtained; hence, inferior quality and strength; the thinnest side stretching most. I do not consider that moving the countershaft from one position to the other would remedy the trouble.

Making Oil-Well Tools in California

SPECIAL CORRESPONDENCE

One of the important industries in the Pacific Coast states is the production of tools and equipment for use in the oil fields, where many unusual problems are encountered. Some operations in the making of tools of this character are here described.

WHEN one takes into consideration the millions of barrels of petroleum produced annually in California and knows something of the numbers of new wells being sunk year by year, it is quite easy to understand why the manufacture of oil-well tools is one of the important industries up and down the Pacific Coast. Such tools are peculiar to the industry in which they are employed. They embody many novel ideas in design and construction, and they constitute a line of equipment with which the majority of mechanics, particularly in the East, have had little or no experience.

Aside from the drilling outfit proper, there are numerous tools just as essential, including apparatus for undercutting and reaming, recovering piping and lost tools, screwing up casing and so on. Necessarily, the sinking of wells to depths in some cases of several thousand feet involves the application of certain interesting engineering principles, and the special processes that have been developed for such undertakings have brought into service a line of implements that exhibit great ingenuity upon the part of their originators.

It is purposed to show in various articles relating to this industry a number of the most important appliances commonly classed under the oil-well tool group and to describe at the same time the special shop methods used in their production.

The present article is devoted to the operations of a shop producing a heavy wrench, or tongs, for pipe and rotary tool joints. This appliance is made by the Dunn Manufacturing Co., of Oxnard, Calif., a city having a number of busy machine shops, but best known to the public in general as one of the great centers of the beet-sugar industry. The plant of the American Beet Sugar Co. at this point constitutes the biggest establishment of its kind, save one, in the world.

DETAILS OF THE TONGS

The Dunn wrenches, or tongs, are manufactured in many sizes ranging up to capacities for 20-in. or larger piping and weighing up to nearly 350 lb. each. Every part is of steel, either forged or cast, for these tools are designed for the severest service. Mechanics who are accustomed to using a long piece of pipe on a heavy wrench, with the expectation that something is going to give or let go, will be interested to learn that wrenches and tongs of the kind here described are often operated with the aid of a 30- or 40-hp. gasoline engine, which sets up the piping or tool joints, without fear upon the part of the workmen that the tongs will fail in action.

In Fig. 1 a medium-size tong is shown suspended from the shop hoist, and at the side, piled upon the floor, will be noticed a large number of parts ready for assembling into complete tools. Fig. 2 gives the detail construction clearly, and Fig. 3 represents a 10-in. tong fitted with 4 in. bushings. Each size is adapted for service on various diameters of pipe through the application of a set of liners, or bushings, made in three parts and readily attached to the three main members of the tool. These members, which form the body, or jaws, of the appliance, are designated as the lever hinge, center hinge and roller hinge, and are shown in the detail sketch, Fig. 2. Thus, the largest wrench, nominally 20½ in., is supplied with bushings for its jaws which adapt it for service on piping down to 13½ in.; and the smallest size, which fits 9⅝-in. pipe, bushes down to a capacity for 4-in. work.

OPERATIONS ON LEVERS

One of the heaviest members of the tongs is the lever, or handle. It is a steel slab several feet in length, forged taper from head to end of handle and finished by planing the head to thickness. The end of the head is shaped to the desired cam-like curve, and several holes are drilled for the attachment of clevises and for the reception of the stud pivot, by which the lever and lever hinge are connected when the wrench is assembled.

In Fig. 4 a pile of several dozen of these levers is near the planing machine ready for the machining of the head to thickness, the first of the series of operations to be performed after the work arrives from the forge shop. This portion of the lever fits into a slot in the body of the tongs proper when the parts are assembled. The process of making the fit is, in the case of the lever, carried on as indicated in this illustration, where two levers are shown side by side upon the platen of the planing machine. A single-point tool is utilized in accomplishing the surfacing of the lever ends.

The pair of forgings are secured against end movement under the cutting action of the tool by a conventional abutment in the form of a parallel backed up by table stops. The ends being machined are held down to the platen surface by a heavy strap bolted crosswise of the work. The two faces of the lever ends are thus machined smoothly. The thickness of the head is left so as to secure a few thousandths freedom between the finished faces and the corresponding surfaces in the jaws of the tongs in which the lever is carried when mounted in place.

Following the planing operation, the forged levers are drilled through the heads to provide an opening for the cutting out of the slot in the end which engages the roller in the opposite member of the hinged tong body to lock the tongs on the work. Also, the clevis holes and the hole for the pivoting stud are drilled through the lever arm and head in the positions indicated in Fig. 3. These drilling operations are accomplished by the aid of a jig of simple construction.

Then the cam-shaped ends of the levers are machined to the necessary curve by placing several levers at one setting on the shaping machine table and finishing

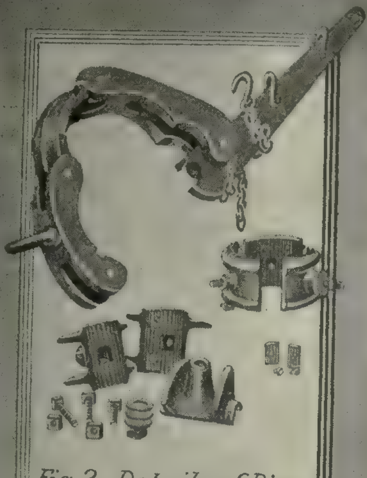


Fig. 2, Details of Pipe Wrench, or Tongs

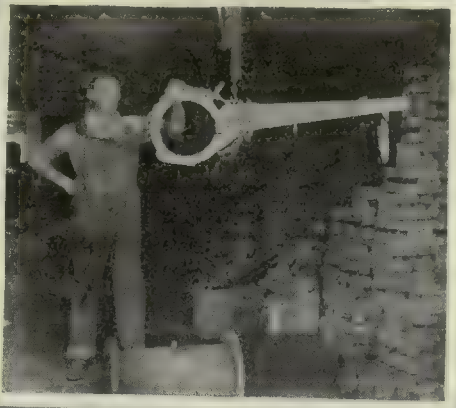


Fig. 1, Big Wrench, or Tongs, for Heavy Pipe and Tool Joint Work

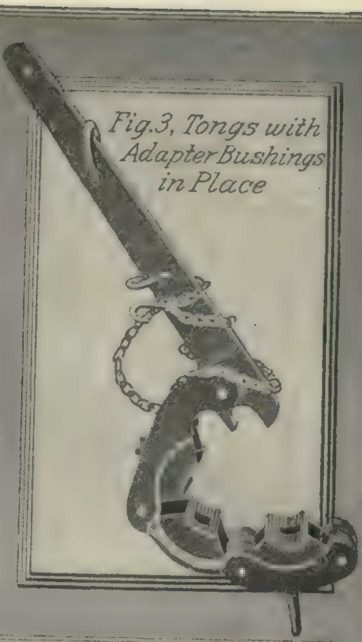


Fig. 3, Tongs with Adapter Bushings in Place

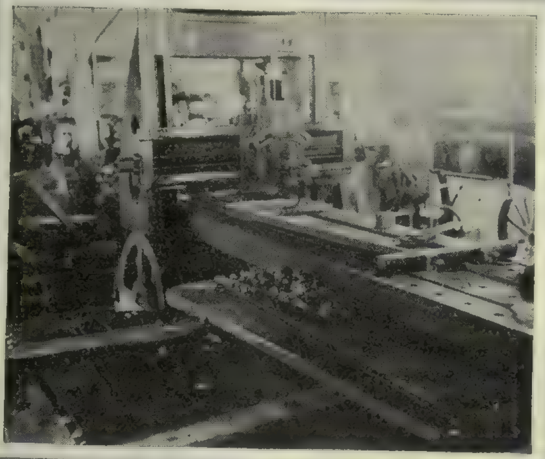


Fig. 4, Levers for the Tongs are Firmly Secured and Planed Two at Once

Fig. 5, Picking Up a Group of Levers Preparatory to Shaping the Ends

Fig. 6, Stack of Levers and Other Parts Ready for Assembling

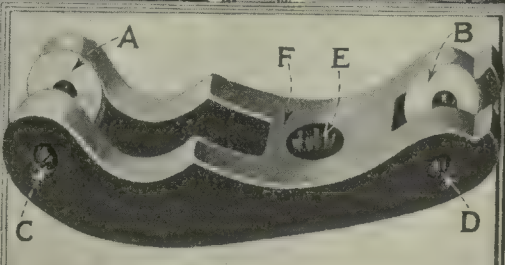


Fig. 7, Main Body Section, the "Lever Hinge"

Fig. 8, Steel Castings are "Set" Slightly Under the Press Before Machining them simultaneously. For this operation the levers are held together by locating pins placed through the holes already drilled. While thus secured, the four or more levers are picked up by the portable crane, as indicated in Fig. 5, and placed in the machine vise, where with the power crossfeed in action the tool is held to a templet and the correct curve formed on the lever ends.

A group of finished levers ready for assembling operations is illustrated in Fig. 6, which also shows a lot of chain for the completed tongs and gives an idea of the arrangement of the tool equipment in one section of the shop.

Machining the Lever Hinge

The three members known as the lever hinge, center hinge and roller hinge, which make up the body of the tongs, are steel castings. The lever hinge is the largest of the three. It weighs, in the case of the heaviest tongs, over 110 lb. A rough sketch of this casting is reproduced in Fig. 7, which with the detail shown, Fig. 2, will serve to convey a good idea of the character of the piece and the nature of the machining operations required in its manufacture.

Referring to Fig. 7, the surfaces to be machined are the slots *A* and *B*, which are finished to width between the bosses by milling; the holes *C*, *D*, *E*, which are jig drilled; and the concave surface *F*, which is bored to the desired radius with the casting mounted upon the faceplate of the lathe. The castings for the other two hinge members are of similar design, and the methods of handling are quite the same as employed for the part under description.

Testing Parts to Avoid Waste in Finishing Operations

Like concave castings in general, these hinge blocks as they come from the steel foundry are occasionally found to be opened out slightly during the cooling process. To avoid the possibility of boring them out too thin at the center when on the lathe faceplate, it is customary to test the rough interior of the segments by a templet before machine operations are started. If it is discovered that the interior is opened out to too large a radius the casting is closed a little by placing it under a press, as in Fig. 8, and applying prssure at the middle point. Here, the casting is shown resting upon two blocks, concave side up and with a round bar across the center to receive the pressure of the screw. After this, the casting is ready for placing in the milling machine, Fig. 9, where the slots are finished at the ends forming the jaws to receive the corresponding ends of the adjacent hinge and lever.

For this milling operation the work is held in special vise jaws that are fitted with holding-down studs and straps by which the casting is prevented from lifting or rocking at either end during the milling cut. The cutter employed is about 9 in. in diameter and is of the inserted-tooth type. As the casting is cored at the ends and provided with bosses, the milling cut in forming the slot to width is only a short one, or sufficient for facing the bosses. The work is set as near the height of the center of the cutter as practicable and fed directly toward the arbor.

The castings for the three hinge parts are put through the milling department in large quantities, as will be gathered from Fig. 10, which shows the work stacked up near the various machines.

The drilling jig for the pivot studs that connect the three hinge parts is illustrated in Fig. 11. All three hinges are milled on their joint ends before coming to this jig, the roller hinge, Fig. 2, being slot milled with a single cutter, as in the case of the lever hinge, Fig. 7. The intermediate, or center, hinge requires straddle milling to form the tongues which work between the jaws of the lever hinge and roller hinge. The straddle-milling process is carried on with the aid of a vise attachment similar to the one illustrated in Fig. 9 and needs no description here.

For drilling the pivot holes the hinge parts are placed in assembled position about the central drum of the jig, Fig. 11, and secured by crossbolts tapped into the wall of the drum. The latter is a casting of the right diameter to suit the size of hinges being drilled and is adapted to carry at the top a simple bushing plate made up in triangular form and fitted with the necessary guide bushes for the drill.

Following the drilling, the bushing plate is removed and the holes are finished to size by reaming, as in Fig. 12. About 0.010 in. is left in the drilling operation for reaming. A long reamer is employed, which has an easy taper at the end for guiding the tool properly into place. The work is handled under a radial drilling machine. Where the hinge castings overhang the table, as in the cases of the larger sizes, supporting jacks are placed under the projecting ends.

Work in the Lathe

One of the most interesting in the series of machining operations on the tongs is the boring of the bodies, or assembled hinges, to the required diameter, and the similar treatment in the lathe of the bushings that adapt the tongs to smaller sizes of pipe.

Fig. 13 illustrates the method of swinging the work on the faceplate. This faceplate is drilled around different diameters of circles to receive locating studs for the numerous sizes of tongs manufactured. When these studs are secured in the plate for a given tong size, the hinge members of the tongs are placed over the studs, as represented, and secured by nuts and washers on the studs. In this way the castings are located centrally for the boring operation. The machining of the interior of the three parts is then a simple operation, which is accomplished with a boring tool carried in a heavy bar supported by a special holder on the cross-slide of the lathe.

The boring tool is shown in Fig. 14, which illustrates the machining of a set of bushings. The latter are located centrally by the tong body in which they are secured, and the boring is done in the same way as described in connection with Fig. 13.

Gripping Dies

In producing the gripping dies, or toothed shoes, which are set one pair in each tongs—that is, near the outer end of the roller hinge, as indicated in Fig. 3—it is the practice here to mill up a long bar of tool steel, to form the teeth from end to end and then cut the bar into short pieces of the right length for individual dies. Fig. 15 shows the form of the teeth, which are of buttress section. Several dies will be seen

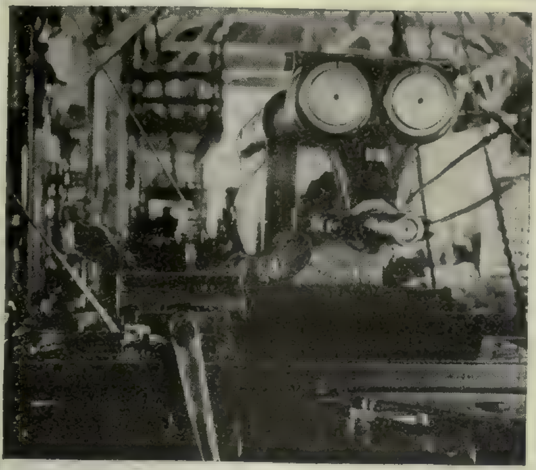


Fig. 9, End Openings for Joints are Milled with Inserted-Tooth Cutter

Fig. 10, Various Sizes of Tong Parts Passing through the Milling Department

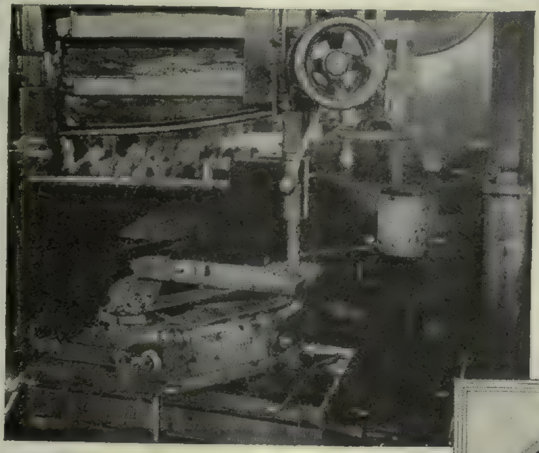


Fig. 11, Drilling Jig for Connecting Pins

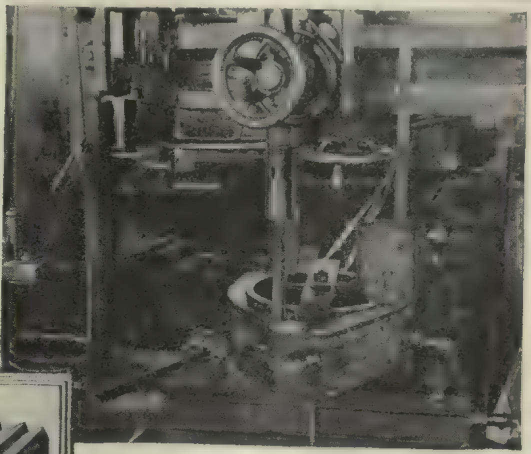


Fig. 12, Application of Reamer to Pivot Holes

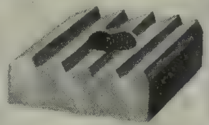


Fig. 15, One of the Gripping Dies

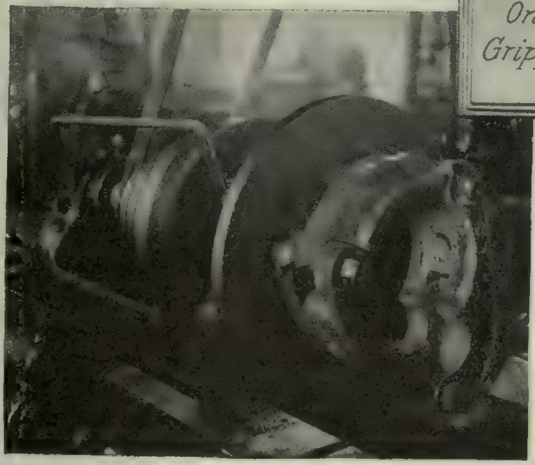


Fig. 13, How the Tong Bodies are Bored Out on the Faceplate

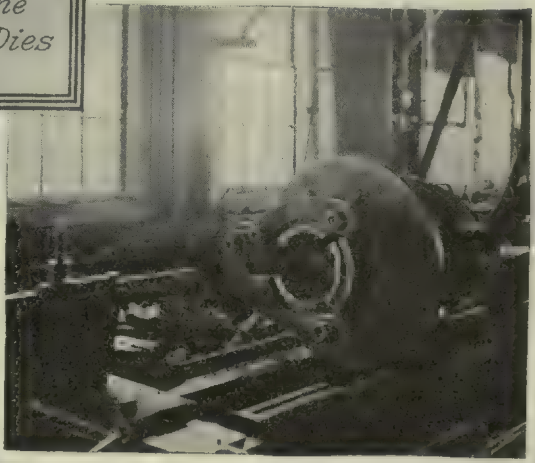


Fig. 14, Method for Boring the Reducing Bushings on the table of the milling machine, Fig. 16, represented in the operation of cutting the bar of grooved steel into correct lengths for these dies. Four saws are used in the gang on the miller arbor, and the special vise jaws are so designed as to hold the bar against tilting when acted upon by the cutters.

These dies are about ½ in. thick by 1½ in. wide. They are provided with five teeth each and with a counterbored hole at the center for the reception of the retaining screw that fastens them in place in a seat milled out in the tong body, or hinge. The holes are drilled through the dies by means of a plain jig. Another simple jig is utilized for drilling the corresponding holes in the seats in which the dies are to be secured when in use.

The jig drilling of these screw holes in one of the bushings, an operation similar to the drilling of one of the tong hinges itself, is represented by Fig. 17. The work is in a vise on the drilling machine table, and the plate jig is held in the seat in the bushing section by means of a pair of tongs gripped over the jig and the work.

In connection with the various references to the liner bushings for adapting the tongs to different sizes of pipe work, Fig. 18 should be of interest. It shows a large number of castings ready for machining into bushings of all sizes. It will be noticed that where these bushes are to provide for a marked reduction in the size of pipe taken care of by a given size of tongs the cross-section through the bushing body is not materially changed; but the additional space between the bushing bore and the bore of the carrying hinges, or tong body, is compensated for in the bushing patterns by increasing the depth of the outer ribs that form the bearing surface for the bushing upon the bore of the tong proper.

Finally, Fig. 19 is included to show a number of wrenches, or tongs, of several sizes all assembled and ready for packing and shipping. They are illustrated with safety grip, retainer chain and large and small clevis attached and with sets of bushings complete. Such an illustration gives some idea of the size of a business of this kind in the various oil districts of California.

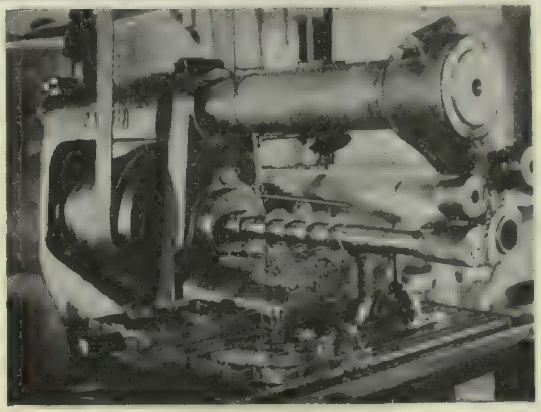


Fig. 16, Cutting the Dies from a Formed Bar

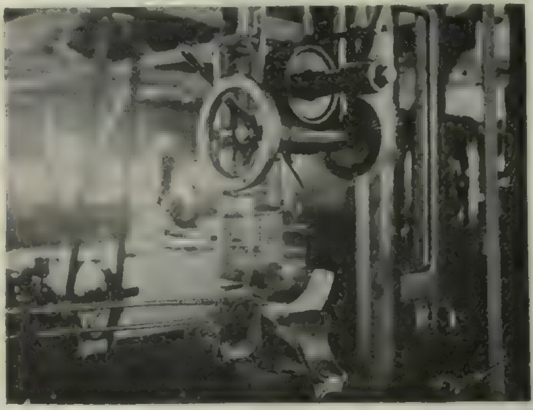


Fig. 17, Jigging a Hole in the Bushings for Holding the Dies

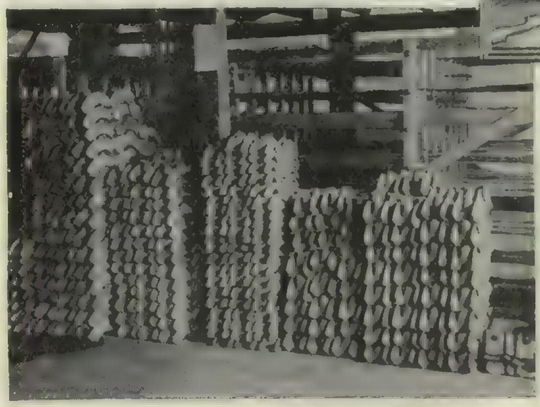


Fig. 18, Bushings of Various Sizes

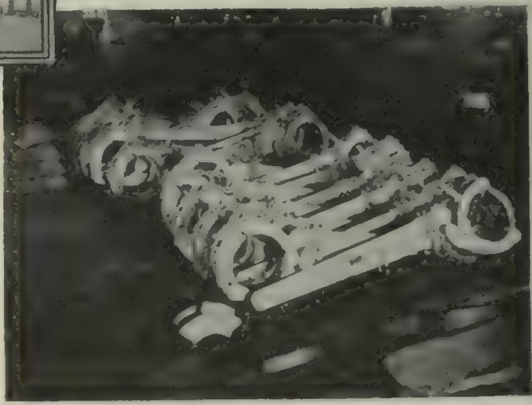


Fig. 19, Group of Tongs Ready for Packing & Shipping, with Chains & Clevis Attached

Heat Treatment and Hardening of Gears*

BY W. H. PHILLIPS
R. D. Nuttal Co., Pittsburgh, Penn.

The heat treatment of steel dates back many years, but it has only been within the last decade that really important strides have been made. The steel man of yesterday, with his equipment of human pyrometers, incorrectly designed furnaces, and limited testing apparatus, if he did succeed in producing a good piece of steel properly heat-treated one day, might not necessarily produce a like product the next. This article outlines some of the modern methods.

IN THE early days, machine parts were designed with a sufficiently high factor of safety for irregularities of material and treatment, while today, when the cost of extra weight, the additional expense in carrying this weight in moving parts, and the limited space for these parts are considered, it becomes necessary to go to a stronger material of a more uniform quality. These demands have resulted in improved methods of manufacture.

By the aid of the better equipped chemical laboratory; and what is even more important, the metallurgical laboratory, with its high powered photo-micrographic outfit, where the steel may be examined after each step through the process, and the results checked and compared; and with the great store of experimental data so carefully correlated, the heat treatment of steel is gradually coming out of the rule-of-thumb class to that of a science.

There are many remaining points that still have to be investigated and developed but, nevertheless, the work accomplished has been very encouraging.

Alloy and Carbon-Steel Gears

Except where weight and space are of paramount importance, alloy-steel gearing is not commercially practical because of its high cost. In the automobile field, where a comparatively small gear tooth must stand great strains, the strength and toughness resulting from alloying certain elements, such as chrome vanadium and nickel with steel, are very desirable, if not absolutely necessary. But this covers a comparatively small area of the gear field and, for the most part, heat-treated carbon-steel gearing is meeting every requirement imposed upon it and still has a great field for development.

Heat-treated carbon-steel gearing may be divided into three general classes; oil-treated, casehardened and special-treated gears. The first two classes were introduced in the sequence given, and have met many problems. Each has its advantage for different services and in this service has proved efficient. There are conditions encountered, however, in which these two grades are not applicable. The third class mentioned has been developed after a careful study of actual conditions and embodies some of the qualities of the former classes.

There are applications where the service is so light that the resultant long life and low maintenance cost do not necessitate a high-grade product. There are other services where the gear must transmit a uniformly high torque without sudden jars or dynamic blows, in which case it is a question of wear alone, surface hardness (as found in the case-hardened produce) being required.

There are still other applications where the load to be transmitted is uniformly low, but with occasional shocks. This last-named condition requires a gear with only medium hardness, but with high ductility, such as the first-class, or oil-treated gear. There are installations, and these are in the majority, where the service imposes the heavy duty with its resultant wear, as well as shocks with the liability of breakage. It is for such service that the third class of special grades of gearing has been developed. Only by analyzing the conditions, and selecting the proper grade, will it be possible to obtain the best results.

Heat Treatment

Without going too deeply into the theory of heat treatment, it might be interesting to describe in non-metallurgical phraseology just what takes place when a piece of steel is hardened. In studying the action of heat treatment it will be necessary to refer to the proximate analysis of the steel or the microscope, as the chemical, or ultimate analysis, gives us very little real information on heat-treated steel.

There are several theories for the hardening of steel, the more notable ones being the stress theory, the carbon theory and the solution theory.

The stress theory bases its contention on the high stressing of the outer shell of the steel when shrinking onto the interior, and on the stresses set up in the crystal change from the hot to the cold metal. The fact that cold working hardens steel is offered in support of this theory.

The carbon theory contends that the hardness resulting from quenching steel is due to the condition the carbon can be held in, it being recognized that carbon can exist in several allotropic forms.

The solution theory contends that the carbon is in solid solution with the iron. This seems to be the most logical explanation, and all phenomena can be explained by it.

If we examine a 0.40 per cent. carbon etched normal steel under the microscope at 50 diameters we find a black network of crystals in a background of white. The black crystal is pearlite, thus the name pearlitic steel. The white background is ferrite or pure iron. If we examine the black crystal at 200 diameters we find it to be made up of alternate layers of black and white. The black is cementite, Fe_3C, which weighs 15 times as much as carbon.

A 1 per cent. carbon steel will have 15 per cent. of its weight as Fe_3C, while the white again is pure iron. The ratio of black to white layers is about 1 to 7. It will be noted that one part of carbon is combined chemically with 3 parts of iron and this mixture is again combined mechanically with 7 parts of iron, so that 1 part of carbon strengthens 10 parts of iron.

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*Paper read at the meeting of American Gear Manufacturers' Association, Chicago, Sept. 14-15.

If the steel is now heated gradually, for every unit of heat added there will be a unit raise in temperature until the point known as the critical point is reached at which point a chemical change takes place with absorption of heat. This change is the going into solid solution of the carbon with all of the iron. If the steel is now cooled slowly the reverse phenomena occurs and we again have pearlitic steel; but if the steel is cooled rapidly enough, the change back of the solid solution is practically surpressed, and a steel obtained with a large amount of carbon and iron in solid solution. This is briefly the theory of hardening.

It can be seen that the more rapid the cooling, the more solid solution of carbon and iron results. Starting from this point the work of the hardener begins. For any given analysis of steel we can get a certain hardness with a certain ductility. These properties are inversely proportional in a general way, so we want to get as much hardness as we may, at the same time retaining sufficient ductility. We usually gain one at the expense of the other; so the varying grades of heat-treated gearing on the market, if they are properly heat-treated, are the result of a juggling of the chemistry, the physical properties to conform to the manufacturer's idea of what is best suited for the different gear installations.

HARDENING BY QUENCHING

While the general theory of hardening of steel by quenching in a rapid cooling medium is well-known, there are many peculiar actions taking place that baffle explanation. It has been found that several pieces of steel of the same uniform analysis ⅝ in. diameter, ⅝ in. thick, heated with the most painstaking care and uniformly quenched, will show variations in hardness on the end surface of as much as 40 per cent.; in other words, Brinnell hardness varying from 341 to 578. This variation being due probably to martensite forming in tension, and compressing inner crystal formation necessitating troostitic crystals. This was investigated by Howe and Levy and the results published in the 1914 yearbook of the American Society for Testing Materials.

OIL TREATMENT

The oil treatment was the first method used for hardening and toughening gearing. This method consists in heating the steel to the required temperature and quenching in oil. This treatment is not severe and does not set up heavy strains in the steel. The ductility is high, but the hardness only slightly greater than that of untreated steel, as is also the strength.

Where it is desirable to increase the hardness and strength somewhat, and still retain a high ductility that is necessary when the gearing is to be subjected to shocks with normally light loads, oil-treated gearing may be advisable. The increased cost of this grade over the untreated grade is not high and for this reason may be worthy of consideration. As shown by the Brinell test, the hardness is increased about 75 per cent., which may seem to be a very material increase by comparison, but it is relatively small. The oil treatment may be applied to forged or cast-steel gears.

The casehardening process consists essentially of a high-carbon case backed up by a low-carbon core. A low-carbon steel is used, the high-carbon case being obtained by treatment. The depth of this case can be controlled, giving any penetration desired. This treatment has been known for a long time but it has been applied to gearing only in recent years.

Comparing the hardness of the case and core with that of untreated steel, the case is found to be four times as hard as untreated steel while the core is only slightly if any harder. When the service is such that heavy shocks do not occur, and all the gear must do is transmit uniform load, the very hard case of this product resists wear well and the gear will have a long life. When, however, the load to be transmitted is variable, and there is liability of heavy shocks, the case will get this strain first and, being very brittle, will tend to fail.

This treatment is somewhat more expensive than other grades as it requires at least five applications of heat to properly harden a gear. Care must be exercised in handling and installing this gear as the case will be spalled off by a slight blow. It is desirable, in order to secure maximum life, that it be run in both directions to utilize the benefit of the case on both sides of the tooth.

With the steadily increasing knowledge of steel and of the methods of heat treatment year by year, the oil-treated and casehardened grades have been improved gradually until now they have been perfected as far as possible, and the metallurgist for some time has been looking to other fields for a grade that would include the good qualities of both, supply what they lacked, and if possible reduce the cost of the heat treatment.

As stated before, the alloy steel had to be eliminated owing to its cost, and the only course left was to develop a treatment for carbon steel that would give the required results.

Heat treatment can in no way be introduced as a cure-all for every kind of gear trouble, and for this reason it has often been blamed for many failures that it was in no way responsible for. It is true it has enough troubles of its own.

Often a gear of poor design, that has been failing in service through some weak section, is heat-treated to correct the trouble and it may happen that the gear fails in the heat treatment.

There seems to be a tendency, in designing, to work in every conceivable shape in order to have the gear do several things—cut down its weight, relying on strength of the treated steel to make up for lack of section, and send it to the heat treating department where it fails.

CONSIDERING THE STRAINS

It is as necessary to take the strains set up in heat treatment into consideration as it is the strains introduced in service. The designer should try to eliminate all abrupt changes in section, introducing generous fillets. He must also remember that the surface of the section to be treated is the only outlet for the internal heat of the section and, in order to get a uniform cooling action, the area of the surface must be kept as nearly as possible in proportion to the cubical content of that section. If this is not done the strains set up in quenching may become excessive and localized at some weak point causing rupture of that section. It is known that in cooling from above the critical temperature, a piece shrinks at a different range below the critical temperature.

In service a peculiar failure occurs under certain operating conditions, it is classed with the common fatigue crack. Wherever this crack shows up it may be safely assumed to be caused by stressing the metal too highly. Formally it was thought safe to stress steel well up to the so-called yield point or elastic limit by "drop-of-beam" method. It is now generally known that the true elastic limit may be much lower, and in estimating this value should not be used unless a great enough factor of safety is used to take care of the discrepancy.

If the steel is stressed beyond this true elastic limit a fracture is frequently started which progresses, causing ultimate failure. Before the failure actually occurs, however, the metal is stretched at the point where fracture begins; and when the stress is removed, at any time during the progress of the crack, the two halves are pressed so tightly together by the adjacent crystals, which are not permanently distorted and which are trying to regain their original position, that the crack is invisible to the eye. There are two cures for such failures, either stronger sections or higher strength steel.

QUESTION OF ELASTIC LIMIT

It is open to question whether this true elastic limit, as recognized at present, is not merely another point in the stress-strain diagram below which steel takes a much smaller permanent set even on the slightest stressing; and, while the work of fatigue is going on, it is too small to measure with any instruments available.

The writer is of the opinion that this is not the case, and any tests which might tend to substantiate these claims have not had simple, but complex stressing, in which individual fibers were overloaded and failed rather than that the whole section being tested was uniformly stressed.

The uncertainty of giving a certain gear, in a lot of say ten or a hundred or more, a test and assuming it to prove that the remaining gears are correct is so great that this method is to be condemned. Also the casting and pulling of a cup of small dimensions after treatment is practically useless in helping to determine the physical properties of the larger piece.

The only satisfactory way, to get at the testing of gears commercially, is to give every gear some form of a test that will enable the manufacturer to check the work. The hardness machines of the type of the Brinnell and Sclerescope, have proven very useful in this work.

From Jack to Bill—Working in a Railroad Shop

Dear Bill—I likes ware I be now awl but one thing. Thayre jellus becaws I gits such a good sallerie and me nevr in a ralerode shop befoar and thay tries to bothur me by tawkin nonsents tawk. Sumtimes I think thay aint atriein to kidd me but doant no no united staits tawk. A man was fasin a peace and wen I ast him wat was it he sed a slidevalve feedvalv that cum out of the air. He must thingk Ime grean to bleev iurn cums from the air and valvs has to be fed laik a bayby. And I ast anuther guy wy a enqun has too carbreturs one each side of the biler and he lafd and sed we cawl em cheks just as tho I dident no a check is wat you gits for sallerie and has the barkeper maik intoo reel munny. Then he sez thayr chekvalvs on the injectr feed.

And thay tawks hoss tawk. A gink toald me a peace was the bridle pin and wen I lafd, for thares no yuse in gittin madd, Bill, he toald me sum calls it a lingk hangur studd and I no well that a lingk is a annimul like a tomcat only bigr and the iurn thing up besaids of the engnear that I thort was a geer shift he sayz razes the lingks, that blaimed cat agen Bill. Eavn the bos yuses sutch tawk and wen I ast him ware a enjun was agoin he toald me to pul a string out of the yard. And I road on a enjun Bill and the firemn kept sayin sutch and the runr repeetin afftur him laik redeye and hiball witch is drinkin tawk. And the runs tels the firmn to ketch them 19 flimsies and I lookd and coodent see no 19 nuthin and awl it was was too peaces of payper wat a gink helld up on a stik for him to grab aint that foole tawk Bill?

I AST HIM WARE A ENJUN WAS AGOING, HE TOALD ME TO PULL A STRING OUT OF THE YARD.

But Ime lurnin in spait of em and Ime goin to fined ware the startin crangk is on a enjun tho the man I ast toald me thays awl selfstarters now.

And one thing reely trubles me Bill the man wat hellpd me git this jobb he tels me sum ralerode men is bein drafteded and I tels him wy Ime saif on acount of havin my bruthers sifficit and he sez if I get ketchd at it Ile be put in prizn for purjri but how cood thay fined out? He sez the guvmunt has spize evryware. I awlwis thort spize was jurmuns dident you Bill?

And my sallerie has been razed Bill. I thort becaws I dun so mutch good wurk on my slotr but I fined awl the men has thare salleries razed and a man tels me thay wantid to raze mine and had to raze awl the rest so thay woodent be two jellus do you bleev he is kidin me Bill? The 5$ a day shop hasent sent for me yit but I no thay will befoar long and I furgut to tel you Bill thets awl a lye abowt thayre havin squirls thare to pik up nuts, for a bos wen I was thare aftur a jobb toald me thare was screans on evry windo so I neadent feal ankshus. He lafd, so I spoas he thort it was a joak. Foaks does laf at sutch fooleish joaks. **JACK.**

P.S.—Bill wat has purjri got to doo with prizns or the guvmunt. I thort it was sumthin abowt fizzik.

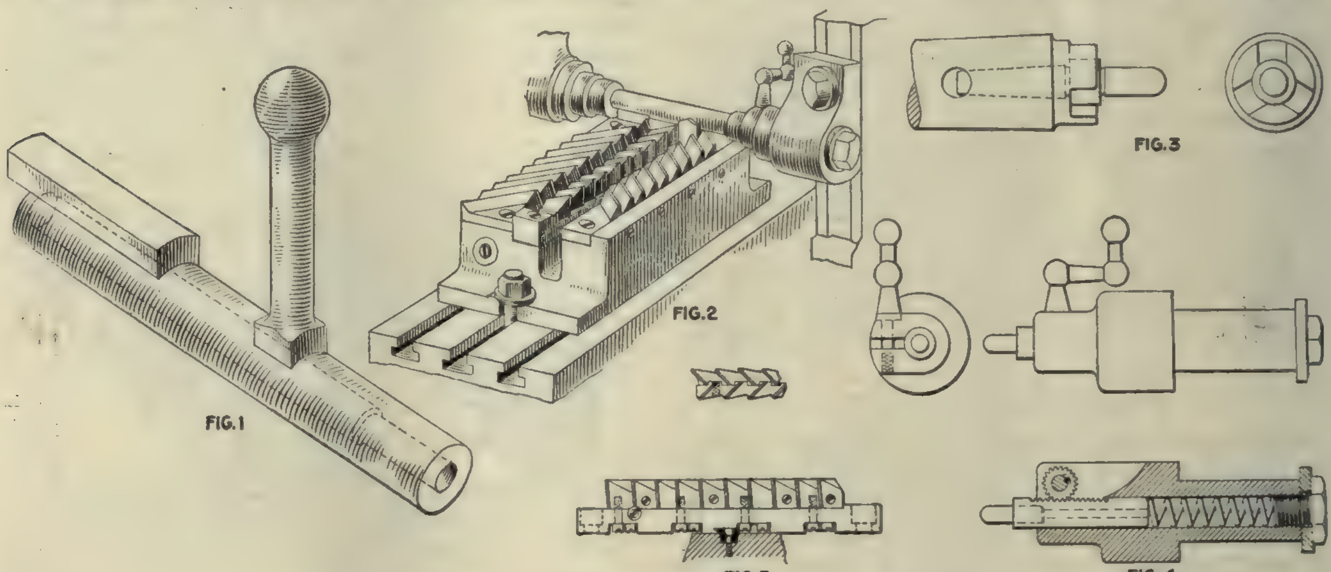
Shave-Milling the Bolt for Army Rifle

By Joseph H. Bentley

The fixture shown is designed to complete the body turning on an army-rifle bolt from the rough forging at one operation. The time of the complete operation is 4 min. or less, and one operator can run several machines.

There are two solid and two interlocking cutters of high-speed steel mounted on a cast-iron base. Owing to their shape and the need for adjustment, the interlocking cutters are mounted on a shoe, and the solid side-milling cutter can be adjusted by screws in the casting.

There are 10 teeth in the cutters at a shear angle of 45 deg., and the surfaces of the casting forming the seats are planed off at an angle that gives a rise of 0.005 per tooth, or 0.050 in all, which is 0.010 more than the stock to be removed. In setting the cutters after grinding, the last, or high teeth are the important ones, and a stone will rectify errors that can exist in the other teeth. For grinding the cutters it is necessary to make a plate planed on an angle calculated to compensate for the angle of the casting in relation to the angle of the teeth.



FIGS. 1 TO 5. BOLT- AND SHAVING-FIXTURE PARTS

Fig. 1—Bolt and machined surfaces. Fig. 2—Machine set-up. Fig. 3—Driving mandrel. Fig. 4—Details of the tail center. Fig. 5—Interlocking cutters and shoe

Fig. 1 shows the bolt and the surfaces that are machined in this fixture. Fig. 2 gives a general idea of the set-up in a miller, showing the bolt on the two centers and the shaving cutters just about to start the cut. Fig. 3 is the driving arbor, which is set into the spindle with a taper shank and has a pilot with a smaller shank that can be easily and cheaply repaired. Three slots are cut for readily engaging the projection on the bolt used for driving.

Fig. 4 is the tail center. The novel feature in this device is the one-motion release and withdraw. It will be seen that the spindle carrying the pilot mandrel has a rack cut on one side, which is actuated by a spur gear mounted on the clamp screw between the casting where it is split for clamping. There is a Woodruff key in the clamp screw, but the keyway in the gear is extended on an arc.

When the clamp screw is released, the key travels a short distance and then picks up the gear, which withdraws the mandrel against the spring pressure. A new piece of work is put in place and the arbor allowed to resume its position snug against the shoulder, when an extra pull on the handle locks it. The handle has a double bend to allow it to rotate freely in the palm of the hand.

Fig. 5 shows the two interlocking cutters for controlling the width between the shoulders of the bolt handle and the projection. They are fastened to a soft-steel shoe with screws from underneath. Four tight-fitting setscrews in one of the cutters are set up to the other cutter to preserve the width after being set. A large-head setscrew is counterbored into the base at the second tooth to a depth that serves as an accurate setting for that end of the cutter. The other is set flush with the side of the shoe. The shoe is held to the cast-iron base by two large screws at the ends plus the dovetail piece in the center, which serves both as a hold-down and as a thrust-stop.

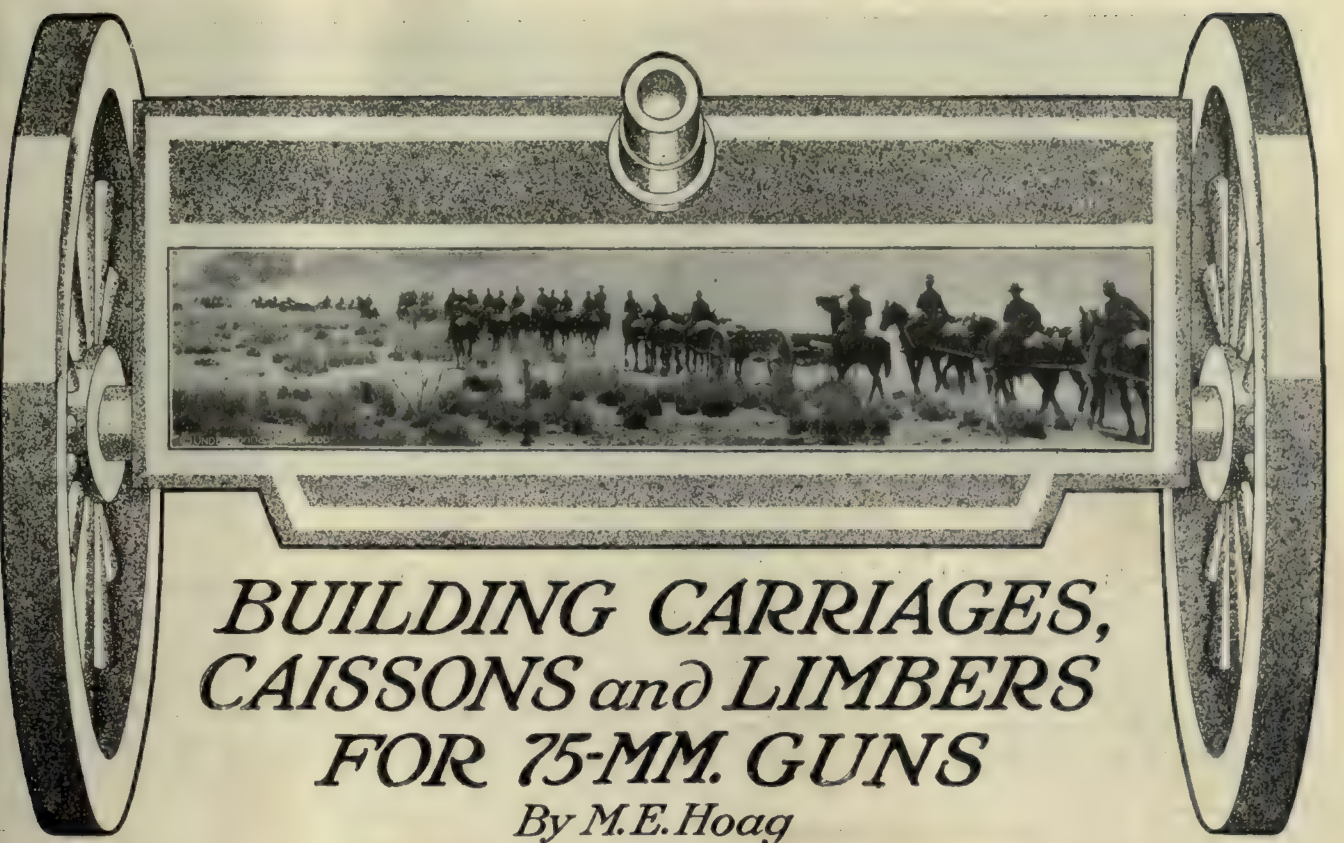
The other two cutters are similar in tooth design, but have no shoe, being mounted on the cast-iron base direct by the same means as above—two screws and the dovetail piece.

Two set blocks are provided to gage each end of the space between the two cutters cutting the sides of the bolt-handle. They are made cylindrical and are stowed out of harm's way in holes bored in the casting, each at its respective end.

Preventing Grease-Cup Trouble

By A. L. Barrett

Much trouble has been experienced by green help screwing grease-cup plungers down and against the bottom of the cup. I have done away with this trouble by putting a sleeve between the handwheel and the cover. I make the sleeve exactly long enough so that the handle takes up against the sleeve just before the plunger reaches the bottom of the grease cup.



BUILDING CARRIAGES, CAISSONS and LIMBERS FOR 75-MM. GUNS

By M. E. Hoag

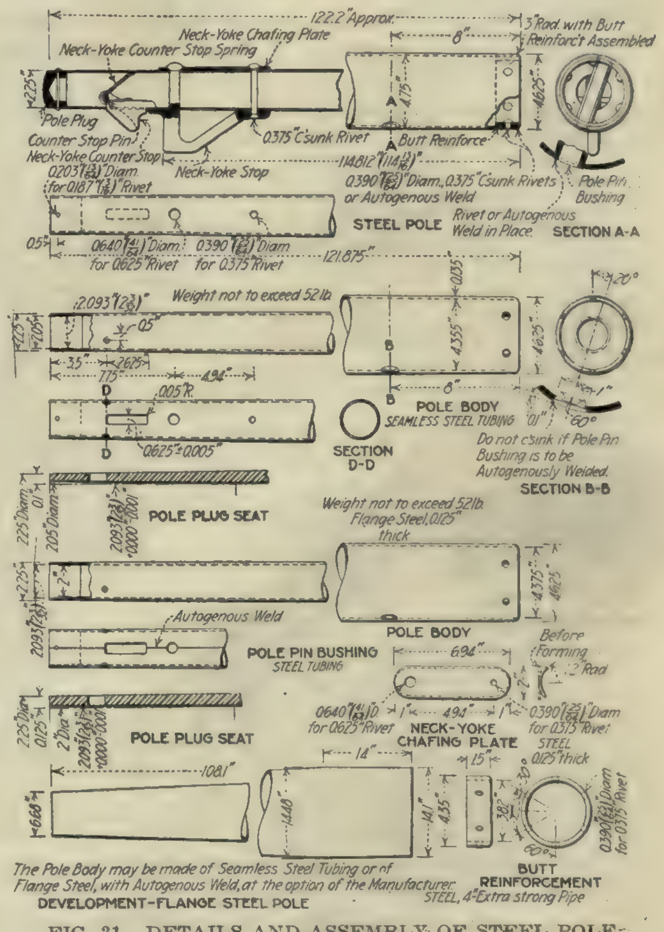
III. The Steel Pole

This article is the third by the same author of the series dealing with 75-mm. gun-carriage equipment, and describes one of the parts on which great reductions in cost have been made, and which required considerable experimental work before the present methods were developed.

THE steel pole for the limber is one of the pieces on which a great reduction in cost has been made, and which requires some interesting tools, dies, etc., in its construction. Formerly, it was the practice to purchase the pole body in the form of a seamless steel tube and afterward to assemble the various parts in the shops. The pole itself cost $100, and the work on the fittings and the assembly cost about $5 so that the total cost was a little over $105. As the pole is now made, from flange steel, the total cost for labor, plus 100 per cent. overhead, plus cost of material, is $12.50. This includes all fittings. Moreover, it was found that the seamless steel pole would not stand up to the test, but showed a tendency to bend and not resume its original shape after being subjected to a bending strain. There is none of this trouble experienced now with the pole.

The drawings, Fig. 21, present very clearly the shape, dimensions and fittings. The developed shape for the steel blank before forming is shown at the bottom of the illustration, and the finished pole at the upper part. Fig. 22 shows the dies for forming the pole body, in position in the hydraulic press. Drawings of these dies are given in Figs. 23 and 24.

The operations on this part of the work are: (1) shear sheet to templet; (2) form in dies; (3) clean with soda; (4) file burr on socket end; (5) weld; (6) paint inside; (7) test—one pole out of every fifty. This carries the piece up to the point of assembly.



The Pole Body may be made of Seamless Steel Tubing or of Flange Steel, with Autogenous Weld, at the option of the Manufacturer.

FIG. 21. DETAILS AND ASSEMBLY OF STEEL POLE

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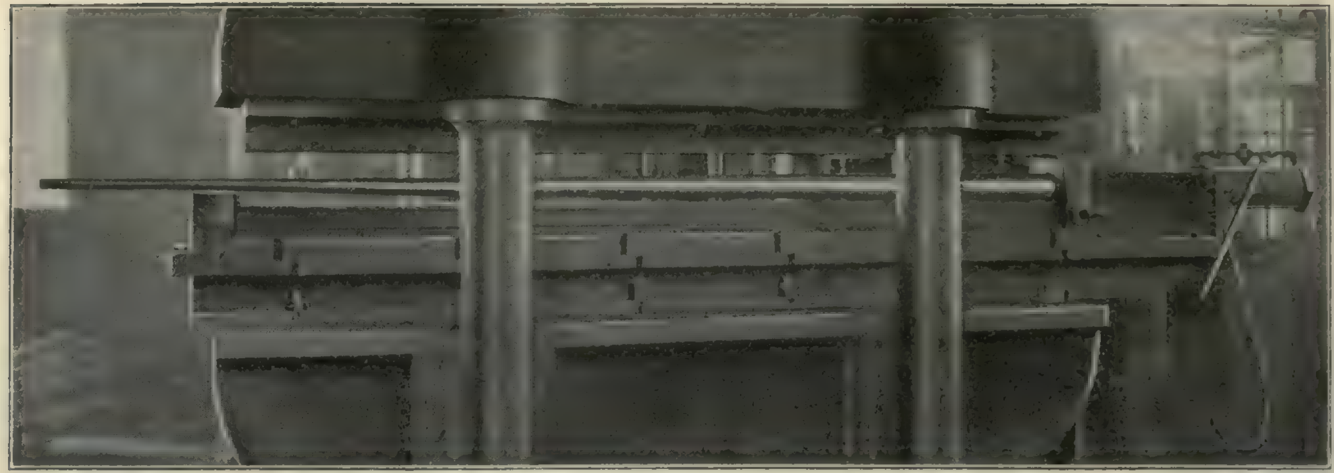
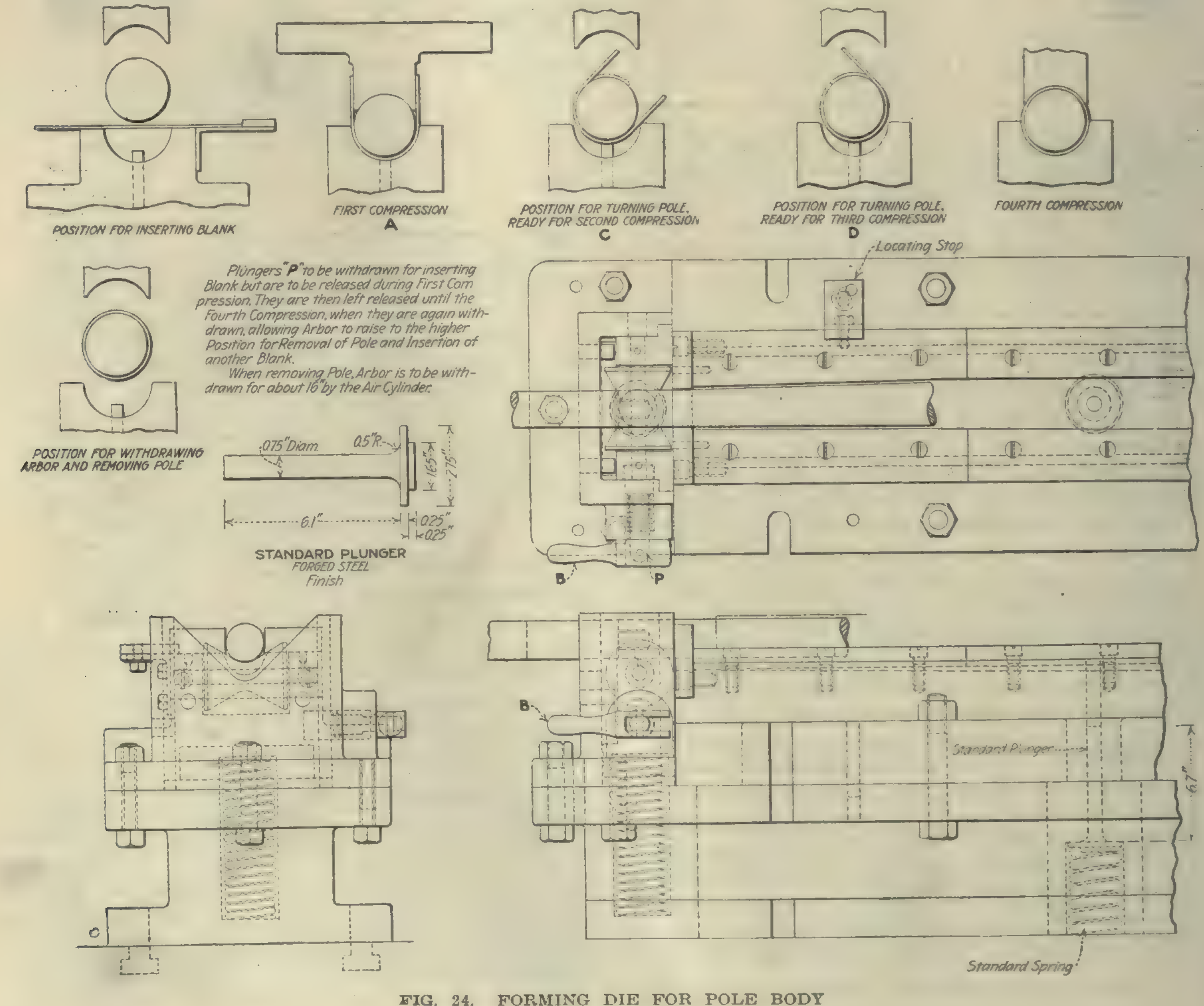


FIG. 22. POLE DIES IN HYDRAULIC PRESS

After the sheets are sheared to size, they are passed under the dies; and as they are closed, they force the metal down into the lower half and up and around the mandrel into U-form, as shown at *A*, Fig. 24. While the dies are in this position, the workmen turn the levers *BB*, which engage pins and prevent the mandrel from returning to its starting position. This leaves just sufficient space between the mandrel and the lower half of the dies for the metal to clear, and the workmen turn it part way over, as shown at *C*. After the second stroke of the dies, it is rotated to position *D*, and the dies again close, finishing the shape; but it is generally given two or three more compressions to give it set and bring the edges closer together. On the


POSITION FOR INSERTING BLANK
FIRST COMPRESSION
A
POSITION FOR TURNING POLE, READY FOR SECOND COMPRESSION
C
POSITION FOR TURNING POLE, READY FOR THIRD COMPRESSION
D
FOURTH COMPRESSION
Locating Stop
POSITION FOR WITHDRAWING ARBOR AND REMOVING POLE
0.75" Diam.
0.5" R.
1.65"
2.75"
6.1"
0.25"
0.25"
STANDARD PLUNGER
FORGED STEEL
Finish
B
P
B
Standard Plunger
6.7"
Standard Spring

Plungers "P" to be withdrawn for inserting Blank but are to be released during First Compression. They are then left released until the Fourth Compression, when they are again withdrawn, allowing Arbor to raise to the higher Position for Removal of Pole and Insertion of another Blank.

When removing Pole, Arbor is to be withdrawn for about 16" by the Air Cylinder.

FIG. 24. FORMING DIE FOR POLE BODY

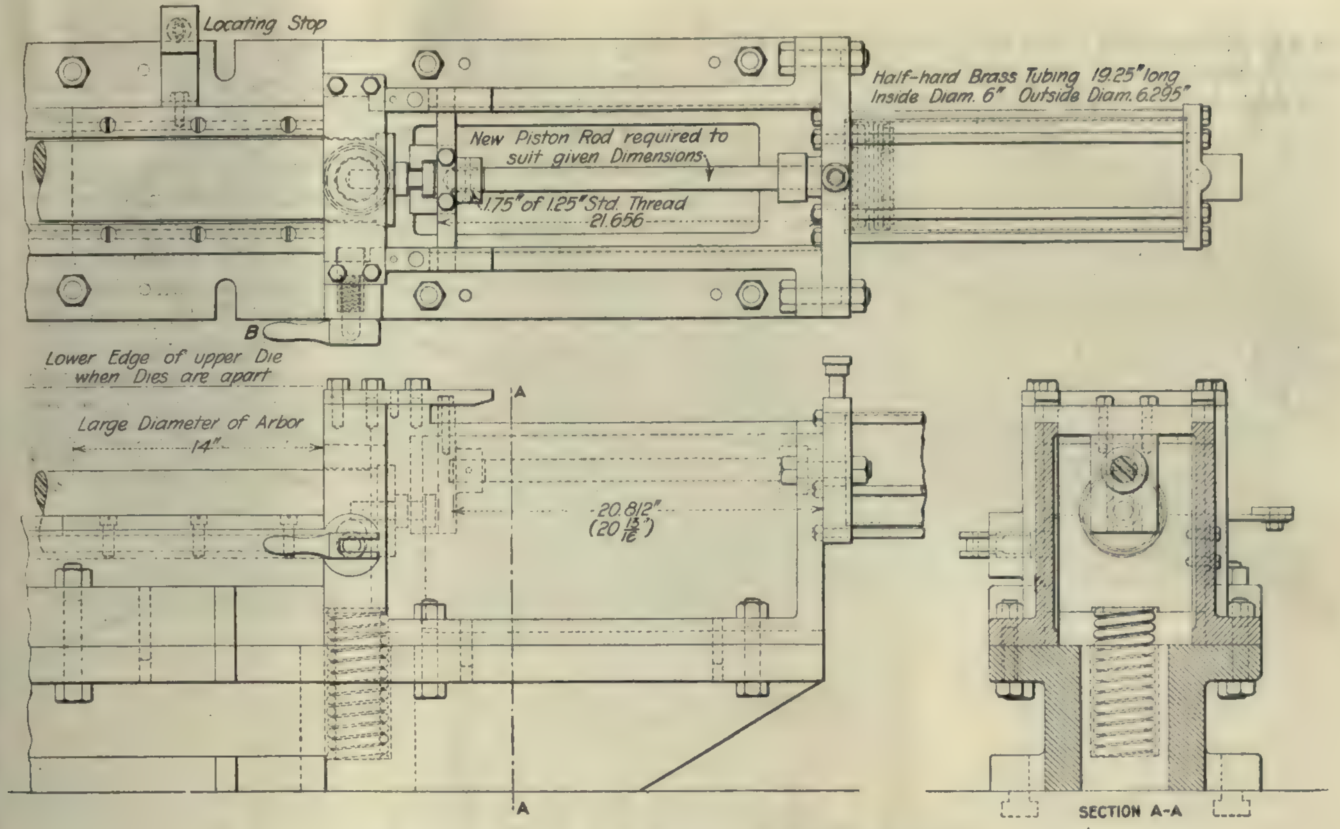

Locating Stop
Half-hard Brass Tubing 19.25" long
Inside Diam. 6" Outside Diam. 6.295"
New Piston Rod required to suit given Dimensions
1.75" of 1.25" Std. Thread
21.656
B
Lower Edge of upper Die when Dies are apart
Large Diameter of Arbor
14"
A
20.812"
(20 13/16")
A
SECTION A-A

FIG. 23. DETAILS OF FORMING DIE FOR POLE BODY

last stroke of the dies the workmen release the levers *BB* and allow the mandrel to rise to its starting position. The air cylinder, shown at the right, withdraws the mandrel sufficiently to clear the reverse taper on the large end of the pole, and the workman pulls the pole off over the small end of the mandrel.

The welding, operation 5, really covers two operations. The first is only a partial welding, or tacking, as shown in Fig. 25. For this operation, oxyacetylene torches are used, and the piece is clamped in the special vise, which is shown so plainly in the drawing that no description is required.

It is right at this point that the inexperienced manufacturer is going to run up against a snag, for he will probably try to do all the welding in one operation. If he does so, the pole will be bent out of shape and become useless. This is due to the expansion caused by the intense heat generated in welding. To overcome

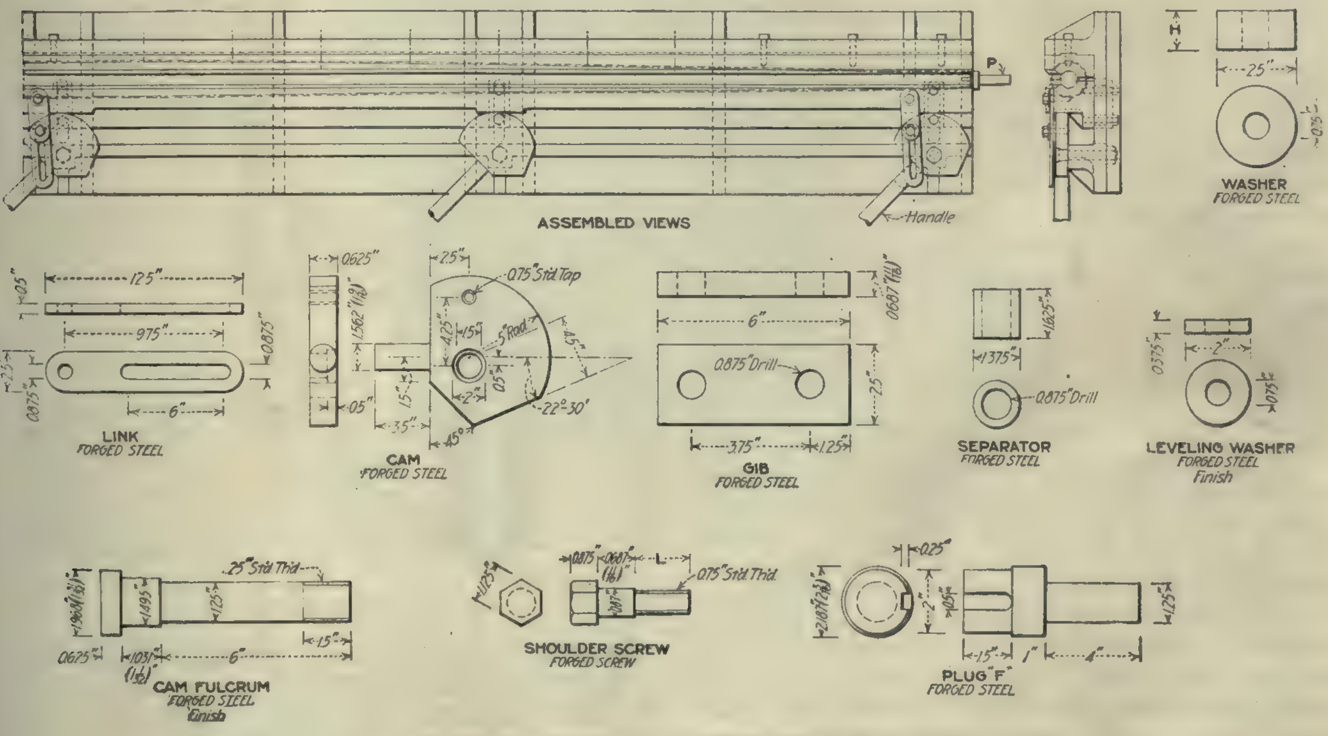


FIG. 25. FIRST WELDING FIXTURE FOR POLE BODY

this trouble, it was found necessary, first, to tack the seam as already shown, and then place the pole under a bending strain in the fixture illustrated in Fig. 26, and so hold it while the complete welding operation is being done. On completing the welding and releasing, the pole will spring sufficiently to bring it straight. This tension no doubt accounts, to some extent, for the greater rigidity of the welded pole.

It is found necessary to do a little reducing, or swaging, on the large end of the pole, and this is handled under the hydraulic press in simple half-round dies.

There now remain 18 assembly operations to complete the pole; (1) Drift and ream both ends and assemble butt reinforce; (2) autogenous weld butt reinforce in pole body; (3) grind for forming; (4) reform socket to fit test tools (half-round dies); (5) turn radius on butt end, face front end, and file burrs; (6) drill for pole-pin bushing; (7) drill for neck-yoke stop, counter-stop pin and end holes for neck-yoke counter-stop slot; (8) punch slots for counter-stop; (9) assemble and weld pole-pin bushing; (10) grind pole socket to fit gage; (11) ream poles through pole-pin bushings; (12) assemble neck-yoke stop and neck-yoke chafing plate to pole body and rivet; (13) assemble neck-yoke stop, neck-yoke stop spring and neck-yoke pin in pole body for riveting; (14) rivet neck-yoke stop pin; (15) fit and assemble pole plug to pole body and drill rivet holes in plug; (16) rivet pole plug; (17) grind neck-yoke stop pin; (18) do necessary filing and finish for inspection.

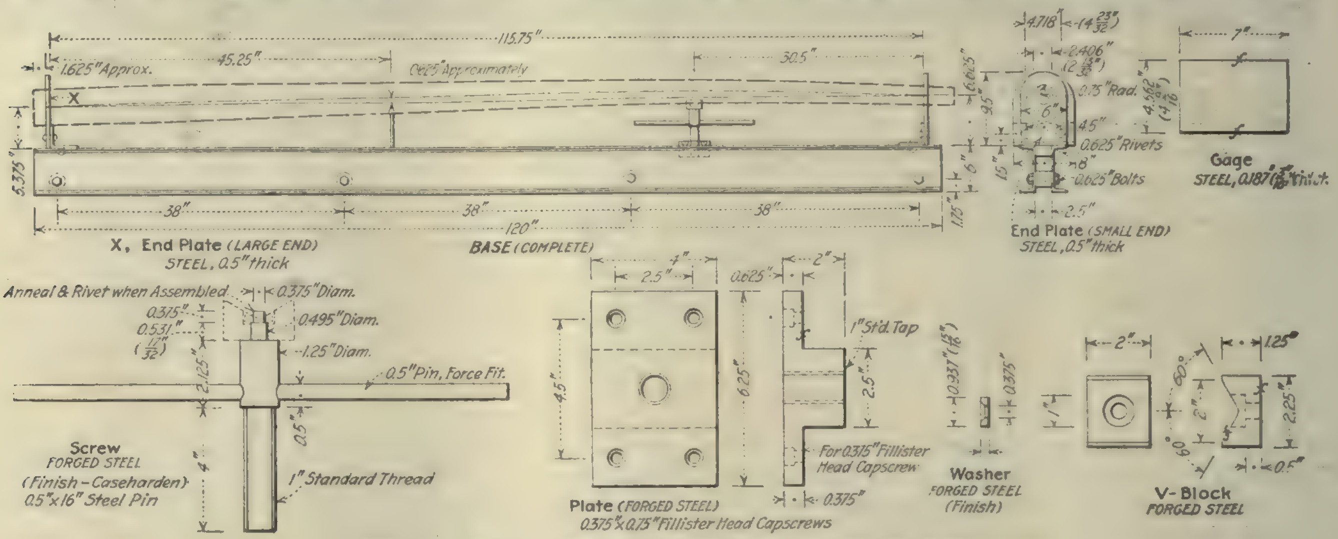


FIG. 26. SECOND WELDING FIXTURE FOR POLE BODY

Bending Dies for Tubing

By William Meyncke

In answer to the questions of F. P. Terry, on page 121, Vol. 47, the following method is suggested. It was used in bending a lot of brass tubing for ornamental work and produced a nice job free from buckle, the pieces being buffed as they came from the press.

The punch is given the required form, with a forward overhang to allow the free ends of the tubing to swing up past the ram of the press. The swinging lower members are pivoted at a distance that will cause them always to bear on the punch as it descends, and should always work against a suitable spring pressure that is even on both members. The punch and die parts should have a half-round groove to receive the tubing and should be the least bit shallow in order to grip the stock and keep it from crawling.

This is the only method I know of which will bend a tube without filling. It works well and does not draw the stock more than would naturally be caused by the bend. Details of these dies are shown below, in which *A* are the swinging members, *B* the pivot pins, *C* the die block, *D* the punch, and *E* the punch stem. The illustration shows a front and a side view.

In operating these dies the swinging members receive the tubing, and the descending punch forces the tubing and swinging members down against the rubber bumper. The swinging members open as the inner ends swing downward, and the outer ends swing up until they are parallel with the punch at the end of the stroke. The back of the punch is cut away to allow the working end to enter the die deep enough to obtain the desired tubing form. The rubber bumper returns the swinging parts to the starting position.

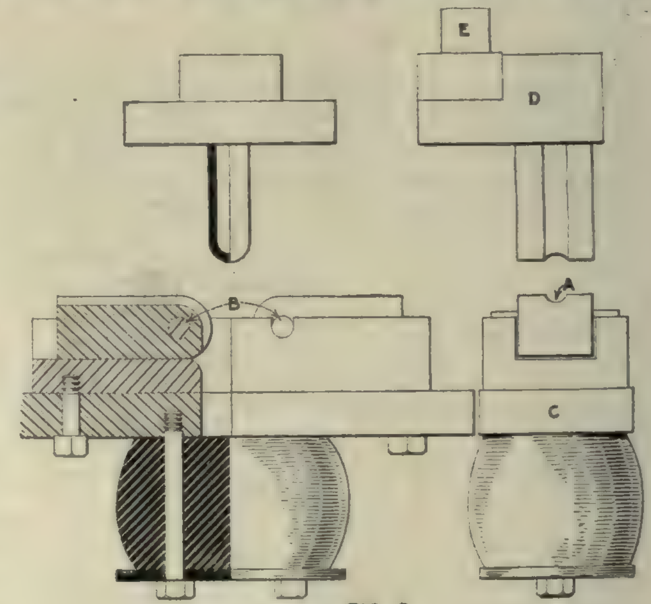
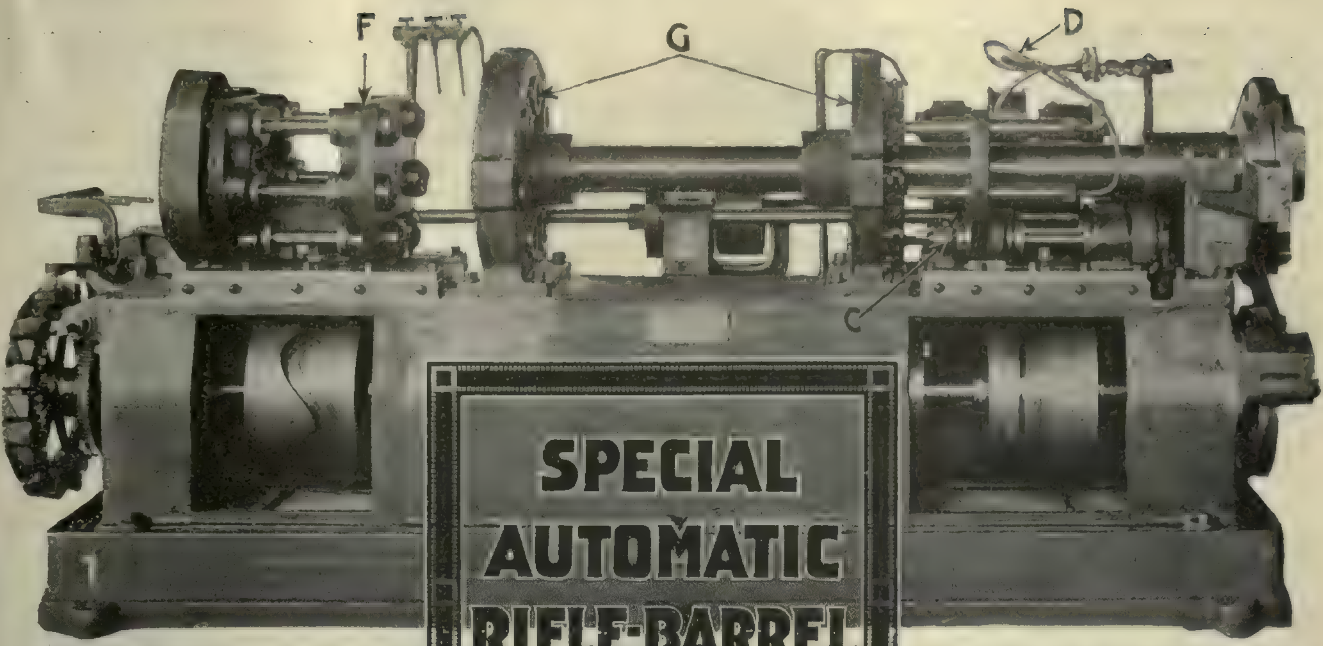


FIG. 2
BENDING DIES FOR TUBING



SPECIAL AUTOMATIC RIFLE-BARREL MACHINE

By
E. H. Ingram

THIS article describes a machine that was designed by the writer while employed as mechanical engineer in one of the largest rifle plants in the country. Several of the machines are in operation there. Three distinct operations are performed simultaneously—cutting the barrel to length, finishing the muzzle end and chambering the cartridge chamber in the breech end.

The machine has three working heads. The head *A*, Fig. 3, is the cutting-off head, which carries a saw and is driven by a separate belt on the pulley *B*. The head *C*, Fig. 1, has two spindles, which are fitted with special-purpose tools. As this is a particular operation, two tools are used, so as to insure a perfectly smooth job. The first tool removes the bulk of the stock with the exception of about 0.005 in.; the second tool finishes the muzzle a perfect finish, as it is absolutely necessary that no burr or roughness be left on the end of the rifling or bore.

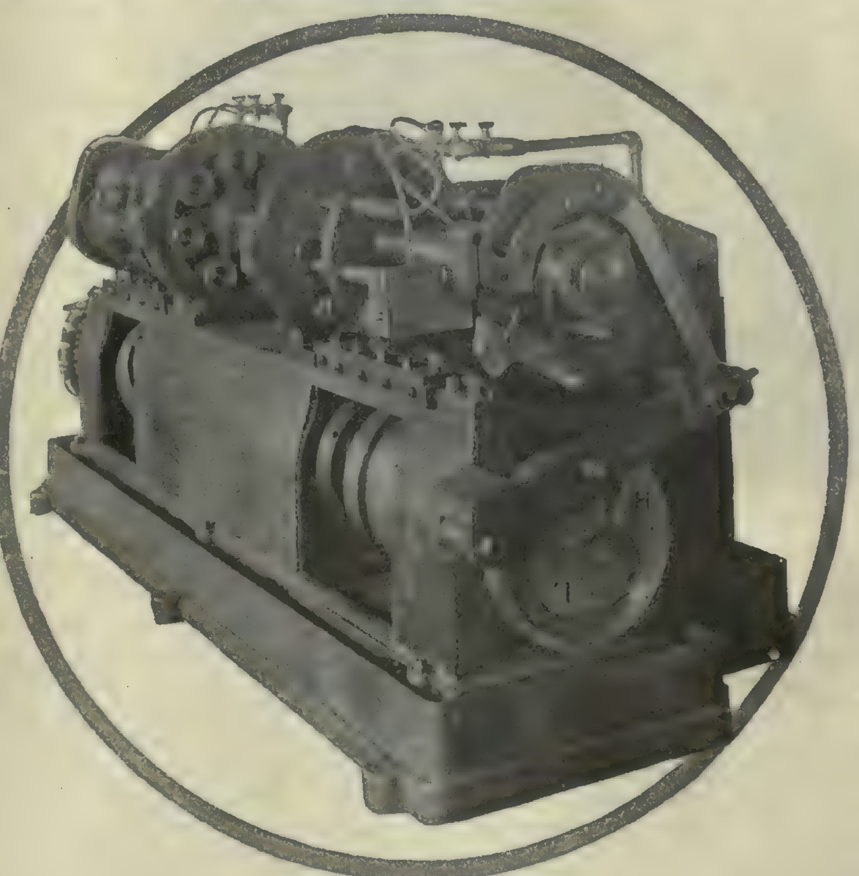


FIG. 2. MUZZLE-WORKING END OF MACHINE

This head also carries the oil connections *D* up to the muzzles of the barrels, by which a force of oil is delivered through all of the barrels with the exception of the one that the cutting-off saw is operating on. This oil supply is furnished by a pump *E*, Fig. 3. The supply is automatically controlled by a special two-way valve so that the oil is shut off when the tools are not in actual operation and when the turrets are indexing, avoiding all disagreeable splashing of oil.

The head *F*, Figs. 1 and 4, has six spindles, which carry a series of tools for boring and reaming the cartridge chamber. Oil is supplied direct to these tools as well as being forced through the muzzle end, so as to insure sufficient lubrication. This chambering is about as important an operation as any on the rifle. It has to be perfectly round, free from all scratches and roughness as well as within a certain maximum and minimum size.

The barrels are held in the turrets *G*, Figs. 1 and 4, which have seven stations, the top station being used for loading and unloading, which is done while the machine is in operation. The chambering tools are set up successively from roughing to finishing. After the first complete revolution of the turret, a barrel is finished every time the turret indexes one space.

The work heads are operated by cams all on one shaft *H*, Figs. 2, 3 and 4. The cam *I*, Fig. 2, which operates the indexing mechanism, is on this shaft, which is driven by the worm *J*, Figs. 3 and 4, and the worm gear *K*. The worm *J* is driven by a pair of differential pulleys *L*. These pulleys transmit a fast and a slow speed, so that when the turret is indexing and when the tools are coming up to the work and backing out, the high speed is used. This shaft runs at normal speed only when the tools are in the cutting operation.

The cam that operates the head *F*, Fig. 1, is three-throw, carrying the tools forward and back three times, removing a proportionate part of stock at each forward movement of the head. In this way complete clearance of the chips is provided for. The force of oil through the muzzle of the barrel washes the chips clear of the tools, thus insuring the required perfect chamber. The spindles of the heads *A* and *C*, Figs. 3 and 1, respectively, are driven by the shaft *M*, Fig. 3, the transmission to the spindles being through gears.

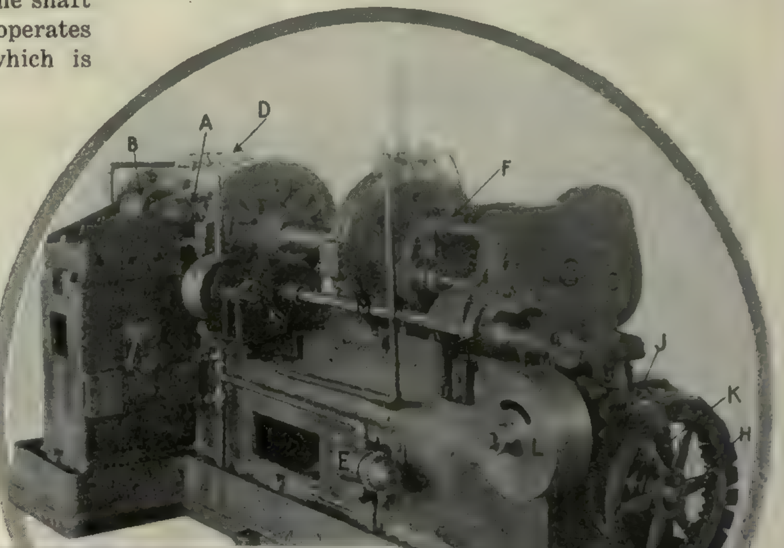


FIG. 3. BREECH-WORKING END

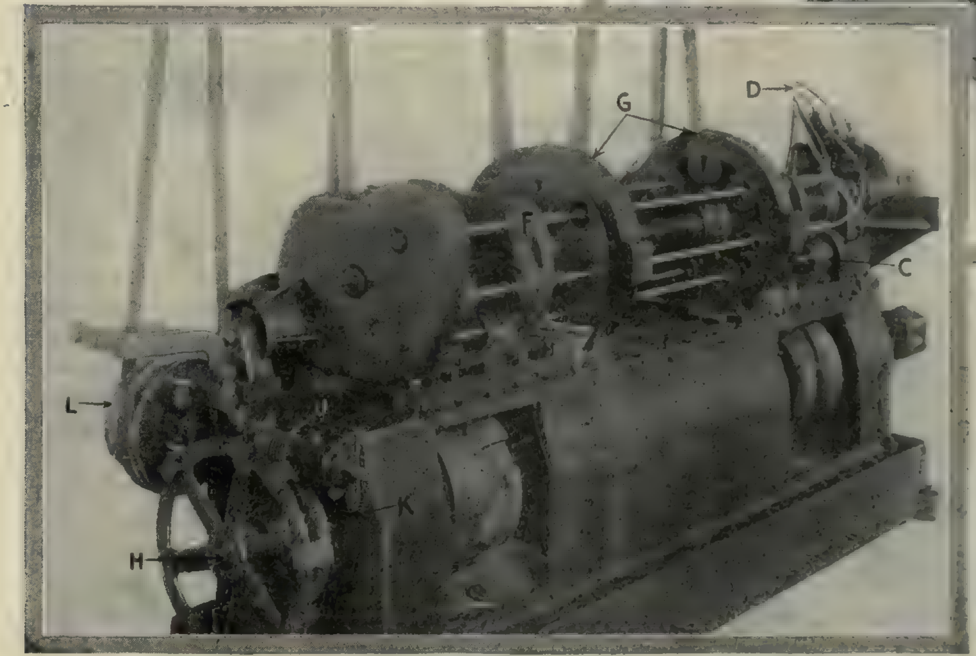


FIG. 4. CAMSHAFT DRIVE

The production and quality from this machine have proved to be far superior to the results obtained from previous methods. Moreover, two operations that were previously done separately are now performed at one time. The following figures are taken from the production and inspection reports: Out of a run of 4280 barrels from the automatic machine 20 were rejected, and out of a run of 2709 from the hand machine 183 were rejected. The production is in favor of the automatic and one operator can run two automatics.

Trade with South America*

By G. E. Briggs

Buenos Aires branch of National City Bank of New York City

At a time like the present, when all thoughts are turned toward the successful accomplishment of the great task which we have set for ourselves, words concerning export may, to a casual observer, seem inopportune. But, in reality, this is precisely the moment when we cannot afford to overlook so essential a phase of our national evolution.

England has realized the imperious necessity of continuing her export activities to an extent which is compatible with her participation in the war. Several of England's greatest industries have continued to manufacture products for foreign markets in quantities hardly surpassed in times of peace. This trade has enabled that country not only to strengthen her already firm hold on her export markets, but has, furthermore, provided a source of revenue that has been of inestimable aid in enabling her to bear the financial burden of the struggle. To such an extent has that country gone in protecting this trade that English manufacturers, in many cases, have been delivering with fewer delays than has been the case with North American manufacturers, in spite of the war-time burdens which England was forced to bear.

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*Extract of paper read at Convention of National Machine Tool Builders Association, New York, Oct. 30-31.

Germany realized the danger of abandoning the foreign markets to her competitors and prior to the struggle filled the custom houses of South America with merchandise evidently calculated to supply the demands of those countries for the duration of the war. Even in the heat of the struggle, no possible outlet for exports was overlooked, and hardware in cases marked: "Made in Switzerland," and many other forms of merchandise arrived in Buenos Aires long after the world in general believed that Germay was entirely cut off from those countries. So that even today, after three years of war, German merchandise is still obtainable in South America. I bring up these points merely to demonstrate the value which other nations place on their export business and the extent to which they have gone to preserve it during the period of trial.

Least of all should the United States neglect the opportunity for national expansion which has been presented and which is not only of inestimable value, but also of necessity. The position of American business men in regard to foreign trade is much more advantageous than it was three years ago. Many of the facilities, the lack of which formerly acted as a great handicap to the exporting house, are now available and others will come when normal conditions prevail. American banks are now established in the principal commercial centers of South America to aid American business in building and maintaining a trade with those countries. The National City Bank has 11 branches in South America and the West Indies. In every branch is a commercial attaché who studies the market for goods manufactured in the United States, supplies detailed information concerning the market to American manufacturers through the foreign trade department of the bank at New York, acts as an intermediary to find manufacturers the proper representatives, keeps in contact with merchants in those countries and puts them in touch with firms in a position to supply goods wanted, reports periodically on general economic conditions and aids the visiting representatives of American houses in establishing themselves.

Well organized credit departments in every branch provide the required information concerning houses in those countries, inform inquirers concerning North American concerns which have approached them and thereby obviate the previous difficulty experienced by both South and North American merchants of ascertaining reliable information concerning the responsibility of houses proposing business. Banks are available and an unsurpassed commercial information service.

New Merchant Fleet To Be Big Help

The lack of transportation facilities, while it will be certain to present great difficulties for the duration of the war, will be obviated when the great fleet of merchant vessels being constructed by the United States for war purposes becomes available after the war for general merchant service under the American flag.

These facilities, which never existed before, will be available for the American manufacturer. The advantage taken of them and the final result depend on the effort of the individual, his ability to supply goods which will compete in quality and prices with those of other producing countries, his selection of the proper representative, and in general his adaptability to the requirements of the market he intends to enter. Even with these facilities and a well-considered course of action, the result is by no means sure and will depend largely on preparatory steps taken at the present time.

Three years ago these importers did not hesitate to say that to the best of their judgment United States merchants would be unable to interest them in doing business, but when a shortage was foreseen, they of necessity began to buy, at first on as small a scale as possible, to ascertain where confidence could be placed. Then finally when the shortage became acute, at least in the case of the Argentine, orders followed which made the heads of business houses consult the atlas to see what manner of country was this whose eight million inhabitants could buy on so large a scale. Steady progress has been made from that point until at the present time the United States, with only three years of experience in general exporting, has come to occupy the position of principal provider of those countries.

Argentine Market Is Difficult

It is an admitted fact that the Argentine market for reasons I have named is the most difficult in the world in which to obtain a foothold. Once the trade is convinced, however, after a long period of trial that the products offered are suitable to the market and can be sold at a profit, and that the concern is serious, as the South Americans say, in its dealings, the very factor which made the entry difficult renders the hard-won position secure.

The Markets for Machine Tools

The Argentine, for example, is a purely cattle and agricultural country. Raw materials for a metal-working industry, generally speaking, do not exist in the country, and in the few cases where mines have been found they are so far from the coast as to render uneconomical their exploitation. There is a considerable importation of machine tools, however, into this country, for use in the government and railroad shops, and in the small industries that exist.

The government maintains shops in connection with its marine and department of public works, and is occasionally in the market for machine tools. Purchases are made almost exclusively from local importers who carry a stock of machinery and are in a position to make immediate delivery. It is their custom to call for competitive bids from these importers. It is necessary, therefore, to approach the government by first selling one of these importing houses.

Seventy-five per cent. of the railroad mileage of the Argentine is owned by English capital, 14 per cent. by the state and 11 per cent. by French companies. The so-called English railroads purchase all their supplies through their London offices, and it is only in very exceptional cases that purchases are made in the Argentine. The French railroads purchase most of their supplies in Paris, it is true, but obtain a much larger proportion of their requirements in the Argentine than do the English roads. The state railroads purchase from local importers, on competitive bids, as do the other departments of the government.

The metal-working industries are permitted to exist through the protection of the Argentine tariff. The principal products are bolts, nuts, screws, wire nails, brass and iron beds and springs. In addition to the establishments which constitute these industries there are many other machine shops engaged almost exclusively in repair business and the manufacture of repair parts.

It is generally estimated that prior to the outbreak of the war 75 per cent. of the machine tools imported, exclusive of those for the use of the English railroads, were of German manufacture. The German manufacturer, through giving the utmost consideration to the requirements of the market, had succeeded in practically displacing the English machine from the market.

American Tools in Railroad Shops

The majority of the American tools in the Argentine are in the shops of the English railroads and have been purchased by the London offices of those railroads from the English offices of the American manufacturers. The most careful mechanical work is done in these shops, and the necessity of having exact high-production machines is realized. Only a few American machines are in the government shops, and still fewer in the smaller industries.

Brazilian Products More Varied

The products of the Brazilian industry are more varied than are those of the Argentine. Even a few locomotives have been manufactured in the railroad shops. As a rule, however, the work is limited to locomotive and rolling stock parts, in general, and to the manufacture of certain small lines in private industry. English and French capitalists are also prominent in railway ownership in Brazil, but a much larger proportion of the requirements of the roads are filled in the country.

English and American machine tools have always been the standard of the market in Brazil, but during the few years immediately preceding the outbreak of the European War, German firms encroached to a considerable extent on this business. A special advantage presented by the Brazilian market in the eyes of the North American builder is the recognition of the superior merits of the American machine, and the willingness to pay the extra price.

A still more favorable market exists in Chile. The principal users of machine tools are the government, and when I mention the government I include also the railroads which are all state owned, and the mines. The government shops are largely equipped with American machine tools at the present time, and as an item of added interest I might mention the fact that a great establishment is now being built there by an American concern, to construct locomotives for the state roads. The Chilian government and administration of railroads usually buy their supplies through houses in Chile. Occasionally, however, at a time like the present, when they are encountering the greatest of difficulty in obtaining supplies, they send a commission to an European or to the American market. Shortly before I left Chile a purchasing agent of the state roads came to the United States to buy supplies of all kinds. It was said at that time that this man would undoubtedly be high up in the administration of the railroads upon his return, and it is to be hoped that his experience in the United States will incline him favorably toward American goods. Shortly thereafter a commission of five or six young men came from Chile to the United States to study the American railroad system. They intend to spend two years in this country, and it is expected that they will be the ones to dictate the Chilian railroad policy of the future. With these favorable influences the Chilian government should be a very good customer for American machine tools.

Plan for Capturing the Trade

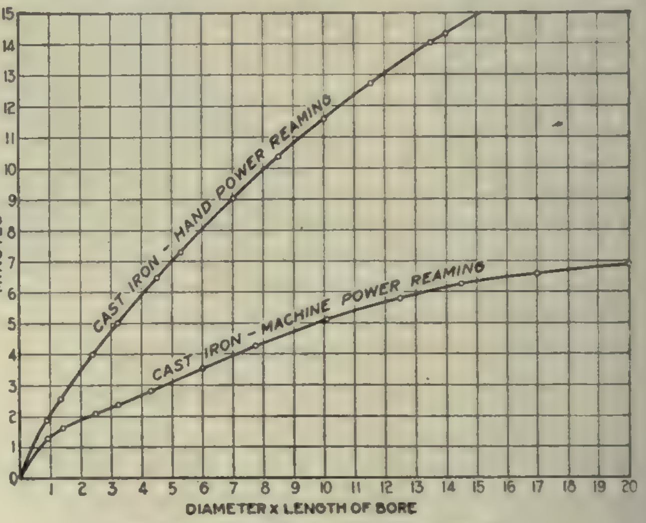
I would suggest the following plan of sales organization as the best adapted to the requirements of machine tool builders: The coöperation of a number of noncompetitive firms in establishing a representative in South America to work through an importer in each market appointed the exclusive agent for that territory.

These houses will carry stock and attend to the orders for the small industrials and shops and others who buy stock in the market. The representative will travel from one market to another, coöperating with the agents and seeing that the attention of the agent to this line is not allowed to fag, and dedicate himself especially to the larger business, acquainting his principals with the opportunity to sell large buyers, who make their purchases in other markets. Such an organization should be built up at the present time in order that the foundation may be well laid and the American business house may be in a position to meet the keenest competition that the world has ever seen on as near an even footing with his competitors as possible.

Reaming Charts and Data

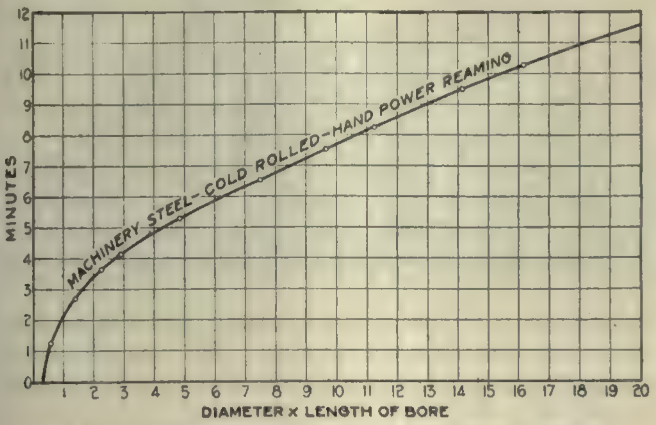
By Karl G. Keck

In a previous issue of *American Machinist* were published data concerning reaming, especially that done on the boring lathe with the reamer held in the turret and forced through the work. Accompanying these data was a request for further information on reaming. In compliance with this request I am submitting the accompanying graphic charts and data.

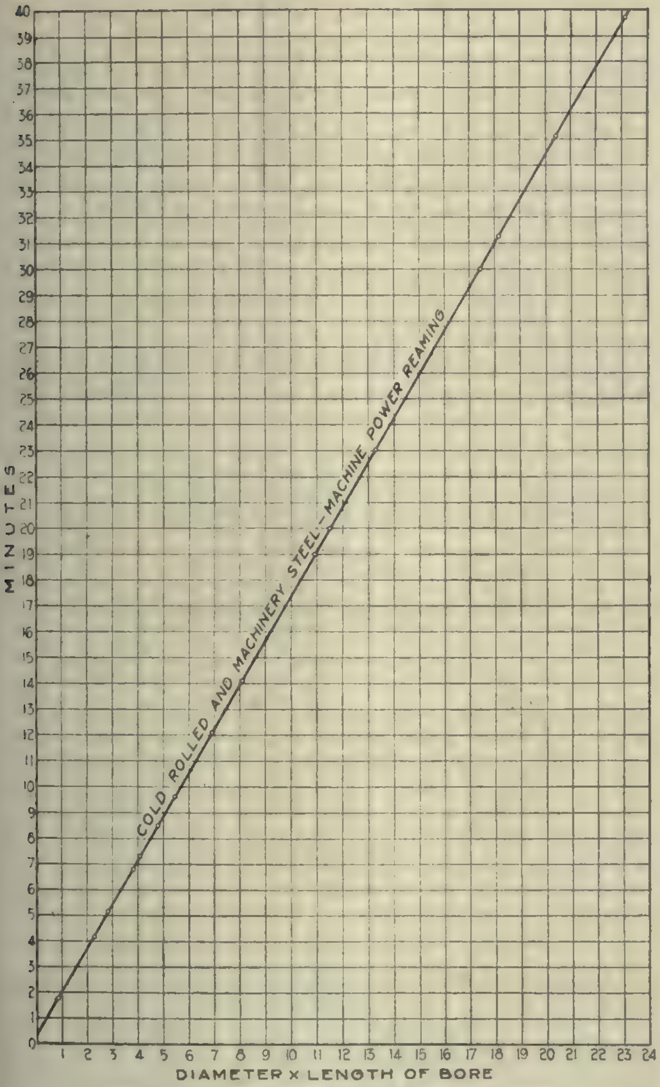


REAMING CHART FOR CAST IRON

These curves are the result of reaming time taken from various metals reamed by hand power and also by machine power. The hand reaming was done by holding the reamer in the vise and turning the work upon it by hand. The machine reaming was done by chucking the reamer in cone pulley and geared lathe heads, mounted on tables, allowing the head to turn, and pressing the work over the turning reamer by hand. A large wrench clamped about the work facilitated holding it and prevented catching by the adjustable reamer blades. These were used in all cases on the heads, while solid reamers were generally used on the reaming block.



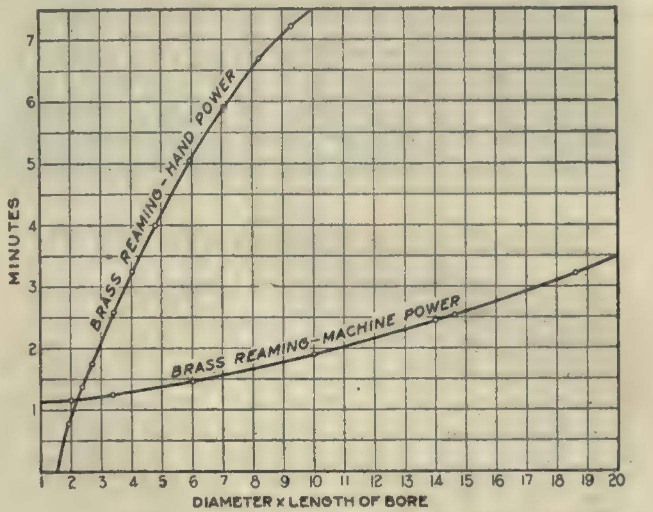
HAND-POWER CHART FOR MACHINERY STEEL



POWER CHART FOR MACHINERY STEEL

The curves are of course not absolute in all cases, as the time varies, as do the quality and quantity of the stock to be removed by the reamer. The curves are averages, giving, practically, time on every piece of work reamed in the reaming department in two months' time and covering therefore all conditions.

The cutting speed of the machine-turned reamers when reaming steel was from 5 to 12 ft. per min., and for cast iron from 7 to 18 ft. per min. A smooth hole resulted in all cases, as the feed was not automatic and the work was pressed upon the turning reamers with constant force, allowing the reamer to perform to its limit. The work was pressed upon the stationary reamers as the strength of the man permitted.



REAMING CHART FOR BRASS

Following is a formula we used in approximating reaming time:

$$\frac{S}{D}=\frac{N}{K};\quad \frac{N}{F}=\frac{L}{T};\quad \frac{SK}{D}=\frac{FL}{T};\quad T=\frac{DFL}{SK}$$

S = Feet per minute cutting speed (peripheral);
D = Diameter in inches;
N = Revolutions per minute;
$K = \frac{12}{\pi} = 3.82$ (approximately);
F = Feed in revolutions per inch;
L = Length of cut in inches;
T = Time in minutes.

Let $\frac{DF}{SK} = D^1$; then $T = D^1L$, a straight-line equation, and for L the lines are parallel. Any other variable will cause the lines to diverge, such as (1) the time of bracing the work to ream, (2) trying different plugs (their weight may influence time), (3) lifting heavy reamers or work.

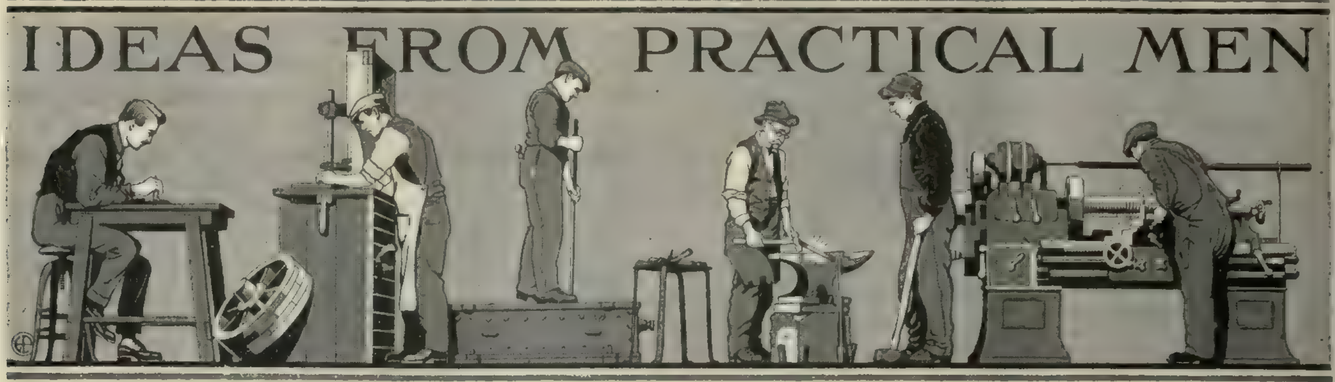
Changing Part Lists

By Ralph R. Weddell

A scheme that eliminates re-inking the box lines on a tracing of a part list or a bill of material is to have the lettering on the opposite side of the tracing from the box lines. Thus when there is a change, the lettering will be the only inking erased, as the box lines, being on the opposite side of the tracing, are not touched by the eraser.

Care should be taken when the original is traced to see that, when the side with the lines is reversed, the guiding inclosure or box lines of the bill of material or part list will be in the correct positions.

IDEAS FROM PRACTICAL MEN



Rack-Cutting Attachment for the Shaping Machine

By M. O. Cross

The principal object of the attachment, or device, illustrated is to afford a cheap and inexpensive method of cutting racks. Rack cutting, as we all know, is one of the perplexing operations in a shop. The attachment herein described may be used on any shaper or planer, to cut racks of any length and any pitch, and it will show a production rate that will surprise any efficiency engineer.

In Figs. 1 and 2, *A* is a master gear containing the same number of teeth as the cutter; *B* is a standard Fellows gear-shaper cutter, of the same pitch as the rack to be cut. A stud is permanently fixed in the clapper box of the shaper. *D* is a master rack, of the same pitch and twice or more the width of the rack to be cut. It is permanently fixed to the vise or bed plate of the shaper. This vise for holding the master rack and the rack to be cut is shown at *E*. A rotating sleeve is placed on the stud, to which are permanently fixed the cutter *B* and the master gear *A; G* is the shaper.

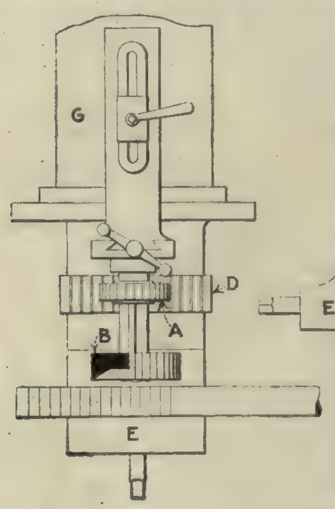


FIG. 1. TOP VIEW

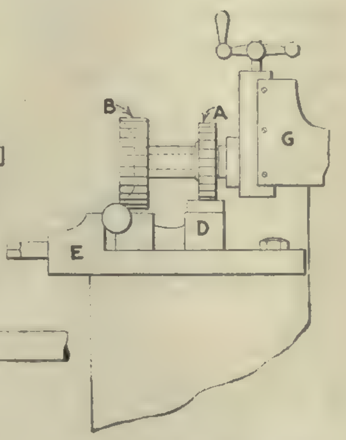


FIG. 2. SIDE VIEW

The operation is as follows: Insert the rack blank to be cut, in the vise *E;* feed the cutter *B* and the master gear *A* down to the depth to be cut. Next, engage the standard longitudinal feed of the shaper, and the gear *A* mating in the rack *D* will revolve the sleeve, which in turn revolves the cutter *B* in proper relation to the circular pitch to be cut.

The racks so cut are more nearly perfect and stronger than those cut with a single cutter, and the production is limited only by the feed. We have cut racks up to 12 ft. in length by simply stepping them along in the vise.

Solid spiral and herringbone racks may also be cut with this attachment, and the cost is comparatively small as compared with expensive miller equipment.

Chart for Determining Approach of Milling Cutters

By A. W. Hinkel

The charts and formulas submitted by Mr. Reuter on page 928, Vol. 46, for determining the "approach" of a milling cutter, give very accurate results. My contention, however, is that, in ordinary time study, estimating the use of three- and four-place decimals in fixing the length of this approach (as by Mr. Reuter's method) is quite superfluous, in view of the time necessary to complete calculations by this method. A tolerance of $\frac{1}{32}$ in. is within good practice.

I have been using a simple chart for this purpose, with very good results. It saves time and is accurate. Two scales are laid off at right angles to each other with divisions of $\frac{1}{8}$ or $\frac{1}{16}$ in., as the user may desire. One scale is extended by a line that corresponds with the center of the cutter. The accompanying sketch illustrates two applications. The one shown by the upper line represents a layout for determining the approach of

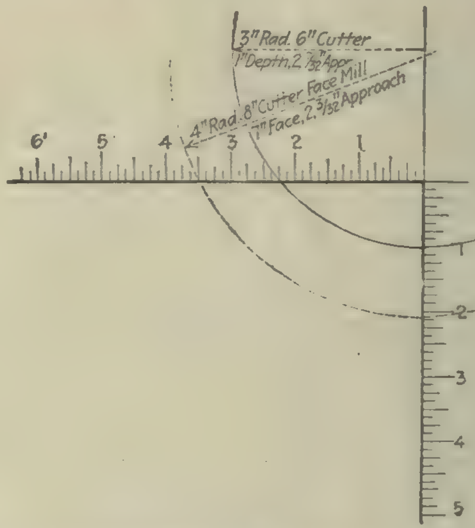


CHART FOR DETERMINING APPROACH OF MILLING CUTTER a 6-in. cutter with a depth of cut of 1 in. The dividers are set at the radius of the cutter, and one leg is placed on the vertical scale at the desired depth of cut. A center is located on the vertical line with the other leg. The first leg is then moved over to the horizontal scale, and the reading at the point of intersection will be the approach of that cutter.

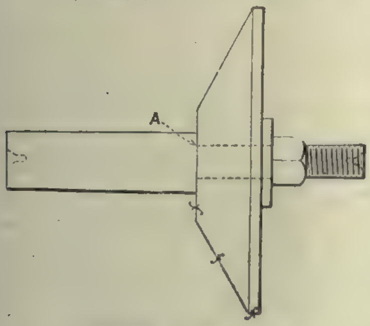
The lower line represents an 8-in. cutter face-milling a 7-in. wide piece. In this case the method is the reverse of the first. Placing the dividers on the horizontal scale at the distance equivalent to one-half of the width of the piece, strike a center on the vertical line. Readings are obtained on the vertical scale.

Various other uses that can be found for this chart will readily suggest themselves.

Arbor Kink Prevents Marring the Work

BY C. ANDERSON

In turning the casting shown, I was often troubled by having the work turn on the arbor, which is made of soft steel. The casting is of iron. Whenever the arbor turned in the casting, the face *A* of the arbor and its corresponding bearing on the work were partly roughed up. Not only was the work disfigured, but the shoulder on the arbor had to be replaced. I tried putting a pipe on the wrench and tightening the nut for all I was worth, but even then it would turn occasionally when the tool caught on a high spot. I have eliminated this nuisance by applying oil on the bearing surfaces, which are no longer roughed if the tool catches on the work. This kink seems very simple, but it has nevertheless saved me a lot of bother.



CASTING AND ARBOR

Producing Army Canteens, and Similar Work

BY A. H. STEEL

On page 516, Henry Ginsburg asks for a method of producing army canteens and similar seamless work. The shell is first drawn round to a shape and size that will produce the canteen, after it is flattened by the finishing operation, at least two drawings being required. After drawing the shell is put on a sectional chuck and spun down at the top to about one-third of the diameter; or as small as possible to still be able to remove sections of the chuck.

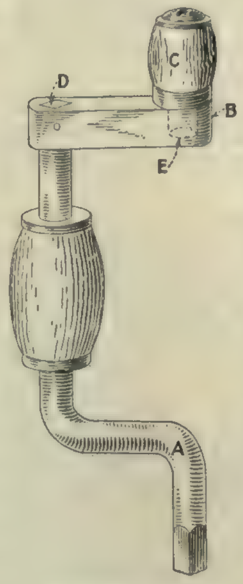
In the next operation they are chucked over a threaded arbor of the required size for the filler thread, the arbor extending to the bottom of the bottle; the neck is spun down, and the metal is spun into the threads of the arbor, producing the threads for the filler cap, the bottle is screwed off the arbor and a ferrule slipped over the outside of the thread and the flange rolled over to finish the top. The bottles are then partially filled with sand, or liquid, the cap screwed on and are then placed under a die and flattened to the shape desired. This method, with some variations, is generally followed to produce the seamless bottle. However, bottles are being made with the neck welded on, the loss being much less from breaking and defective metal.

Cranked Chuck Key

BY S. E. FREW

To operate the jaws of independent lathe chucks, we tried using a socket or square shank in a bit brace. This suggested the tool shown, which is a crank brace having a throw of 1¾ in. It is somewhat handier for small chucks than the larger bit brace used at first.

The part *A* is made in one piece from ⅜-in. steel rod. The part *B* is of flat iron ¾ x ⅜ in., with two holes *D* and *E*, the latter being tapped for the handle *C*. One end of the rod *A* is driven tight in the hole *D* and held by a pin. The handle *C* is made of parts from a bicycle pedal. This device has been used for some time and has proved to be very useful. It is most valuable where the work is such as to require that the positions of the jaws be changed frequently, but will be found to be of considerable value in any shop where any amount of chucking work is done. The upper end of the part *A*, indicated by *D*, may or may not be squared although the former method of construction would probably insure longer life of the tool.



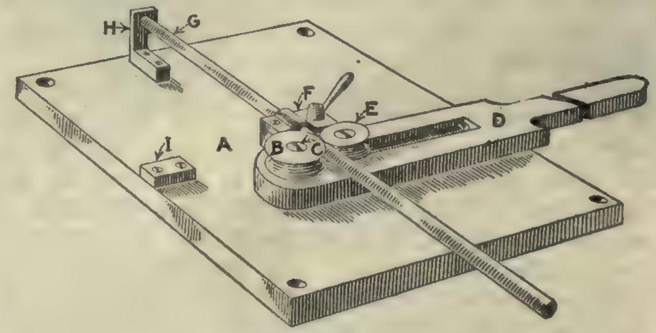
CRANKED KEY

Bending Pipes

BY STEPHEN JAROSS

In reply to the request for a better method of bending the pipes shown by F. P. Terry, on page 121, an illustration is given of a fixture that will bend the pipes referred to.

The iron base *A* carries a pilot roller *B* the size of the required bend minus spring-back of the work. The pin *C*, which acts as a fulcrum for *B*, is also the fulcrum for the lever *D*, which carries at *E* a similar roller to *B*. The roller *E* is adjustable to and from *C* to permit various sizes of pilot rollers *B* to be used. At *F*



PIPE-BENDING FIXTURE

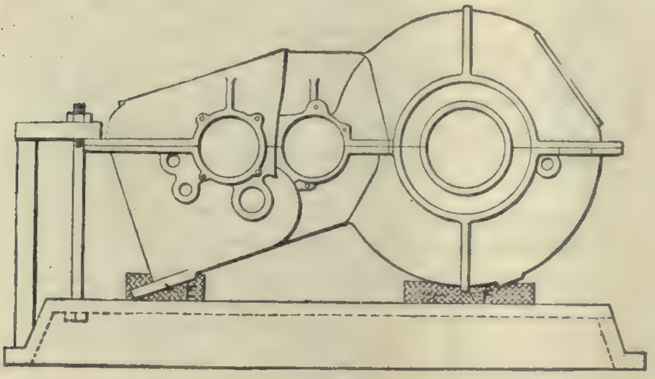
is a clamp for the tube *G*, and at *H* a stop for the end of the tube. At *I* is an adjustable stop, as the tube will spring back slightly. If a different-size circle is desired, the roller *B* must be changed accordingly.

The grooves in the rollers *B* and *E* should be turned about 0.010 in. deeper than the radius of the pipe. As the pipe is only $\frac{1}{16}$ in., it should be filled with fine, dry sand plugged tight on the ends, and heated on the portion that is to be bent. The sand will help to stretch even and hold the heat longer for the operation. The bend can be made in one operation.

Babbitt Blocking for Irregular Work

By J. C. Vize

The illustration shows a casting that was to be machined on a No. 4 Cincinnati milling machine. We were unable to secure it to the subplate in the usual way with clamps and ordinary blocking. The idea of babbitting as at *E* and *F* occurred to me, and I tried it with satisfactory results.



METHOD OF APPLYING THE BABBIT

Cutting a Cam on the Lathe

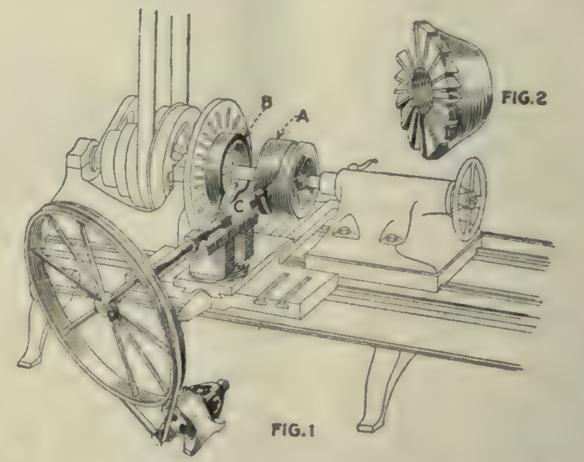
By Robert A. Wilson

The cam shown at *A*, Fig. 1, is of the drum type. It consists of a cast-iron drum 11 in. in diameter by 8 in. long, onto which is shrunk a machine-steel cylinder 1½ in. thick, thus making the outside diameter of the cam 14 in. The groove in the cam is 2½ in. wide and extends the full 1½-in. depth of the steel sleeve. The throws on the cam are 35 deg. 3½-in. advance, 90 deg. dwell, 35 deg. 3½-in. retard, 200 deg. dwell.

It was essential that the cam be very accurate. As it was found impractical to cut these cams on the miller, owing to the fact that the cutter dug in on the steep spiral, it was decided to cut them on the lathe; but a lathe tool would not give satisfactory results. Therefore, the rig shown in Fig. 1 was devised and handled the job in a very satisfactory manner.

A master cam *B*, made from a paper development of one side of the groove, was bolted to the faceplate of the lathe. A bracket with a roller the same size as the one that was to engage the cam was fastened to the lathe carriage. A sheave was put on the back of the lathe, and over this was passed a chain with one end attached to the lathe carriage. On the free end was hung an 800-lb. weight. This arrangement kept the roller always in contact with the master cam.

The lead screw of the lathe was removed to prevent accidental engagement, and the apron was taken off to reduce weight. The milling rig shown at *C* was attached to the lathe carriage and was driven by a 2½-hp. motor placed on the floor and belted to the large pulley as shown. This reduced the speed of the milling cutter to 120 r.p.m. The drive pulley was removed and the lathe driven direct from the lineshaft, which, with the back gears, reduced the spindle speed to 2 r.p.m. The special-shaped milling cutter, Fig. 2, was made of the same outside diameter as the cam roll, and it was fed to depth by the cross-slide on the lathe.



FIGS. 1 AND 2. THE CAM-CUTTING RIG AND THE SPECIAL MILLING CUTTER

This rig handled the work rapidly and in a very satisfactory manner.

Deodorizing Lard Oil

By Robert H. Schafer

Mechanical Supt., Bridgeport Brass Co.

In answer to an inquiry by Ernest E. Hess, I beg leave to state that I had pratically the same experience, and after experimenting with several oils I finally found a substitute in an oil called "Exanol" made by the Union Petroleum Co., Philadelphia. This is I think very close to a mineral lard oil, and the price is very reasonable. The makers claim that it is strictly sanitary, and I know from its use in our machine shop that it has all the good qualities necessary for its proper function. I use it for all kinds of work on Jones & Lamson, Libbey and Cleveland Automatics, Landis or Bryant grinding machines.

Fastening Locknuts

By J. A. Simmons

On some types of machines subjected to a large amount of vibration it is hard to prevent locknuts from working loose. If spring lock washers cannot be used, a thin copper washer covered with a dilute copper sulphate solution will take care of any tendency of the nuts to work loose. The copper washer, being soft, acts like a spring washer, and the solution tends to freeze the nuts and washer together.

The Taft-Peirce Measuring Machine

SPECIAL CORRESPONDENCE

THE illustrations show a measuring machine, designed and built by the Taft-Peirce Mfg. Co., Woonsocket, R. I., for their own use. The design is such that the accuracy is dependent upon the accuracy of the measuring bar and measuring screw only. The various bearing surfaces are so arranged that they do not in any way detract from the accuracy of the measurements. Even the bearing of the measuring screw thread itself is so disposed as to be maintained practically uniform. No sliding members are utilized in the measuring part of the machine, and it is, therefore, very sensitive.

The machine is of a massive and rigid construction. The main frame *A* of the machine is a single casting which is molded and cast with the ways downward to insure their density. The total length of the main frame is 96 in., height 41 in. and width 9 in. Internally it is provided with a number of boxweb braces, disposed to prevent change of shape. It is supported by a 3-point bearing. The width over the ways is 7 in. One 90-deg. V *B* and one flat way *C* are provided for the measuring head *E* and slide *D*. The measuring centers have a height of 6½ in. above the ways. The area of the V-way is 1½ times that of the flat. The machine has a capacity up to 40 in. between the anvils *I* and *M*.

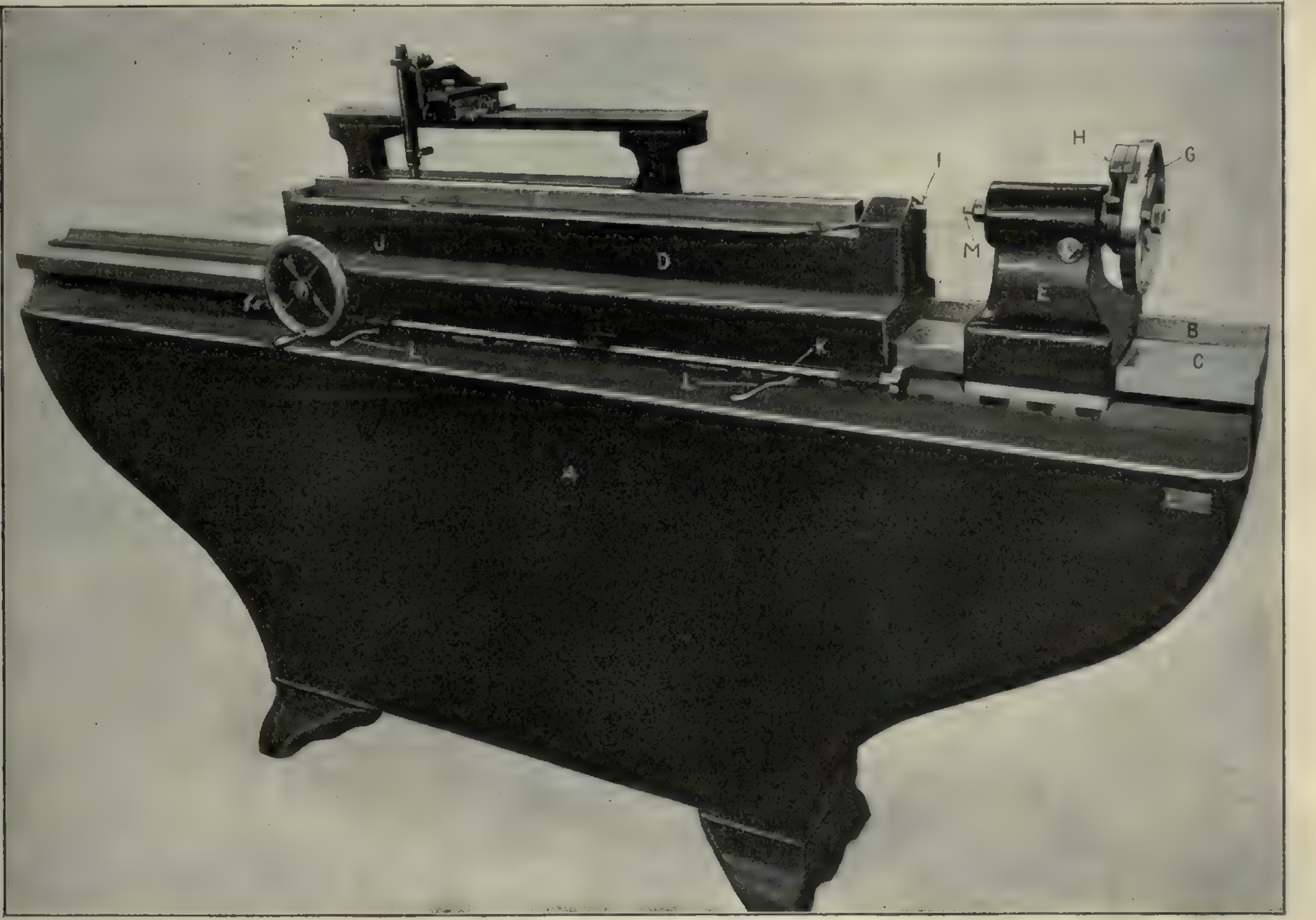


FIG. 1. TAFT-PEIRCE MEASURING MACHINE

The measuring bar *F* is made of Jessops tool steel, the coefficient of expansion of which is the same as the bulk of the material in the work which the machine will be depended on to measure. The center of the upper face of the bar *F* was drilled for the first inch with four ⅛-in. holes spaced ¼ in. apart. The balance of the bar was similarly drilled but at intervals of 1 in. The holes thus drilled were plugged with gold. After lapping the upper surface of the bar and gold plugs, cross lines were ruled in the gold plugs. The first four spaced accurately ¼ in. apart and the others 1 in. apart. The screw in the measuring head *E* has an extreme travel of 0.30 in. This in combination with the lines on the measuring bar permit measurements from 0 to 40 in. to be made. The measuring screw has 40 threads per inch and the shortness of the movement required greatly reduced the difficulties incidental to the production of an accurate screw.

The wheel *G* mounted on the screw, is graduated with 250 divisions giving direct readings to 0.0001 in. It is easily read by any one familiar with the micrometer caliper, as one revolution of this wheel has the same value as one revolution of the ordinary micrometer thimble. It is graduated in a similar manner except that the thousands are subdivided into 10 parts. The vernier *H*, carried by a bracket, can be readily adjusted and gives readings to 0.00001 in. The slide *D*, carrying the fixed anvil *I* and measuring bar *F*, is operated by the handwheel *J*. The spindle on which *J* is mounted carries a pinion engaging with a rack fixed in the bed of the machine. This mechanism controls the traverse of the slide on the bed and is used for rapid approximate adjustments of the slide.

For fine adjustments the knobs on the ends of the rod *K* are manipulated. Mounted on the rod *K* is a worm which engages with a wormwheel mounted on the spindle of the handwheel *J*.

The slide is clamped to the bed of the machine by the two levers *L* conveniently placed at the front.

The measuring head can be set at any point on the bed so that it is not necessary to operate the slide constantly in any one position. The screw, spindle and nut are self-contained in a sleeve, which is held in the plain cylindrical hole in the head, the general design of which is to secure accuracy of alignment.

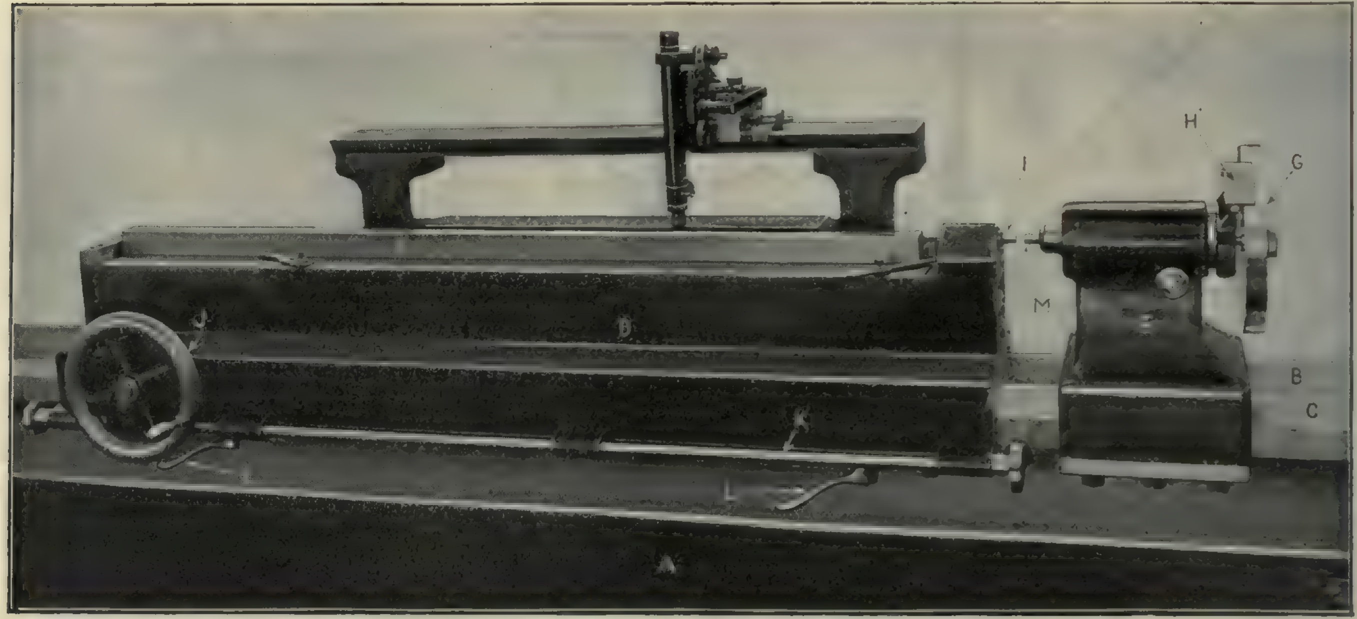


FIG. 2. ENLARGED VIEW OF MEASURING ELEMENTS

The microscope bracket is mounted on ways at the back of the machine and can be set at any position along the full length of the machine. The bracket carries a slide holding the microscope, and is equipped with fine adjustments, so that it can be set in any desired position. The microscope is equipped with lenses magnifying 100 diameters, a vertical illuminator for reflecting the light upon the bar, and a filar micrometer to obtain fine adjustments.

The filar micrometer is not used to obtain measurements in any way. This microscope enables the setting of the slide, by means of the fine lines on the measuring bar, accurately in position. The weight is 2600 lb.

Inspection Without Reason

By M. E. Hoag

Recent conversation with a manufacturer engaged on fine toolwork would seem to indicate either a lack of judgment or ignorance on the part of certain designers and inspectors of thread gages to be used on munitions.

Under ordinary conditions this would not matter so much, but at a time when early delivery of contracts is of vital importance it seems almost a crime that the final say-so should be placed in the hands of theorists instead of in the hands of practical men with a thorough understanding of working conditions.

While we recognize the fact that certain parts of munition work require considerable accuracy, we fail to see why thread gages of 0.308-in. diameter, with U. S. F. of thread, should be held to within 0.0001 in. on any dimension, and especially why the root diameter of the thread should be held to this figure.

Theoretically this is all very nice; but if makers of gages are forced to put it into practice, it means that there will be probably not more than three or four manufacturers in the United States who can qualify on the work, and this in turn means that contractors will not be able to secure proper gages in time to make delivery.

That this so-called inspection is a farce is evidenced by the fact that a certain maker sent a gage to headquarters for approval, and it came back with the notation that it was 0.001 in. too small. The maker tested it and found it to be correct and returned it to headquarters as a new gage, and it was again returned with the notation that it was 0.001 in. too large. Possibly the maker had a "putting on" tool and made the gage larger in that way.

It has always been the writer's opinion that for manufacturing purposes it is good practice to make the root diameter of the male (U. S. F.) thread gage slightly under size and to make a plug gage having the proper root diameter a part of this male gage. The same rule applies to the female or ring thread gage. The diameter at the bottom of the thread groove is made a little large, and a plain ring gage made to the proper outside diameter of the male thread gage is used to gage the outside diameter of the work.

If we are to make munitions on a manufacturing basis, some of this unnecessary fineness of finish must be cast aside and practical working limits be substituted.

Editorials

The Problem of Manning the Shops

WITH machine shops crowded with orders, with nearly every customer claiming preference on account of his work being more or less connected with the war, and with Government officials demanding haste and urging double or triple shifts, the lot of the machine builder is not a happy one. Yet he is, almost without exception, doing his level best, and doing it cheerfully.

Much as he dislikes to run his shop at night, because it means an added burden which he cannot escape, he would not object seriously were he not confronted with the problem of securing the necessary employees. It is often difficult enough to keep a full force in a single shift.

Nor can this be laid to a real shortage of labor as yet, for there are still men enough in most sections. The great difficulty is that there is such a wide variation in wage rates that many men prefer to wait until they get the maximum, or if they take a job it is only until they can secure an opening in a shop paying the higher rate.

One of the reasons for this condition is due to the many "cost-plus" contracts which have been let, and which seem inevitable under the circumstances. Yet this makes it an object for the contractor to pay high wages, as the more he pays the more he takes.

A modification of this plan has been proposed whereby the manufacturer receives the cost, plus a fixed profit per piece. But while this eliminates the profits on the wages, it still leaves him free to offer as much more than the current wage as is necessary to secure all the men he needs, to the detriment of those who are manufacturing at a fixed price, even though their work may be just as important to the Government as the other.

Another serious problem is the stealing of men by firms with a cost-plus contract from firms which are also doing work needed by the army and navy. This is causing grave concern in some quarters and is sure to prove a serious problem unless there is a real attempt at some plan of coöperation which considers production first, and gives careful and equitable thought to the rights of both the employer and the employed.

Production must come first in all cases because any delay means an unnecessary sacrifice of life on the other side. No quarrels here must jeopardize the lives of our boys in France.

Combining Shop and School Education

A MOVEMENT to secure a better grade of workmen for the coming generations has taken definite shape in Newark, N. J., by the beginning of class instruction for twenty-two boys employed by the Weston Electrical Instrument Works of that city. It marks the beginning of a direct coöperation between the public schools and the manufacturers of Newark. The boys will be taught in the plant by an instructor from the public high schools. The course begins with geometry and physics, without textbooks, and making the lessons apply largely to the problems of the Weston shop. When the plan is extended as is now planned, the instruction will give special emphasis on the problems of each shop.

In the Weston shop, all the expenses are paid by the firm, but this may be modified to some extent in other shops; the main thing being to begin the education where it does not already exist, and to extend it where it is already in vogue. All education, which will tend to produce better workmen, to increase efficiency in the years to come, is one of the great necessities of the present.

The Weston plant is also inaugurating a shop-and-school plan similar to that of Fitchburg, Mass., except that it is reversed. Instead of going from the school to the shop, these boys go from the shop to the boys' vocational school for a week and then return to the shop. The boys alternate in pairs as in Fitchburg, but are paid for the week in the school the same as in the shop. The management of the Weston shop is to be congratulated on making such a substantial contribution to the inauguration of a much needed educational activity.

The extension of this work is confidently expected by the school authorities. They are also looking for aid both from the state and from the Federal Government under the Smith-Hughes Act. Education must not be overlooked or neglected because it is more important now than ever before, and it is just as much a war measure as anything not directly connected with shot and shell.

Help Prevent Damage in Shipment by Proper Packing

A BULLETIN recently issued by the Pennsylvania R.R. to shippers says in part: "Before the war, loss and damage on this railroad cost over a million dollars a year. This year it will reach two million dollars. Such a waste is indefensible.

"You are not responsible for all of this. We do some of it. That is the reason we want to coöperate with you to stop it. We are doing our best to handle your goods properly, but it is hard to do when containers are so light that they wont hold together.

"You can help by: (1) Using stronger containers. Boxes should be strong enough to carry the commodity safely. (2) Packing your goods properly. (3) Crating your furniture better. (4) Marking your goods plainly and removing all old marks.

"We can appreciate your desire for economy in packing your goods in these days of high prices for wood, nails, paper, etc., but as we said before, we believe if packages are prepared better it will save money for both of us."

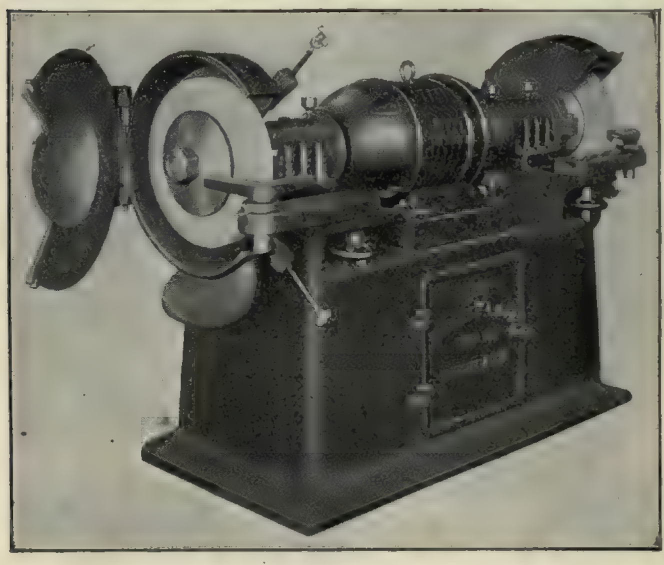
This seems to leave little to be said and we sincerely hope that the desired coöperation may be forthcoming.

SHOP EQUIPMENT NEWS

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

United States Electric Grinding Machine

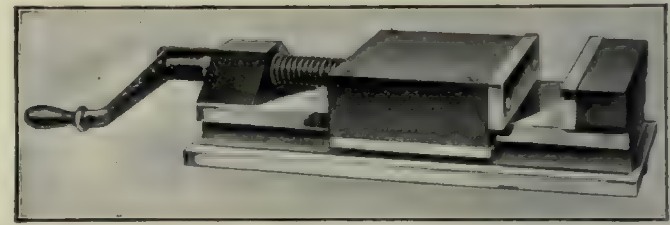
The United States Electrical Tool Co., Cincinnati, Ohio, is now manufacturing a new ball-bearing motor-driven grinding machine in two sizes. The motor of the machine shown has a capacity of 5 hp. and the two wheels measure 18 x 3 in. The second machine has a $7\frac{1}{2}$-hp. motor and 24 x 4-in. wheels. The motors used are Westinghouse type CS. Guards are of steel and can be furnished either with or without exhaust connections as desired. The motor can be furnished with a push-button switch for stopping and starting if ordered made up in this manner. The weight of the smaller machine is 2200 lb.



MOTOR-DRIVEN GRINDING MACHINE

Cleveland Machine Vise

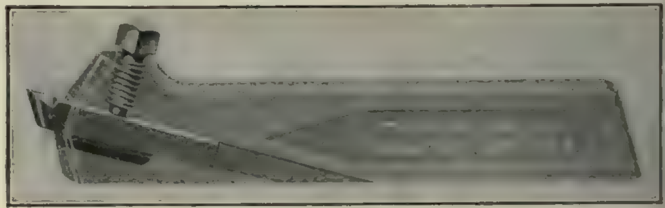
The Cleveland Milling Machine Co., Cleveland, Ohio, is now marketing the plain machine vise shown in the illustration. The base is cast and has a finished flange on all four edges. This gives a large base, which not only makes the device solid, but allows it to be clamped in positions which would otherwise be impossible. The tongue slot on all vises is made an exact distance from the face of the solid jaw. This feature has been incorporated for use where the vises are used in pairs on the machine table. The jaws are of steel and may be readily removed in case of need. To overcome the danger of the vise breaking at the corner of the solid jaw, the base is cast with a core running up into the jaw, which, it is claimed, allows an even distribution of metal and eliminates shrinkage or spongy metal. The movable jaw is gibbed around the outside which obviates the necessity of milling slots in the base for clamping the gibs directly underneath. The regular equipment includes one pair of clamps and bolts, one hand crank and hardened and ground tongues. The weight is 50 lb.



CLEVELAND MACHINE VISE

Ready Toolholders

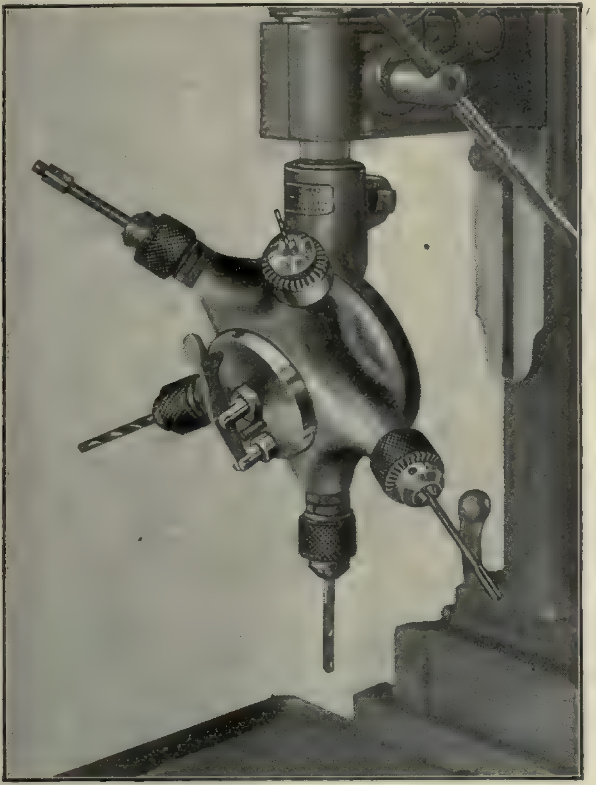
The illustration shows a toolholder manufactured by the Ready Tool Co., Bridgeport, Conn., that has been placed on the market in two larger sizes than have been previously marketed. These new sizes are known as type X4 and type X5. The sizes of the cutters handled are $\frac{1}{2}$ x 4 in. and $\frac{5}{8}$ x $4\frac{1}{2}$ in., while the over-all size of the holders is 1 x 2 x 12 in. The holders are made either straight or with a right or left offset. The holders are made of drop forged chrome nickel steel, and have a half-round section of tool steel electrically welded in place to prevent wear at the lower side of the cutter.



READY LATHE TOOLHOLDERS

Spafford Drilling Machine Turret Head

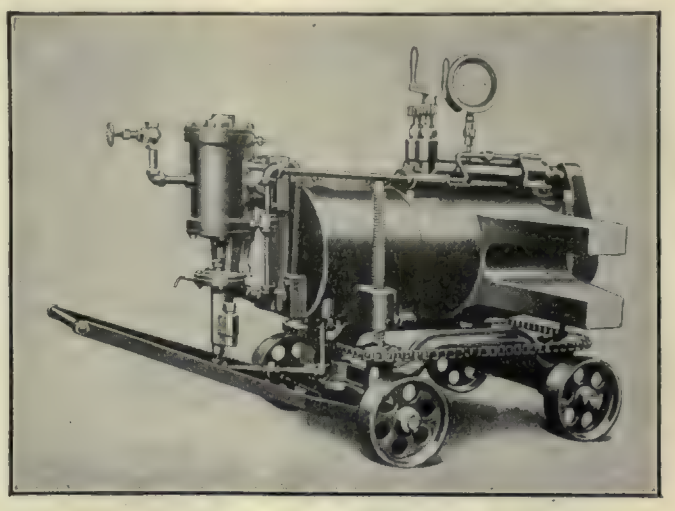
The illustration shows the new 5-spindle turret drilling head attachment that is being manufactured by the Spafford Tool Works, 10 Hoadley Place, Hartford, Conn. It is claimed that the construction of the head is very simple, compact and strong, and that the device takes little more room lengthwise than a chuck. The device is indexed to the various positions by pressing the lever shown at the front, when the turret may be moved around either way to any position whether or not the machine is in operation. The spindles are ball bearing, all those except the one in position for work remaining idle at all times. The spindles run at the same speed as the drilling machine spindle and are central with it. The device is claimed to enable a considerable saving of time where tools of various sizes may be used on each piece of work. The head is built in three sizes, the largest having a maximum drilling capacity of 2 in.



SPAFFORD FIVE-SPINDLE DRILLING HEAD

Watson-Stillman Crankpin Press

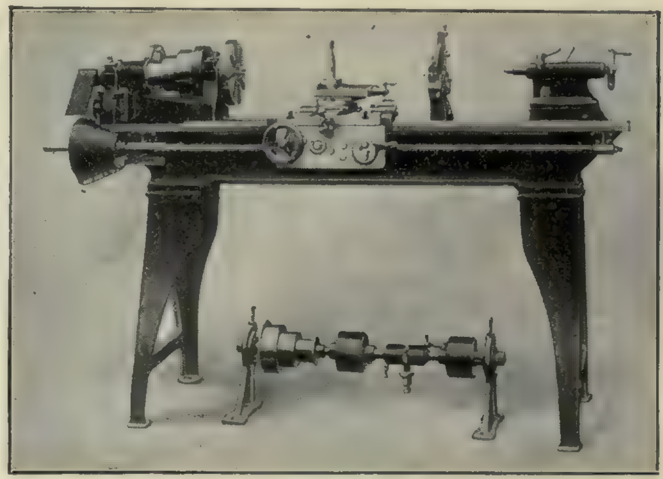
This portable hydraulic press is used for forcing crankpins into locomotive and engine wheels or for other miscellaneous shop and field work. It is the product of the Watson-Stillman Co., Aldene, N. J. The pump is operated by an air engine, and the operating valves are so placed that the man in charge can operate the press in addition to directing the work of the men. A gage is provided that indicates the pressure required to seat the pin, thus making it easy to detect a loose fit. The frame of the press is of open-hearth steel, the side forks being cast integral. The reservoir is mounted at the rear of the press, and the ram operates from the front of the cylinder casting. The height of the cylinder is controlled by four vertical screws mounted on the flat wheeled truck. These screws are connected by means of a chain and sprockets so that any motion of one communicates a like motion to the other three. The ram is returned to the starting position by a small hydraulic cylinder mounted at the top of the press, the piston being connected to a lug on the end of the ram. The presses are built with capacities ranging up to 300 tons.



HYDRAULIC CRANKPIN PRESS

Shepard Lathe

The Shepard Lathe Co., 217 East 8th St., Cincinnati, Ohio, has recently placed on the market a new 12-in. semi-quick-change screw cutting engine lathe that is illustrated. A reversing clutch is incorporated in the headstock rendering it unnecessary to reverse belts or watch a dial when chasing threads. This is due to the fact that the lead screw-nut and the change gears remain engaged, the feed being instantly reversed by the small lever at the front of the headstock. Another feature is the semi-quick-change mechanism which places and locks all the change gears in a cone on the feed roll, and it is by shifting this cone that the proper ratio is obtained. Other features claimed are long bearings on the carriage, compound rest and tailstock; extra

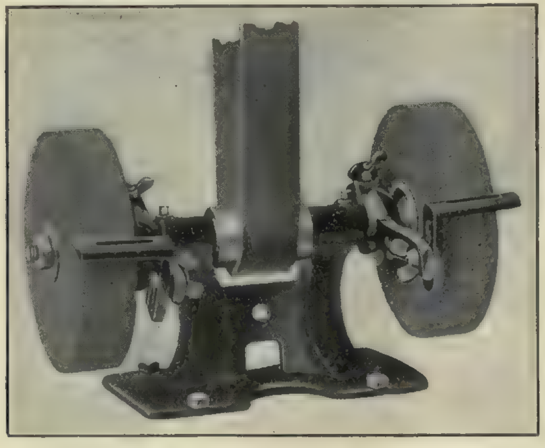


SHEPARD QUICK-CHANGE LATHE

wide belts; large spindle; graduated power cross-feeds; and steel gears for all sizes under 3 in. in diameter. The machine is also made in the 10-in. size, either size being furnished in cone-head, with cone-head motor attachment or geared-head type.

Luther Bench Grinding Stand

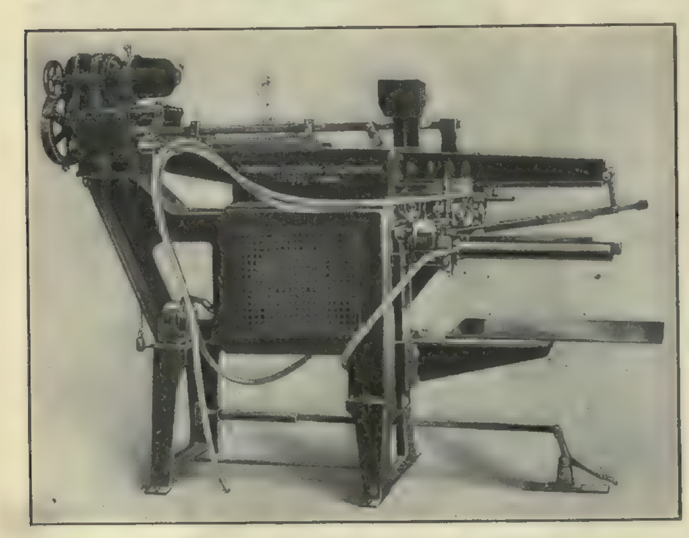
The Luther Grinder Manufacturing Co., 285-289 South Water St., Milwaukee, Wis., is now marketing a small power grinding stand known as their No. 306. The wheels used are 6 in. in diameter and 1⅜ in. thick, coarse and fine wheels being regularly furnished. The machine is claimed to have extra large bearings. It is intended to be fastened to a bench or heavy table and weighs 15 lb.



BENCH GRINDING STAND

Thomson Seam-Welding Machine

The Thomson Electric Welding Co., Lynn, Mass., are now marketing 4 new electric seam-welding machines for welding material not exceeding 16-gage thickness. The 4 machines are known as Nos. 306, 312, 318 and 324, which are of such size as to allow work up to 6, 12, 18 and 24 in. long respectively, to be handled. The illustration shows the 18-in. machine. It is claimed that electric welding is not only faster than lock-seaming or soldering, but is much stronger and neater in appearance, and produces an absolutely air-tight joint. The work to be welded is secured on a jig on the lower horn, or arbor, when pressure on the foot treadle engages a clutch causing the welding roller on the upper horn to move forward. When the roller comes in contact with the stock, the current is automatically turned on, passing from the roller through the metal to be welded to the lower copper horn and thence to the transformer. The resistance of the metal to be welded generates a welding heat so that the pressure caused by the roller makes a continuous weld along the seam. When the roller reaches the end of the seam the current is automatically turned off, and the roller returns to its original position. The welding time depends considerably upon the length of the work, but it is claimed that seven hundred 6-in., three hundred 12-in., two hundred and fifty 18-in. or two hundred 24-in. welds may be completed in an hour. The machines are supplied for alternating current only. A voltage regulator is provided to obtain various welding voltages for different kinds and thicknesses of stock. The welding roller bearing and the lower horn are water cooled.

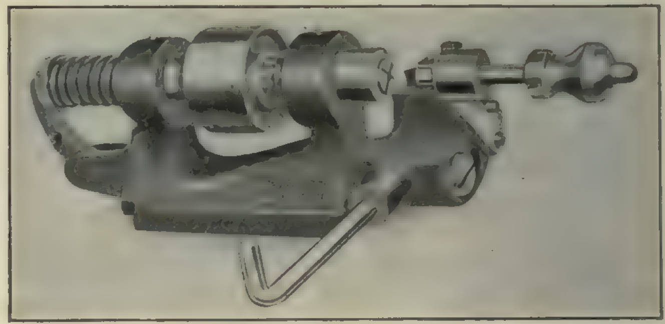


ELECTRIC SEAM-WELDING MACHINE

Floor space of 6-in. machine, 96 x 32 in.; weight, 2750 lb. Floor space of 12-in. machine, 78 x 24 in.; weight, 3500 lb. Floor space of 18-in. machine, 84 x 24 in.; weight, 3150 lb. Floor space of 24 in. machine, 90 x 36 in.; weight, 3500 pounds

De Mant Shell Trimmer

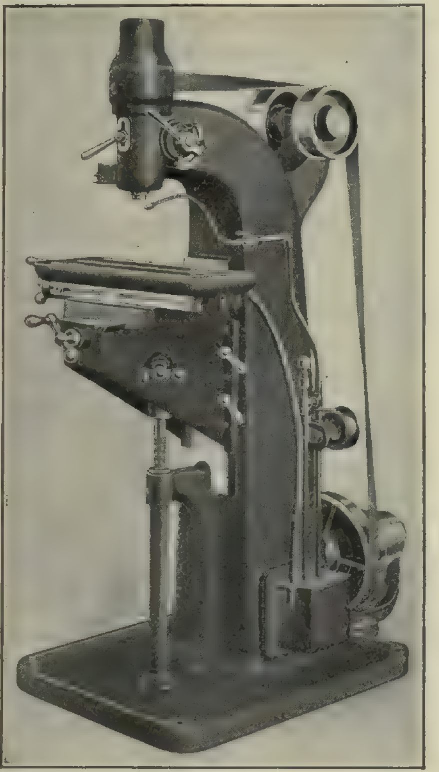
The shell trimmer illustrated is one that has recently made its appearance on the market. It is semi-automatic, and adjustable for trimming shells from ¼ to 2 in. long and from $\frac{1}{16}$ to ½ in. in diameter of any desired thickness. Shells may be fed without stopping and starting the machine. A toolpost permits positive operation with the least effort, and a release lever ejects the finished work without the necessity of stopping the machine. The spindle is hardened and ground to size, and is fitted with adjustable spring chucks. The machine may also be modified for use in filing and polishing pins or other small articles. The bench space occupied is 6 x 15 in. Equipment includes a spring chuck knockout rod and an adjustable inserting bar. The weight is 23½ lb. The De Mant Tool and Machine Co., 79 East 130th St., New York City, is the manufacturer.



SHELL TRIMMER

Taylor & Fenn High-Speed Milling Machine

The vertical high-speed milling machine illustrated is the product of the Taylor & Fenn Co., Hartford, Conn. The machine is intended for the lighter classes of vertical milling with high spindle speeds, and is also adapted for light profiling operations. The spindle is of tool steel hardened and ground, the lower taper bearing running in a bronze bushing. A hardened steel thrust collar is used to prevent the thrust being taken by the taper. The spindle and bushing are mounted in a steel sleeve in the head. This gives a 2-in. vertical movement, controlled by a lever on the side of the head, and operated by a pinion, mounted on the lever shaft, meshing with teeth cut in the steel sleeve. Stops for controlling the depth of cut are provided as well as a means for locking the sleeve in any desired position. Double-row self-aligning ball bearings are used for the spindle pulley. These are independent bearings from those used for the spindle, this construction relieving the spindle of all belt-pull and strain. Idler pulleys are made of aluminum and are mounted on double-row self-aligning ball bearings. The vertical screw for the knee is fitted with a ball thrust bearing. The screw is inclosed and can be moved to its maximum limit without touching the floor. Water channels are provided on the table, their outer edges being milled in the same plane as the top of the table to support extra large fixtures. The table feed screw is of coarse pitch and has a double ball thrust bearing, a feature that makes the table movement sensitive and quick for profiling work. Automatic feed is provided in both directions, and stops are incorporated. A complete water system is also included, the tank being located in the base. The pump and piping may be seen on the side of the column, the outlet pipe having a control valve and an end of flexible tubing. The weight of the complete machine is approximately 1050 lb.



VERTICAL SPINDLE MILLING MACHINE

Longitudinal movement, 11 in.; cross movement, 6 in.; vertical movement of knee, 9½ in.; spindle movement, 2 in.; maximum distance from end of spindle to top of table, 11½ in.; center of spindle to column, 10 in.; size of table, 9 x 21 in.; working surface of table, 6 x 8 in., with ⅝-in. T-slot; size of hole through spindle, $\frac{13}{32}$ in.; taper in spindle, No. 7 B. & S.; number of speeds, eight, 246 to 4000 r.p.m.; floor space, 50 x 30 in.; net weight, 1050 pounds

Skilled Workers Wanted in the Air Service, U. S. Army

There is room on the ground behind the lines abroad for capable skilled American workers.

The air fighters need the backing of skilled men to keep each airplane ready for instant and constant service; to bring up supplies, ammunition, food, clothing, without which the men in the air are useless; to construct and maintain the airdromes, for housing the planes and quartering the men.

Squadrons have been and are now being formed for service abroad. Picked men are being enrolled from various classes of skilled workers; these men will be given special training, according to their vocations, in work required in the Air Service. They will get actual practice work on airplane motors, trucks, airdrome construction, and everything that will be done in service.

The Air Service calls for the following kinds of skilled workers:

Chauffeurs
Auto mechanicians
Automobile engine repairmen
Office clerks
Carpenters
Radio operators
Electricians
Instrument repairmen
Cooks
Coppersmiths
Armorers (machine gun repairmen)
Sailmakers
Photographers
Machinists
Blacksmiths
Motorcycle repairmen
Stenographers
Cabinetmakers
Draftsmen (mechanical)
Magneto repairmen
Metal workers
Automobile engine (testers)
Rope riggers (cordage workers)
Propeller makers (airplane)
Riggers (airplane assemblers)
Telephone linemen
Toolmakers
Vulcanizers
Welders
Lithographers
Packers
Telephone operators
Motorcyclists
Plumbers
Painters
Tailors
Gas works employees
Buglers
Molders
Patternmakers
Telephone adjusters
Barbers
Truck masters
Bricklayers
Cobblers
Propeller testers (airplane)
Boatmakers
Saddlers

Applicants must be physically sound, white, and from 18 to 40 years of age. They will be enlisted as privates and will remain as such until assigned to their proper place in a squadron.

After enlistment the men will be sent to a camp for several weeks of military training and special instruction in the work required.

Squadrons are being formed continuously and as soon as a man is qualified he will be assigned to a squadron and given rank according to his ability.

Clothing, food and quarters are provided free and the pay is in addition; it should be remembered that this pay is all clear gain, as living expenses are borne by the Government.

Applicants should apply to Volunteer Bureau, 119 D St., N. E., Washington, D. C., giving name, address, where employed, trade, number of years in trade and whether subject to draft.

Keeping Belt Glue in Bottle

By C. Anderson

We used to keep our belt glue in an iron pot. After the first time it was used it was not much good, as it would often be months before it was needed again. It would then be pretty well dried out, requiring long heating before it was ready for use.

We now keep our belt glue in a bottle, heating it up in a pot of water. In this way it does not get hard, as it is not exposed to the air, and only a few minutes' heating makes it ready for use.

Supplying Skilled Artificers for the Army and Navy*

By Capt. Cyril Asquith

I will endeavor to say a few words about the specific work which in the Ministry of Munitions it is my duty to discharge. That work consists in the provision of skilled artificers for service in the technical branches of the army and navy.

Artificer is a name we have in the army for skilled men. It is nothing more nor less than a skilled machinist. I think it would probably surprise you to know how large those demands are. The technical branches of the army—that is to say, like the Army Corps, Royal Flying Corps, Royal Engineers, and so on and so forth—comprise altogether about half the total number of the armies. I don't say those corps consist wholly of skilled men, but they consist of skilled men to a greater or to a lesser extent.

Army Needs Thousands of Skilled Machinists

Just to give you some notion of the magnitude of the demands which they make, I may mention that as we left England a demand was presented by the War Office for 40,000 skilled men to work on the railways behind the lines in France, and that about three or four weeks ago we heard that a further demand for 15,000 highly skilled machinists had been presented.

We are embarrassed in our attempts to meet those demands by the fact that in common with practically every other European power, we made the mistake in the first year of the war of permitting the enlistment in infantry and other regiments of highly skilled machinists who would have been much better employed either in civil life upon munitions or in these technical branches of the army to which I refer.

Now, those men have in very many cases been killed or disabled or taken prisoner, or they have been simply lost, can't be traced, or for one reason or another they can't be made available. But, nevertheless, we do attempt to meet these big demands, so far as possible, by pointing out to the war office any skilled men in infantry whose whereabouts, whose unit we have been able to trace, and recommend the War Office to transfer them to a technical branch of the army. The only other source from which we can hope to meet the War Office demands is skilled men already working on munitions of war in civil life.

Of course, it will be readily understood that the utmost caution and reserve has to be observed in withdrawing such men. If they are withdrawn from the more important plants or from the more important classes of work, output suffers correspondingly, and we can't afford that output should suffer. Nevertheless, the greater the output is of munitions of war, the greater the number required of these very skilled artificers who are needed to maintain them in repair at the front. So we live in a rather vicious circle. But we attempt as best we can, from those two sources—the skilled men in infantry and civil men working in civil life—to meet the demands which are presented to us. As I say, our great difficulty has sprung from the mistake we made in allowing the skilled men to enlist in units where their skill could not be employed.

We look to you, gentlemen, to avoid that mistake, and we look to you with the utmost confidence. In fact, we know already that your War Department has taken steps to avoid it. It is about the only mistake we think you should avoid. We have been immensely impressed in the course of our tour with the enormous reservoir of ability and energy and resource which America contains. It gives us high hopes of a certain victory.

Regulation of Trade Disputes*

By H. W. Garrod

The chairman suggested that I should say something upon our method of dealing in England with trade disputes. I can do that briefly.

We haven't got a method, and there is no method. If there is a method, it is part of the larger method of trying to make truth and justice in the Kingdom of Heaven prevail.

We have had, in all, only three labor disputes since the war began, which could be called serious. One of those lasted, I think, ten days, and neither of the other two lasted as much as a week. They were serious to us. They might not be thought serious elsewhere.

Secondly, I'd call attention to the fact that since the war began we have had no dispute at all—no strike, I mean—no strike at all in Great Britain which has arisen out of a demand for higher wages.

Thirdly, and I think equally striking, we have had no dispute at all in which the responsible officials of the trade unions have not stood loyally by the government and against their men. They might have bargained when we first passed our Munitions of War Act—they might have made a bargain with the government that there should be no strikes, and in every instance they have used influence at crises, to keep the peace.

I'd even go a little further and I'd say that in the three serious disputes which I referred to just now, and in the great majority of the lesser disputes which have occurred, I don't believe that the rank and file, the men as a whole have been behind the strike that occurred. In the three instances which I mentioned, at any rate, the work was done, I am fully convinced, after trying to think over the thing impartially, ultimately, that bad work, by a small band in each case of trade union officials, local officials, who were in revolt, not against the government, but against the central officials of their own union, and who were also deeply tinged with pacifism.

I will just add one other word, if I may, which I hope won't be taken as being anything in the nature of advice or criticism. Since we have been in this country, a period now of nearly ten weeks, we have been witnesses from a distance of a very considerable number of trade disputes which have been, so far as we could judge, serious, and, in some cases, prolonged. But what I want to say is that if one-eighth—I think that is no exaggeration—of the industrial troubles which we have witnessed in this country in the past two months had taken place in England, over the whole period of the past two years, we should long ago have been compelled in England to sue for disgraceful peace. That, I think, gentlemen, is a serious and solemnizing reflection, and I want to leave it to you without comment.

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*From a speech at the luncheon to the Special Mission of British Ministry of Munitions to United States, given by the Editorial Conference of the New York Business Publishers' Association, Nov. 13, 1917.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Nov. 17, 1917—Unless one is blessed with a sufficient income to live on (and if he is, a good sized chunk is being appropriated in some form of war tax) it is extremely difficult for him to serve his Uncle Samuel, no matter how much he may want to, or how valuable he may be. If you have money enough to come to Washington at your own expense, to pay your expenses at a hotel or boarding house (and this takes real money these days), you can usually manage to accept a call to duty when it comes. Otherwise you are doomed to be listed a slacker, no matter how much you may desire to put your experience at the disposal of the U. S. A. And I am not referring now to the man who is hunting a chance to help, but to the one who has been sent for, and who feels it his duty to respond.

THE PROCEEDING

The proceeding is about thiswise: Someone suggests that you are just the man for a particular piece of work, perhaps in the Ordnance Department, and you get a wire or telephone call to come to Washington for a consultation. Being a loyal American citizen, you pack your grip, draw some money from the bank, if there is any left after paying the last grocery bill, and obey the call.

You look over the job, they size you up, and you both decide that the work has to be done and that you can do it. And, as the only way you can get on the payroll (not immediately but in the future), or have any authority, they offer you a commission as lieutenant or possibly captain. But this is only the beginning, you are not yet drawing even carfare.

You begin work at once, because they need you badly, and your application for a commission starts on its weary way. You become still more weary in the meantime, especially if your supply of funds is not ample, and you have to wire back home for more.

If you really need money before you get on the payroll, and you do unless you are in John D's class, you apply for a clerkship at $1800 a year, and after swearing a few times, in a perfectly proper, legal and dignified way, you get in the way of a check for $150 per month. For Congress, in its wisdom which passeth all understanding, limited the civilians, who could be employed at over $1800 a year by the Ordnance Board, to thirty. And there are nearer a thousand civilians now on the board, with twice as many more needed.

When you get the $150 a month coming you can usually quit drawing on the home bank account if you stop smoking, cut out such extravagance as the movies, and walk instead of ride. Then you fondly anticipate the arrival of your commission, not so much for the glory of wearing the uniform, and being saluted forty-seven times on your way to work, as to have it all settled and to get the few extra dollars that the folks back home really ought to have.

After a while, from six to ten weeks, the commission gets through the Adjutant General's office and you get your permission to wear the uniform which if you had money enough, or credit enough, you have probably ordered already. But you still are not on the payroll.

You have been working all the time, you are still at it just as you were before you ever got the clerkship, but you do not go on the payroll until you have been officially called to duty; and until this call comes from the proper office, signed by the proper officer, you are still, theoretically, of course, back in Kalamazoo or Jersey, or wherever your home happens to be. But when the call finally comes, in another four to eight weeks, you know you really belong there, and you begin to draw from a half to a third of what you earned before for work three times as hard as you ever dreamed you could do.

There are many men with just the training needed by the Government at this time, who simply cannot do this. For it costs real money to live in Washington these days. In many cases their former employers are paying their expenses until they get finally planted within the fold and can draw whatever stipend is handed out to them. And even then, many are receiving the difference between their old salary and the new.

UNBUSINESSLIKE METHODS

Of course, it is all wrong, it is not business-like in any way, and if our worthy Congressmen had to go through the same agony to get theirs, things would change in a hurry. In their desire to protect the Government from everybody but themselves, they have placed the most petty and picayunish restrictions on the other departments; all of which loses time, causes unnecessary hardship, and is generally inefficient at a time when real efficiency means much to us as a nation, both now and in the future.

There is an excellent opportunity for price regulation right in Washington, and one which has a direct bearing on the conduct of the war. And this is the matter of housing and living for the hundreds who have been called to help during this crisis.

Men who have given up their positions to work at a much lower salary, after they finally get on the payroll, are confronted with exorbitant rents and prices for everything. Men who have good homes in or near New York are compelled to pay from two to three times as much in Washington for the same kind of a house, making the sacrifice doubly heavy in order to do their bit. There are householders in Washington, who are renting their houses furnished for enough money to enable them to pay all their expenses of living in Baltimore, or other cities or towns not far away.

It surely seems as though there should be some way of preventing the men who are already sacrificing more than most of us, from being robbed of what little they receive by exorbitant rents and living expenses. Profiteering is not confined to foodstuffs and munitions, and it should be amputated by the most approved methods.

Niter Cake for Pickling Brass

Niter cake, as a substitute for sulphuric acid in pickling brass, is finding extensive use in Great Britain according to a paper by H. W. Brownsdon before the Birmingham section of the Society of Chemical Industry. The quantity so used in that country now runs into several hundred tons per week. Difficulty in obtaining raw material, coupled with the increased demand for sulphuric acid for other purposes, has resulted in an extended application of niter cake solutions in place of dilute sulphuric acid for pickling annealed brass.

Niter cake, is essentially crude acid sodium sulphate and while the latter in the pure anhydrous state contains theoretically 40.8 per cent. of sulphuric acid, the free acid found in niter cake may vary from 5 to 30 per cent. For pickling, the niter cake solution should show 3 to 5 per cent. sulphuric acid on titration; there is no advantage to be gained in using solutions of higher acid concentration.

While niter cake is a variable product, annealed brass from a pickling point of view may be even more so. Given clean work, niter cake solutions replace dilute sulphuric acid quite efficiently, but with dirty work the difference is much more marked, and niter cake solutions, even under the most favorable conditions, may fail to pickle the work satisfactorily. It is little consolation for the manufacturer to know that his troubles lie in his annealing furnaces. Much may be done to overcome troubles as follows:

The niter cake solution should be as hot as possible. Its acid content should be tested frequently and maintained at 3 to 5 per cent. by the addition of niter cake.

The hot annealed products may be quenched in water whereby much scale is mechanically loosened prior to pickling.

The hot annealed work may be placed direct into the niter-cake solution, and the pickle can thus be maintained at a high temperature without auxiliary steam heating.

Oxidizing agents such as ferric salts, bichromates or persulphates may be added to the pickle, but in many cases the price is prohibitive.

Electrochemical aid might be sought by using a low voltage current, making the lead lining of the vat the cathode and the work to be pickled the anode.

Movement of the work in the pickle, or the agitation of the pickle during pickling, or both.

The difficulties met with in the successful use of niter cake solution can only be overcome in a satisfactory manner by paying close attention to the conditions governing the annealing so as to obtain the annealed brass as clean as possible, and by using the niter cake solution under conditions which will most strongly stimulate its pickling activity.

Personals

Alvin Whitehead is now associated with Clark & Harrison, dealers in machinery and equipment, 149 Broadway, New York City.

W. C. Webster has resigned his position as secretary, general manager and director of the Nichols Copper Co., 25 Broad St., New York City.

Cecil Ogden, for the past twenty-three years with the Rivett Lathe and Grinder Co., Boston, Mass., is now superintendent of the J. T. Slocomb Co., Providence, R. I.

C. B. Murphy has been elected secretary of the Lawson Aircraft Corporation, Green Bay, Wis. **C. I. Smith,** who was formerly in this position, has resigned on account of other interests.

R. H. Daniels has been appointed manager of the export department of the Goodyear Tire and Rubber Co., Akron, Ohio, succeeding **J. C. Macfadyean,** who has left the company to engage in business for himself.

Business Items

Rothweiler & Co., Seattle, Wash., has recently moved to their new factory.

The A. H. Petersen Manufacturing Co. is the new corporate name of the P. & B. Manufacturing Co., 1614-1624 Fratney St., Milwaukee, Wisconsin.

The Wagner Electric Manufacturing Co., St. Louis, Mo., has opened a sales office at 116 Auburn Ave., Atlanta, Ga. Charles M. Welch, formerly Indianapolis branch office manager, is in charge.

The Russell Motor Car Co., 93 Dewey Ave., Buffalo, N. Y., has recently been incorporated. They have purchased a large factory and are equipping it to undertake a contract for the United States Navy Department.

The Nagle Corliss Engine Works, Erie, Penn., has opened an office at 39-41 Cortlandt St., New York City, with Frank W. Richardson in charge. Machinery handled will be air compressors, vacuum pumps and Corliss engines.

The General Electric Co., Schenectady, N. Y., announces that its repair shop at Atlanta, Ga., is fully equipped to give customers repair service on all classes of direct- and alternating-current apparatus. Correspondence in regard to repair work should be addressed to the engineering department, General Electric Co., Third National Bank Building, Atlanta, Georgia.

Obituary

Frank O. Curtis, of the Curtis Screw Works, Buffalo, N. Y., died on Oct. 29.

Joseph Reid, President of the Joseph Reid Gas Engine Co., Oil City, Penn., died on Oct. 23.

Catalogs Wanted

The Russell Motor Car Co., who have purchased a new factory at 93 Dewey Ave., Buffalo, N. Y., would be glad to receive catalogs and other literature from manufacturers.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Condensed Clipping-Index of Equipment

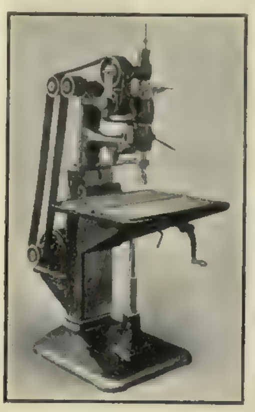
Clip, paste on 3 x 5-in. cards and file as desired

Tapping Machine

Rickert Shafer Co., 613 West 11th St., Erie, Penn.

"American Machinist," Nov. 1, 1917

On this machine the forward and reverse motions are obtained through a patented friction drive which it is claimed practically eliminates the lost motion between the driving and reversing of the tap. Capacity in steel, ¼ to ½ in.; in cast iron, ¼ to ⅝ in.; total height, 70 in.; working surface of table, 20 x 24 in.; maximum distance from table to chuck, 19 in.; distance from spindle to column, 12½ in.; spindle travel, 4½ in.; horsepower required, 1; net weight, 800 lb.



Drilling Machines, High-Speed "Model L-1"

Detroit Tool Co., 1487 St. Antoine St., Detroit, Mich.

"American Machinist," Nov. 1, 1917

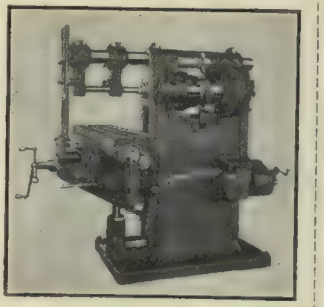
This machine is made in both the bench and floor types, being intended especially for manufacturing work. Its capacity is drills up to ⅜ in. in diameter. Two speeds are obtained by cone pulleys; the maximum being 8000 r.p.m. The spindle is driven from a vertical shaft by means of an open belt; the drive from the pulleys to the vertical shaft being through a pair of bevel gears. All bearings are of the annular ball type. The weight of the bench machine is 156 lb., while that of the floor type machine is 428 lb.

Milling Machine, Plain No. 3

Ford-Smith Machine Co., Ltd., Hamilton, Ont.

"American Machinist," Nov. 8, 1917

Working surface of table, 53½ x 13½ in., with three ¾-in. T-slots; longitudinal traverse, 34 in.; vertical traverse, 20 in.; cross traverse, 10 in.; distance from face of column to brace, 30¾ in.; diameter of front spindle bearing, 3⅜ in.; spindle speeds, eighteen, 12 to 260 r.p.m.; diameter of overhanging arm, 4½ in.; distance from overhanging arm to center of arbor, 9⅝ in.; width of belt, 3½ in.; feeds, twelve, 0.006 to 0.092 in. per spindle revolution; floor space, 95 x 115 in.; weight, 5500 lb.



Tapping and Drilling Machine, Automatic "Cinti."

W. H. Simmons & Co., 208-212 Lawrence St., Cincinnati, Ohio

"American Machinist," Nov. 8, 1917

Maximum diameter of work, 12 in.; maximum distance from spindle to table, 25 in.; vertical adjustment of spindle, 3¼ in.; vertical adjustment of table, 5 in.; diameter of spindle in sleeve, 13/16 in.; diameter of table, 10 in.; diameter of cone pulley steps, 3½ to 7 in.; width of belt, 1½ in.; size of tight and loose pulleys, 7 x 1¾ in.; tapping capacity in cast iron, up to ⅝ in.; drilling capacity in cast iron, up to ⅜ in.; spindle speeds, 150, 250, 390 and 600 r.p.m.

Demagnetizer, "Smith"

The W. F. Davis Machine Tool Co., 540 West Washington St., Chicago, Ill.

"American Machinist," Nov. 1, 1917

This device is made in various sizes, and claimed to completely demagnetize any metal parts as fast as they can be passed through it. The demagnetizer is intended primarily for use on parts that have been machined on magnetic chucks. This device will do its work more effectively and cheaply than other types of apparatus now on the market, so it is claimed

Gage, Thread "Prestwich"

H. E. Harris Engineering Co., Bridgeport, Conn., manufacturers; Coats Machine Tool Co., 30 Church St., New York City, selling agents

"American Machinist," Nov. 8, 1917

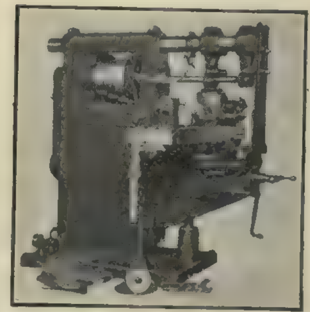
This fixture for the "Prestwich" fluid gage makes it applicable to thread gaging work. It was designed by J. H. Wilhelm of the Frankford Arsenal. The work is supported on two 60-deg. V-blocks, the gage spindle being fitted with a steel roller with a 60-deg. V-groove. The graduations on the vertical scale of the instrument indicate differences of 0.0001 in. The base of the fixture measures approximately 2 x 2 ft. and weighs 250 lb.

Milling Machine, Universal No. 3

Ford-Smith Machine Co., Ltd., Hamilton, Ont.

"American Machinist," Nov. 8, 1917

Working surface of table, 52 x 12 in., equipped with three ⅝-in. T-slots; longitudinal feed, 30 in.; cross feed, 10 in.; vertical feed, 19 in.; face of column to brace, 34 in.; diameter of front spindle bearing, 3⅜ in.; spindle speeds, eighteen, 12 to 260 r.p.m.; diameter of overhanging arm, 4½ in.; distance from overhanging arm to center of arbor, 9⅝ in.; width of belt, 3½ in.; feeds, twelve, 0.006 to 0.092 in. per spindle revolution; floor space, 95 x 115 in.; weight, 5750 lb.



Grinding Machine, Internal

Van Norman Machine Tool Co., Springfield, Mass.

"American Machinist," Nov. 8, 1917

A feature of this machine is the manner in which the grinding head may be moved out of the way to facilitate inspection of the work. Automatic table traverse, ⅛ to 1⅝ in.; hand table traverse, 4½ in.; motion of workhead cross-slide from center of wheel spindle, 4½ in.; swing over table, 11 in.; distance from floor to center of wheel spindle, 44 in.; table traverse speeds, 4; wheel spindle speeds, 4; workhead speeds, 4; weight, 1850 lb.

Patent Applied For

WEEKLY PRICE GUIDE O

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect 12 m., Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Nov. 16, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	....	$20.00
No. 2 Northern Foundry, Chicago......	33.00	$33.60	26.00
*Bessemer, Pittsburgh	36.30	....	29.95
*Basic, Pittsburgh	33.00	36.30	25.95
No. 2X, Philadelphia..............	33.75	33.75	25.00
*No. 2, Valley..............	33.00	33.00	25.00
No. 2, Southern Cincinnati..........	35.00	....	22.90
Basic, Eastern Pennsylvania..........	45.00	45.00	26.00

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Nov. 16, 1917	One Week Ago	One Year Ago	Nov. 16, 1917	One Year Ago	Nov. 16, 1917	One Year Ago
Structural shapes ...	$4.195	$5.25	$3.50	$5.00	$3.60	$4.195	$3.35
Soft steel bars......	4.095	5.00	3.50	4.50	3.60	4.095	3.35
Soft steel bar shapes	4.095	5.00	3.50	4.50	3.60	4.095	3.35
Plates, ¼ to 1 in. thick	4.45	10.00	4.25	7.00	4.10	4.45	4.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Nov. 16, 1917	One Year Ago
Pittsburgh, mill	$4.50–5.00	$2.75
Warehouse, New York..............	4.75	3.50
Warehouse, Cleveland	4.45	3.45
Warehouse, Chicago	4.50	3.35

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Nov. 16, 1917	One Week Ago	One Year Ago	Nov. 16, 1917	One Year Ago	Nov. 16, 1917	One Year Ago
*No. 28 black........	5.00	6.445	9.00	4.50	5.75	3.90	6.445	4.10
*No. 26 black........	4.90	6.435	8.90	4.40	5.65	3.80	6.435	4.00
*Nos. 22 and 24 black.	4.85	6.295	8.85	4.35	5.60	3.75	6.295	3.95
Nos. 18 and 20 black.	4.80	6.245	8.80	4.30	5.55	3.70	6.245	3.90
No. 16 blue annealed..	4.45	5.645	8.20	4.45	5.20	3.95	5.645	4.00
No. 14 blue annealed..	4.35	5.545	8.10	4.35	5.10	3.85	5.545	3.90
No. 12 blue annealed..	4.30	5.495	8.05	4.30	5.05	3.80	5.495	3.85
No. 10 blue annealed..	4.25	5.445	8.00	4.25	5.00	3.75	5.445	3.80
*No. 28 galvanized...	6.25	7.695	10.50	6.50	7.00	5.50	7.695	5.60
*No. 26 galvanized...	5.95	7.395	10.20	6.20	6.70	5.20	7.395	5.30
No. 24 galvanized....	5.80	7.245	10.05	6.05	6.55	5.05	7.245	5.15

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Nov. 16, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Nov. 16, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	15.30	6.30
Chicago	15.00	5.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*	
⅜, 11/32, 5/16, ¼, 7/32, 3/16 No. 8, 5/32 and No. 10 ⅛ .... No. 12 .... 3/32, No. 14 and 1/16 .. No. 18 .... No. 20	21.00@30.00

*Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Nov. 16, 1917	Cleveland Nov. 16, 1917	Chicago Nov. 16, 1917
Tire	5.00	5.00	4.50
Toe calk	5.70	5.50	4.75
Openhearth spring steel...	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Coppered bessemer rods...	9.00	....	....

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4......	29%	17%
4½ to 6......	44%	32½%	4½ to 6......	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	37.9%	23.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	41.9%	26.9%

Malleable fittings. Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Nov. 16, 1917	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	35.00
Tin, in 5-ton lots..............	74.00	62.00	45.00
Lead	7.25	8.50	7.00
Spelter	7.88	8.50	12.50

*Government price.

ST. LOUIS

	Nov. 16, 1917	One Month Ago	One Year Ago
Lead	7.13	8.00	7.00
Spelter	7.63	8.25	12.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Nov. 16, 1917	One Month Ago	One Year Ago	Nov. 16, 1917	One Year Ago	Nov. 16, 1917	One Year Ago
Copper sheets, base.	35.00–37.00	35.00	37.50	36.00	38.50	35–36	36.50
Copper wire (carload lots)	36.00	38.50	35.00	32.00	33.00	33.50	37.00
Brass pipe, base...	38.50	43.00	47.50	42.00	46.00	42.00	46.00
Brass sheets	35.75	40.00	45.50	35.00	43.00	35.00	38.00
Solder ½ and ½ (case lots)	40.50	39.25	28.50	40.00	27.00	38.00	34.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Nov. 16, 1917	One Year Ago
Mill	$29.00	$42.00
New York	30.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.............................. 19.00

	In Casks		Broken Lots	
	Nov. 16, 1917	One Year Ago	Nov. 16, 1917	One Year Ago
New York	20.00	18.00	20.50	19.00
Cleveland	21.00	16.75	21.25	17.50
Chicago	21.00	17.00	21.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Nov. 16, 1917	One Year Ago
New York	14.00	13.50
Cleveland	16.00	13.00
Chicago	16.00	13.50

Manufacturing Small Electric Motors

By M.E.Hoag

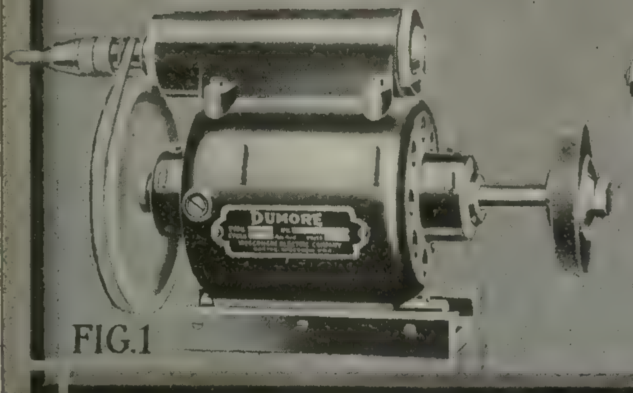


FIG.1

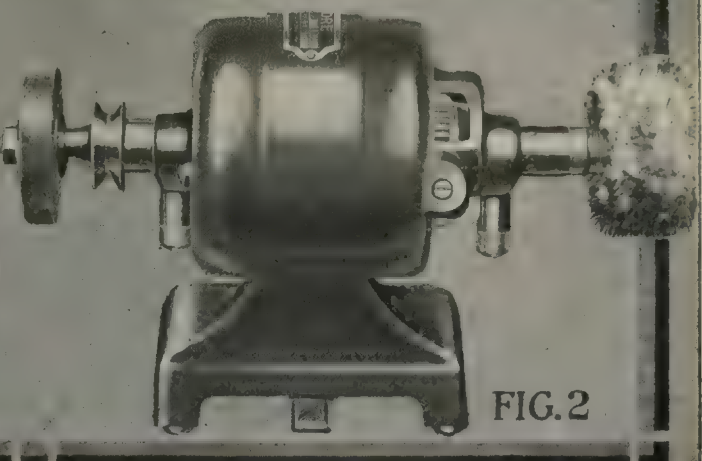


FIG.2

THE building of high-speed electric motors like those used in the construction of internal grinding machines and small sensitive drilling machines, involves some refinements and difficulties seldom found in ordinary motor work. This article is made possible through the courtesy of the Wisconsin Electric Co., of Racine, Wis., manufacturers of the "Dumore" grinding machines and other motor-driven specialties. The grinding machine shown in Fig. 1 was designed to meet very high-speed requirements necessitated by the use of small grinding points and wheels, and will suggest a multitude of uses to the tool- and diemaker. The spindle of the secondary, or internal grinding attachment, is claimed to attain a speed of 50,000 r.p.m. Such high speeds demand extremely close work, and that all rotating parts must be in perfect dynamic balance. The grinding and buffing motor shown in Fig. 2 is intended for dentists, jewelers and toolroom work. The sensitive drilling machine, in Fig. 3, has a wide range of uses and will handle the drilling of small holes successfully. All of these high-speed motors are mounted on SKF ball bearings. To test these bearings for concentricity, the test gage shown in Fig. 4 was made, and by its use a variation of 0.00025 in. is readily detected. The base and bearing supports are of cast iron. The arbor *A* is of hardened steel, ground and lapped to fit the bushings *B*. These bushings are adjustable and may be tightened to insure a wringing fit with the arbor. The dial indicator is mounted on an adjustable support and is adjustable for different sized bearings. The bearing to be tested is slipped on the end of the arbor *A*, and the outside raceway rotated against the contact point of the indicator. The outside race is then held stationary, and the arbor *A* and inside race rotated. The bearing may then be given a third test by turning the arbor *A* and the entire bearing at the same time. In Fig. 5, *A* shows the internal grinding spindle with ball bearings and other parts assembled. *B* shows the armature and shaft with bearings and other parts in place. The piece *A*, Fig. 6, is the internal attachment mounted in its housing ready to be attached to the body of the grinding machine. *B* is the base which carries the holder for clamping in the toolpost of a lathe. The screw shown in this base meshes with the threaded part of the housing shown at *A*, Fig. 7, and is used to obtain fine adjustments, independently of the carriage. *B* is the upper housing for the motor as seen from the under side, and shows the seats for the ball races. *C* shows a field magnet with windings in place ready to be assembled in the housings. All shafts and spindles in these grinding machines are ground to close limits, and on account of their small size it is not deemed advisable to groove or undercut a wheel clearance at the shoulders. These shoulders must also be dead square with the axis of the shaft because they act as stops for the ball bearings. In Fig. 8 is illustrated a set of attachments for squaring the shoulders and removing the rounded corner left by the grinding

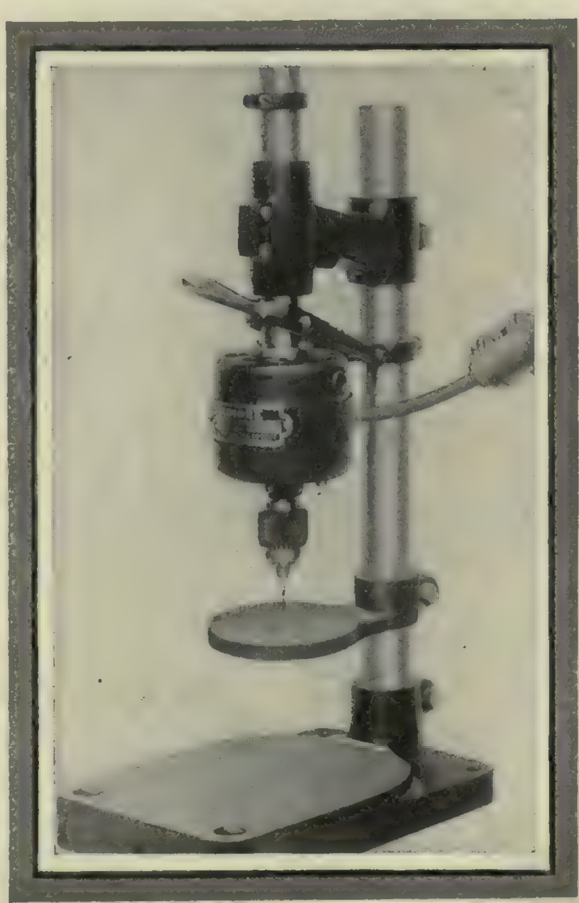


FIG. 3. "DUMORE" SENSITIVE DRILLING MACHINE

wheel. The roller back rest *A* supports the shaft. At *BBB* are toolholders for holding small high-speed tool bits—suitable screws being provided for tool adjustment. It will be noticed that these tool blocks are mounted on a base *C*, so that after once setting them to gage, the entire fixture may be removed from the lathe without disturbing the tool adjustment.

In applying ball bearings to motors of this type it is essential to have the bearing seats in both halves of the housings accurately spaced and in alignment with each other, otherwise when the two halves of the housings are fastened together the resultant twist would cause the bearings to bind. To insure alignment of the bearing seats, the two halves of the housing are clamped together and the seats milled at the same time. The fixture and cutter for handling this operation are shown in Fig. 9. The lower half of the housing is dropped into the fixture; the special cutter *A* is placed in position between the lathe centers and the upper half of the housing shown at *B* is placed in the hinged lid *C*. The two halves are then closed on the cutter by the screw *D*. The cutter shaft acts as a stop against the oil flanges on the inside of the housings and controls the depth of cut.

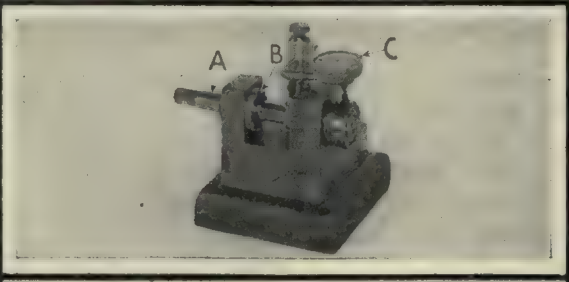


Fig. 4 Test Indicator for Ball Bearings

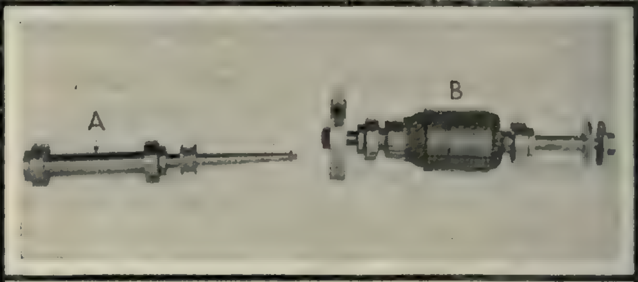


Fig. 5 Armature and Grinding Spindle

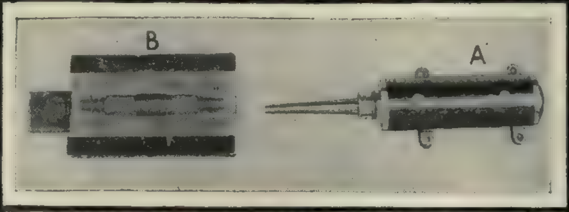


Fig. 6 Grinder Base & Grinding Spindle Housed

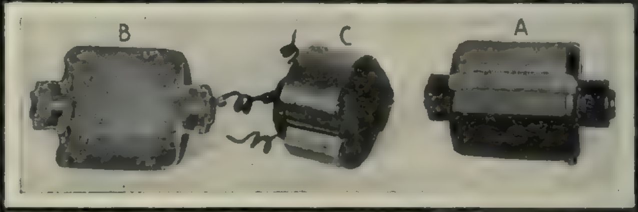


Fig. 7 Motor Housings and Field Magnets

The cutter used in this operation is shown in Fig. 10. The shaft *A* and the cutter bodies *BB* are of one piece of steel, bored and threaded at each end. The centered plugs *CC* are threaded on their inner ends, and screw into the internally threaded ends of the shaft. They are also fitted with lock nuts *DD*. The slotted blocks for the cutter blades, one of which is shown at *E*, are milled clear through and into the bored portion of the shaft. Previous to milling out these slots, holes are located and drilled to take the steel balls seen at *F*. Cams equal in number to the number of blades in the cutters are milled in the plugs *CC* as shown at *G*. These cams receive the steel balls on top of which the cutter blades rest. Screws supply suitable means for clamping the cutter blades in position. After the cutter blades are once assembled and ground they may be adjusted by loosening the lock nuts *DD* and turning the plugs *CC* to increase or decrease the diameter of the cutters. The action of this cam adjustment is positive and all the cutter blades will be found in correct cutting position without regrinding. The writer understands that patents have been applied for on this form of adjustable bladed cutter and reamer.

Some fine dies are used in making interchangeable armature and field laminations. A set of progressive dies for armature laminations are shown in Fig. 11. The core punch *A* is made from a single piece of "Blue Chip" steel, and the ends are supported and bound by the steel ring *B*. The die *C* is also made of "Blue Chip." The stripper *D* is removed to show the die more clearly. Carbon steel dies were tried on this work, but owing to the fact that black iron is used for the punchings they would not stand up for more than 10,000 or 15,000 punchings without sharpening. With the solid "Blue Chip" dies shown, it is not unusual to secure from 40,000 to 50,000 punchings with one sharpening of the dies. The dies for the field laminations are of practically the same construction as those for armatures and are shown in Fig. 12. The commutators for these small motors are built up from mica and copper segments on a steel core with "Fibroid" insulation. After assembling they are passed under a swaging die and subjected to heavy pressure, which condenses all parts, and forces them into contact.

For slotting the shoulders of the copper segments to receive the wires from the armature windings, the die shown at Fig. 13 is used. The trigger seen at *A* is used as a gage in locating the center of one segment, and at the same time holds the commutator in position on the punch. As the punch descends this trigger enters the slot *B* in the die. In this slot, but not clearly shown in the illustration, is a spring plunger with a roller at the end which engages the trigger *A* and forces it against the commutator segment and prevents the possibility of its slipping out of central position. When the commutator has passed clear

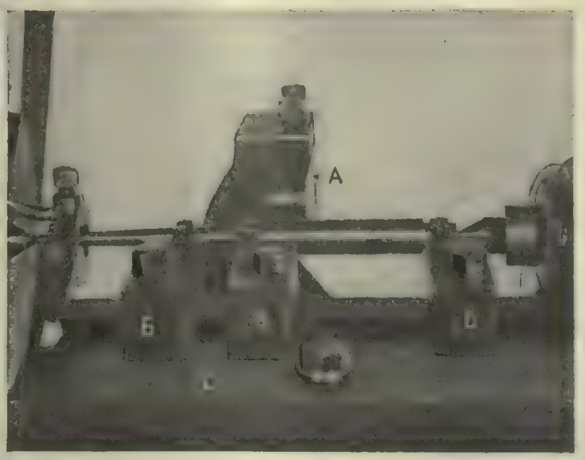


Fig. 8 Squaring Shoulders on Grinding Spindle

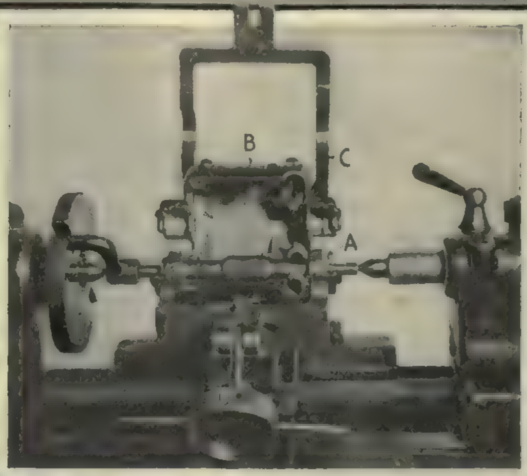


Fig. 9 Seating Ball Bearings in Motor Housings

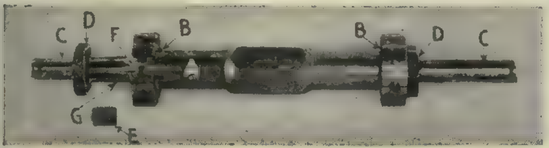


Fig. 10 Adjustable Inserter Tooth Cutter

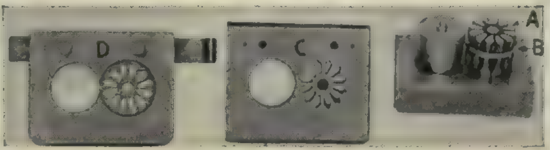


Fig. 11 Progressive Dies for Armature Laminations

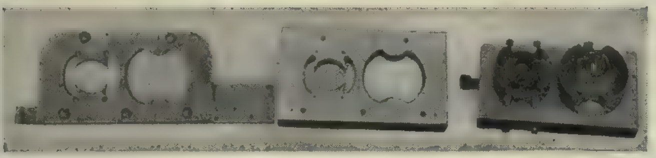


Fig. 12 Progressive Dies for Field Laminations

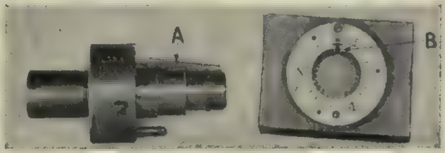


Fig. 13 Dies for Slitting Commutator Segments

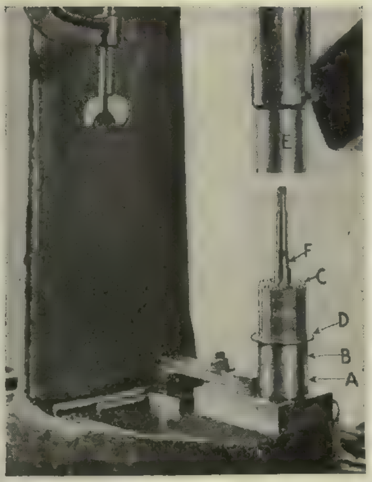


Fig. 14 Assembling Jig for Armatures

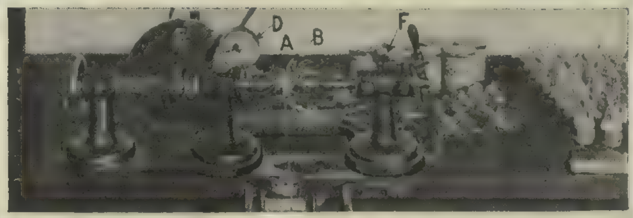


Fig. 15 Machine for Winding Armatures

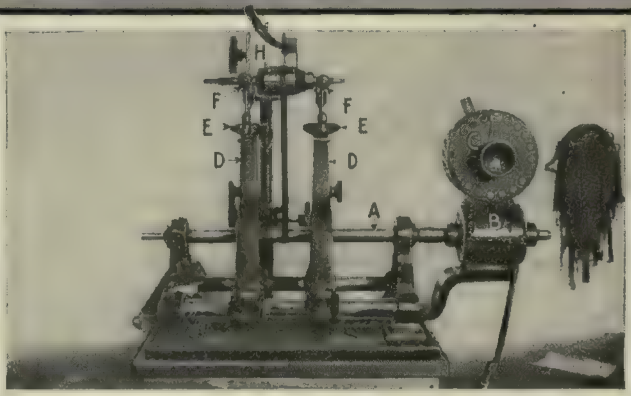


Fig. 16 Dynamic Balancing Machine

through the slitting dies this same roller engages the upper part of the trigger causing it to tip and release the work. The die here shown punches 24 slots at once, which is measurably faster than the work could be handled on a milling and indexing fixture.

In assembling the armatures of these motors the jig shown in Fig. 14 is used in an ordinary arbor press. The lower part *A* is of steel and hollow to allow the armature shaft to pass through. The upper part *B* is of hardened steel and is fitted with 12 hardened and ground steel pins *C* which pass through the openings in the segments and locate them in position. A brass ring *D* acts as a pad and aids in stripping the work from the fixture. The "Fibroid" insulation is used at each end of the armature and the segments are assembled and pressed together until they are of gage length. The shaft is then inserted and pressed into place. A circular recess in the piece *E* clears the ends of the pins *C*, and a suitable opening permits the shaft to pass into *E* and register against the shoulder *F* so that the pressure is not exerted against the extreme end of the shaft. Winding the armatures of these small motors calls for very rapid work and is handled by girls, as are also a large number of other light operations that require skill and deft fingers.

THE WINDING MACHINE

For this winding a special machine, shown in Fig. 15, has been developed and embodies a number of interesting features. A clutch at the end of the shaft *A* is of suitable form to take the armature and is provided with a key which enters one of the armature slots and locates the piece for winding. The tail stock spindle carries a revolving head similar to the one on the head stock spindle, but with two brass wings *BB* which guide the wire into the slots. The wire is carried on a spool at the front of the bench and held with a piece of leather by the operator and guided into the work. The dial indicator *D* registers the number of turns of wire for each winding and may be set back to zero as desired. The machine is driven by the friction disk *E* which is operated by a foot lever. These winding machines make about 3000 r.p.m. so it is very necessary that means be provided to prevent the tail spindle from slipping back and releasing the armature. This is taken care of by the pin *F* which is automatically brought into action as the operating lever is depressed and before the spindles start to rotate.

THE QUESTION OF BALANCE

It is very important that the armatures of high-speed grinding machines be in perfect balance, and this does not mean *static balance*, but *dynamic balance*, and to insure perfect results along these lines the dynamic balance machine shown in Fig. 16 was designed and built. To those familiar with machines of this type no description is necessary, but for those who have not used them a few words will not be amiss.

The main shaft *A* is driven by the motor *B* which is equipped with a speed regulator and reverse mechanism *C*. The uprights *DD* slide on two rods at the base of the machine and are adjustable for center distances so as to accommodate shafts of various lengths. At their upper ends these uprights carry two cups which contain soft rubber disks through which pass two rods, on the upper ends of which are two hardened and ground steel rollers. The shaft of the armature being tested rests on these rollers, in much the same manner as in a common type of static balancing machine. In front of these rollers are two metal points with knurled heads *FF*, adjustable for height and distance from the armature shaft, so that the points may be brought to bear on the shaft at points central with its axis.

The armature is driven from the shaft *A* by an elastic rubber band. To operate the machine an armature is placed in position and adjustments made. The motor is then started and those parts of the shaft opposite the points *FF* are given a thin coating of prussian blue. When the machine has reached its proper speed the points *FF* are brought forward until they touch the rotating shaft and scribe a line in the blue coating. The motor is now reversed and the operation repeated, and the relation of the two sets of lines scribed by the points indicate the exact location of the heavy point in the armature. A sensitive drill *H* situated back of the testing machine makes it easy for the workman to drill out a little from the armatures where required.

In building this machine considerable trouble was experienced in getting the machine to work correctly owing to the fact that the armature of the motor *B* was not in perfect dynamic balance, and in order to overcome this trouble it was necessary to remove the armature and balance it on the machine which was driven by a motor through a rubber band drive to the shaft *A*.

Amount of Metal a U. S. Soldier Carries

A table showing that more than 18 pounds of metal enters into the composition of articles required for the equipment of each infantryman has been prepared by the Ordnance Bureau of the War Department. The metal equipment carried by each infantry soldier weighs 294.65 oz., and an additional weight of 114.7 oz. is added by equipment of cotton, wool, leather and wood. The Ordnance Bureau, therefore, supplies each soldier with approximately 25 lb. of equipment, this being exclusive of that supplied by the quartermaster corps.

A memorandum on materials entering into the composition of the articles of equipment of an infantryman furnished by the Ordnance Department is as follows:

Bacon can—0.4 oz. iron and steel and 8 oz. tin.
Bayonet—15 oz. iron and steel and 1 oz. wood.
Bayonet scabbard—2 oz. iron and steel, ½ oz. brass, 1 oz. aluminum, 0.3 oz. other metal, 1 oz. cotton, 2 oz. wood, and 0.7 oz. leather.
Canteen—5 oz. aluminum and 1.8 oz. other metal.
Canteen cover—0.2 oz. brass, 3 oz. cotton, and 1.8 oz. wool.
Cartridges (100)—47.4 oz. brass, 36.4 oz. metal in bullet, and 12 oz. explosive.
Cartridge belt—10 oz. brass and 14.1 oz. cotton.
Condiment can—4.35 oz. tin.
Cup—5.5 oz. aluminum and 0.6 oz. other metal.
Fork—1.5 oz.
Front sight cover—2 oz. iron and steel.
Gun sling—1 oz. brass, 7 oz. leather.
Haversack—1.8 oz. brass, 24 oz. cotton.
Knife—1 oz. iron and steel, 0.7 aluminum.
Meat can—0.3 oz. iron and steel, 12 oz. aluminum, 0.1 oz. other metal.
Oiler and thong case—1.5 oz. brass, 1.5 oz. leather.
Pack carrier—0.3 oz. iron and steel, 6 oz. cotton, and 1 oz leather.
Pouch for first-aid packet—0.3 oz. brass and 1.6 oz. cotton.
Rifle—107 oz. iron and steel and 29 oz. wood.
Shovel—25 oz. iron and steel and 4 oz. wood.
Shovel carriers—5 oz. cotton.
Spoon—1.7 oz.

An explanatory note says the metal used in the bullet is a lead and tin composition inclosed in a jacket of cupro-nickel.

Manufacturing Hardware For Reënforced Ammunition Boxes

BY F. E. MERRIAM

The wooden packing cases for some of the ammunition used by the Allied nations require the use of a number of pieces of special hardware that cannot be purchased on the open market and must, therefore, be made up by the box maker. This hardware is not particularly difficult to manufacture, consequently the methods about to be described are of interest for other reasons, and derive their importance from the fact that circumstances required the use of very unsuitable machinery under very unfavorable conditions.

THE orders we received for ammunition boxes and the accompanying hardware were never very large at any time and, as a rule, could not be foreseen, consequently at no time did the purchase of suitable machinery seem justified. The regular shop equipment included a number of machines which, with the addition of fixtures and attachments, could be used for the work in hand. This machinery, in addition to being of improper size, type, etc., could not be moved together but remained scattered throughout the shops where it was required for other and more important purposes. Thus, the conditions under which the hardware was manufactured were unfavorable in every way and conducive to high costs and poor production.

Fig. 1 illustrates the general appearance of the packing boxes and indicates the general appearance of the hardware used. It will be noted from *A* that the handle consists of three parts, the wire grip, the wire loop and the strap for attaching the handle to the box. Beginning with the wire grip there are three essential operations; cutting blank from rod, bending blank to shape for hand hold and curling ends for attachment of link.

Fig. 2 is a diagram of the press attachment used for the first two operations, illustrating very well how unsuitable some of the machinery proved to be. For this operation a long stroke press should have been used, but none being available the attachment was devised. This attachment fastens to the front of the press, being operated by the balance arm, and since but little power is required it works very satisfactorily. The fixture is very simple and requires little explanation. As part *A* descends it comes in contact with the parts *BB* causing them to swing about the pivots *CC* forcing the blank to take the shape of the form *E*, also shown at *F*. The return stroke of the press withdraws *BB* allowing the removal of the finished piece and the insertion of the blank ready to repeat the operation. Following the bending operation the ends are curled to receive the link *G*, and lastly closed over the link as shown at *H*.

Figs. 3 and 4 illustrate the method of curling the ends, which are completed in two operations. As can be seen in Fig. 3 the handle is placed flat on the die, the ends against the stop, while a spring clamp holds it in place during the operation. As the punch descends it forces the handle into the grooves in the die thus giving the required shape, the bending being made, of course, far enough from the ends to leave enough material to complete the loop. Following this operation the link is placed in position and the loop closed by the tools shown in Fig. 4.

MAKING THE LINK

The making of the link, or wire loop, consists of essentially three operations; cutting off blank, bending ends and curling to complete loop. These operations are shown in Fig. 5. The rod is sheared to the proper length by a simple operation that requires no explanation. Following shearing, the blank passes to a double punch and die, Fig. 6, where the ends are bent to the form shown at *B*, Fig. 5, thence to the second part of the machine where it is again bent or curled as shown at *C*, thus joining the ends and completing the loop.

The first bending operation leaves the link clinging to the punch or die, and to make certain its removal and transfer to the next operation with safety to the operator, the knockout and transfer devices shown at *A* and *B*, Fig. 6, are utilized. The knockout is very simple and can be readily understood from the diagram. The transfer device, however, requires some explanation. During the forming of the blank the two wedge-shaped pieces *D* act on the tapered portion *G* of the transfer device *B*, moving it toward the punch until the notches *E*, Fig. 7, grip the link. The return stroke of the press causes the device to move in the opposite direction sufficiently to bring the link into position for the final operation which is performed by the punch *F*, Fig. 6. The action of the punch *F* is similar to that of punch *C* and simply bends the link in the center, joining the two ends and completing the loop.

MAKING THE HANDLE STRAP

The strap which fastens the handle to the box is next in order and its manufacture consists of five operations: Punching screw holes, blanking, preliminary curling to receive link, final curling and bending angle at end. The stock from which these straps are made is 2 x $\frac{1}{16}$ in. steel. The first press performs three operations in the order given above. At commencement of this series of operations the strip of steel is pushed under the stripper in Fig. 8 to a point where the end will just be sheared, and punching and shearing then takes place. The end of the strip is then brought up against the stop just beyond the curling die and the operations take place in the order already indicated. After the curling operation the strap is left in the shape at *A*, ready for closing over the loop. The shape and position of the curling dies are shown at *B*. Immediately following this operation the curling is completed, joining the loop and strap, and the end of the strap is then bent to a right angle for fastening to the bottom of the box. Fig. 9 shows the fixture for the final bending operation which connects the strap, loop and handle. Fig. 10 shows the tools for bending the angle on the end of the strap, these being placed in the same press with those for forming the strap. The fixture in Fig. 9 is used as follows: The long end of the strap is placed upright in the slot *L* and when the punch *M* descends it causes the curved end to bend until it lies close to the body of the strap, thus forming the loop for inclosing the link. During this operation the loop is held in place by the handle which is laid back over *N*. Bending for the angle is so simple as to require no explanation, being performed at the same time as as the final curling.

The small angle *D*, Fig. 1, serves to fasten the side of the box securely to the bottom and is made in four operations: Punching for screw holes, shearing, countersinking and bending. The punching, shearing and bending operations are similar to those already shown for the handle strap and the countersinking is performed in an ordinary drilling machine. Fig. 11 shows the arrangement of the tools in the press for these operations. They are very simple and self-explanatory.

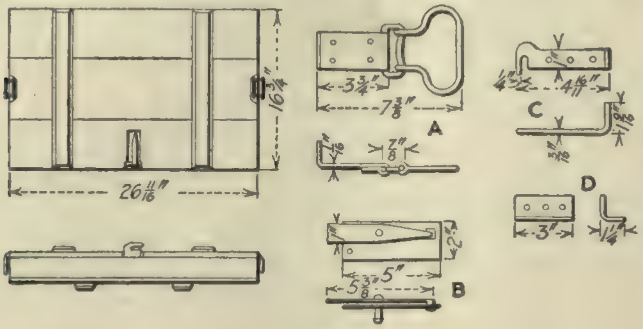
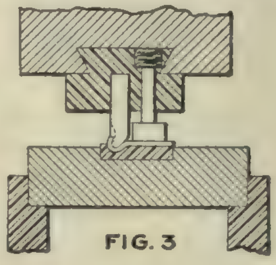
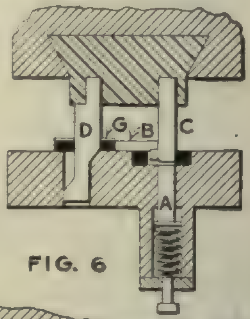
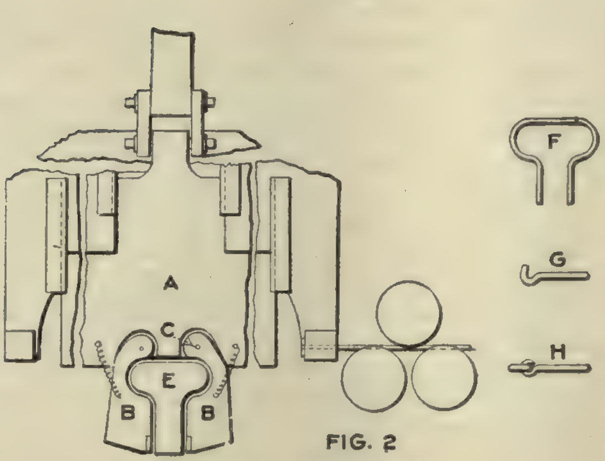


FIG. 1







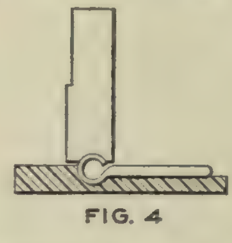


FIG. 4

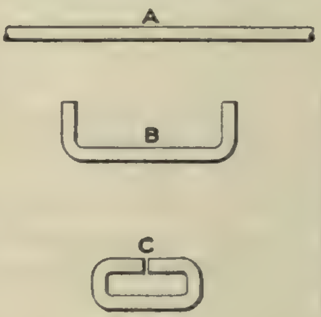


FIG. 5

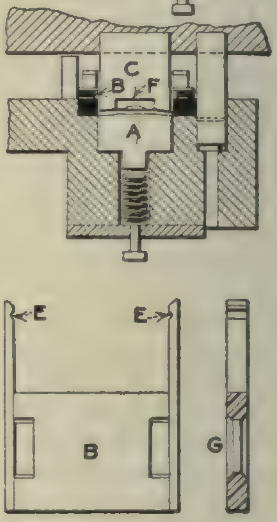


FIG. 7

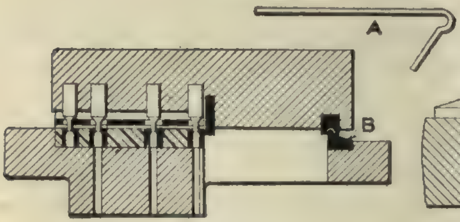


FIG. 8

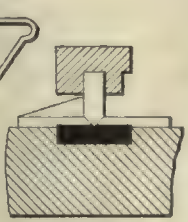
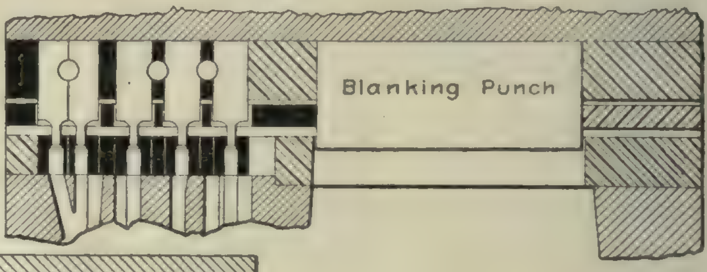


FIG. 10



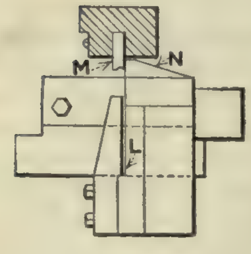


FIG. 9

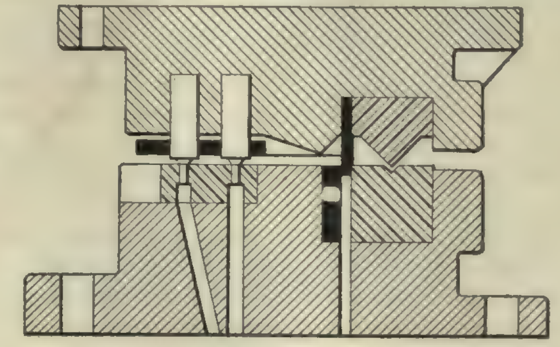


FIG. 11

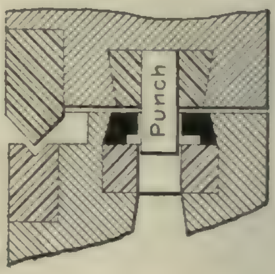


FIG. 12

FIGS. 1 TO 12. THE AMMUNITION BOX AND HARDWARE, AND THE TOOLS USED

Fig. 1—Ammunition box and its accompanying hardware. Fig. 2—Fixture for forming handle. Fig. 3—Starting the loop. Fig. 4—Finishing the loop. Fig. 5—Steps in evolution of the link. Fig. 6—Link-forming fixture. Fig. 7—The link gripper. Fig. 8—Strap-punching and forming device. Fig. 9—Strap loop closer. Fig. 10—Angle bender for strap end. Fig. 11—Fixture for angle plates. Fig. 12—Fixture for the hook

The latching device for the cover consists of the latch on the cover, *B*, Fig. 1, and a formed hook attached to the side and fastened to the bottom of the box. The construction of the latch requires only very simple operations of punching and shearing for the spring plate, while the portion which engages the hook is forged. The manufacture of the spring plate and latch do not call for any attachments of particular interest and therefore no sketches are given.

The hook used in connection with the latching devices is the heaviest work on any of this hardware and there are four operations: Punching, blanking, countersinking and bending to form the angle. The finished hook is shown at *C*, Fig. 1. The punching, blanking and bending operations are of course all performed in one operation in a press and the countersinking in a simple drilling machine. Fig. 12 shows the arrangement of the tools, including the die for the angle, which is formed at the same time.

It has already been mentioned that the machinery was not at all suitable for the manufacture of this hardware and in no instance is this better illustrated than in the case of the press used for forming the wire handle. In this case the press furnished but little more than a means for communicating the necessary motion. The press used was very large and necessarily heavy, awkward and slow; all of which are exactly the opposite characteristics of those most desirable. In a varying degree the other presses used were unsuited, but in these cases the unsuitability was less pronounced. To offset these characteristics as much as possible the number of operations were multiplied, and in one instance they amounted to five. The machinery could not be brought together, which greatly increased the expense of handling, for in some instances the machines were in buildings at considerable distances apart.

Regulations for Handling Explosives

Any person in the United States found with explosives in his possession after Nov. 15, and who does not have a license issued by the Federal Government showing the purpose for what the explosives are to be used, is liable to be arrested at once, and fined up to $5000 or sent to prison for one year or both.

This is the principal clause in a war measure passed by the last Congress which is now being put into effect by the Bureau of Mines, Department of the Interior, which Bureau has been charged with its enforcement. Francis S. Peabody, of Chicago, a well-known coal operator familiar with the use of explosives, large amounts of which are used in the coal mining industry, has been appointed by Secreary of the Interior Lane to act as assistant to the Director of the Bureau of Mines, Van H. Manning, in the enforcement of the law. Under the law, the Director of the Bureau is empowered to utilize the services of all United States officers and all police officers of the states, including the city police forces, county sheriffs, deputies, constables, and all officers in any way charged with police duties. The police of the cities have already been organized for this work, headed by a committee of chiefs of police in the big cities, of which Major R. W. Pullman, superintendent of police of Washington, D. C., is chairman. The police are not only to look after the enforcement of the law, but are also to make thorough investigations of all dynamite outrages and fires and make reports.

Persons apprehended in plots to blow up factories and bridges will be turned over to the authorities for prosecution under Federal or State laws. Most states have specially severe punishments for these crimes. New York has an extreme penalty of twenty-five years imprisonment for the placing of dynamite with intent to blow up property. The penalty provided in this Federal measure is to cover the illegal possession of explosives.

The law provides that everyone who handles explosives must have a license. The manufacturer, the importer. and the exporter must have licenses issued by the Bureau of Mines in Washington. The seller of explosives and the purchaser of explosives must also have licenses, these to be issued generally by county clerks, or other local officers who are authorized to administer oaths. There will be at least one licensing officer in each county, and more agents will be designated if the county is sufficiently large to warrant it. If a state has laws providing for a system of licensing persons manufacturing, storing, selling or using explosives, the state officials authorized to issue such state licenses shall be designated as Federal licensing agents; also city officials qualified to issue city explosives licenses will be given authority to issue Federal licenses. A Federal license will not relieve any person from securing licenses required under state laws and local ordinances.

In each state there will be appointed a state explosives inspector, who will represent the Bureau of Mines in the administration of the law within the state.

Only citizens of the United States, or of countries friendly to the United States, may obtain licenses.

Contractors, mining companies, quarrymen and others using large quantities of explosives, which are handled by employees, may issue explosives to their employees only through those employees holding a license, called a foreman's license.

The purchaser of dynamite, in obtaining a license, must state definitely what the explosive is to be used for and will be held accountable for its use as stated and the return of any explosives that may be left.

With the strict enforcement of this law, the Federal authorities hope to prevent explosives falling into the hands of evilly-disposed persons and to put a stop to all further dynamite plots.

New York Firm Wins Washington Navy Yard Contract

The competition for the contract for the construction of the big machine shop at the Washington Navy Yard was settled by Rear Admiral Harris, Chief of the Bureau of Yards and Docks, Navy Department, in favor of the Industrial Engineering Co., of New York City. The bid of that company for the work of $936,655 was the lowest one received.

This building is designed for the manufacture of gun mounts, torpedoes and other ordnance supplies for use in the war with Germany. The work is to be done as rapidly as possible, and it is expected the building will be completed in about six months. The making of this contract marks the practical beginning of the comprehensive plans for the expansion of the ordnance-making facilities of the local gun factory.

Machining a Tool-Feed Bracket

By J. P. BROPHY
General Manager Cleveland Automatic Machine Co.

This article is interesting in that it illustrates the method of handling a machine part in one of the large machine building plants.

BEFORE describing how we manufacture the tool-feed bracket, which is shown in Fig. 1, we wish to say it is one of the most particular parts of the Cleveland Automatic, and when all the operations are complete these feed brackets are interchangeable.

Fig. 2 shows this feed bracket *A* held securely in a fixture *B*, which is in turn attached in a very rigid manner to the faceplate *C* of a heavy turret lathe. In this operation two holes are finished simultaneously by a bar held in the turret, the cutters being mounted tandem. The boring bar is held as shown, and passes through the steadyrest *D*, which is mounted on the lathe carriage, while the extreme end of the bar is supported by a bushing in the spindle. The holes to be finished are at each end. The boring and reaming bars are supported close to the faces of casting, and there is no possible chance for deflection or loss of alignment.

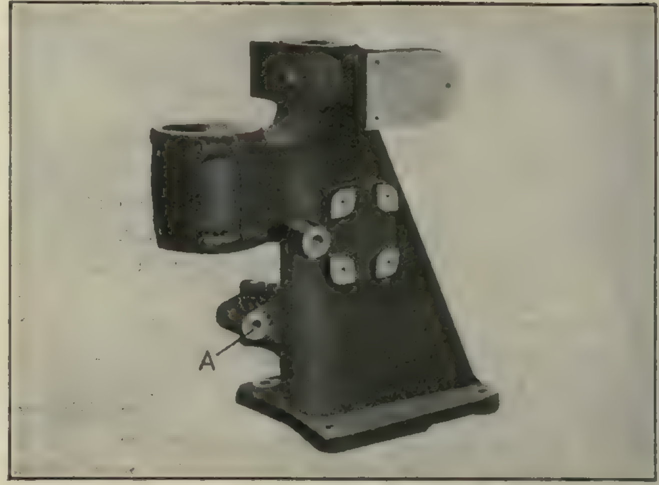


FIG. 1. TOOL-FEED BRACKET

Fig. 3 shows the second operation, which is milling the cap seat *A*, with a set of gang cutters *B*, which finish the faces and tongues at one cut. In this operation the work is supported from the holes finished as shown in Fig. 2. The fixture used in this operation is mounted

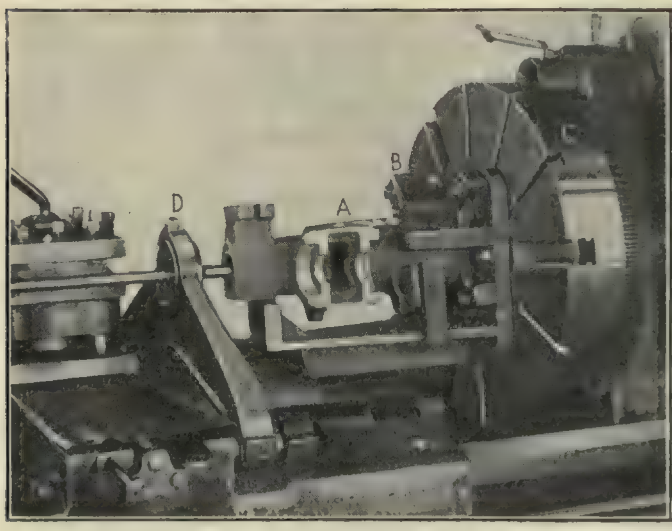


FIG. 2. BORING OUT

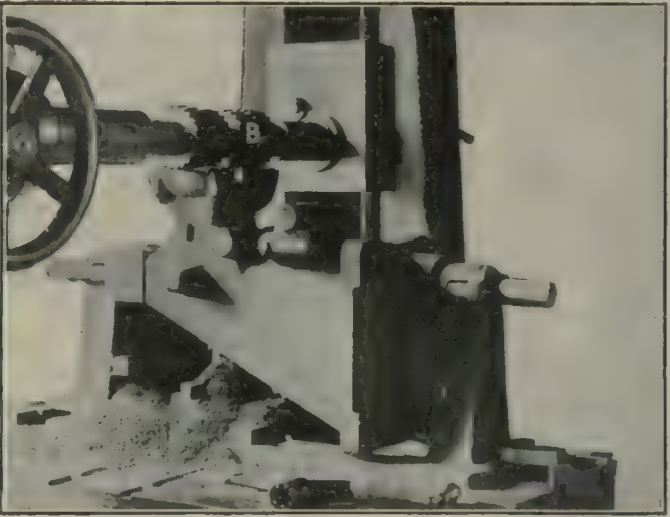


FIG. 3. MILLING CAP SEAT

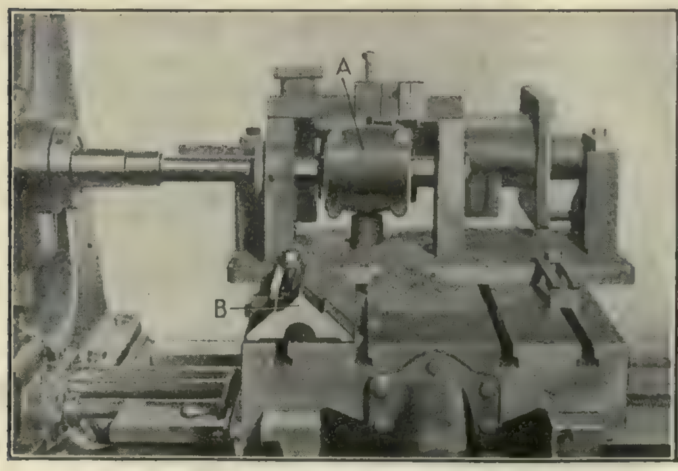


FIG. 4. BORING OUT CAP BEARING

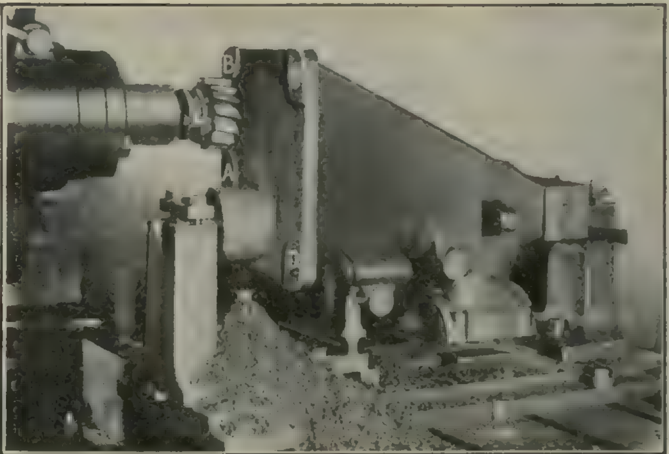


FIG. 5. MILLING THE BOSSES

on the table of the horizontal boring mill illustrated. In Fig. 4, *B* is a gage to fit the tongues milled for the cap. The bar is placed in position, and the half-round in this gage fits the bar and also the tongue for the cap *A*. The locating screws in the fixture are then brought forward touching the outside of the casting, and the bracket is locked in position and the hole bored. We now have the two main holes bored, and all the drilling is gaged from these holes.

Fig. 5 shows the operation of milling the bosses at the base. The cutter is fed vertically at *A* and *B*, and the table is moved to finish the surfaces *C* and *D*, being located for this operation from holes finished as described in Fig. 2.

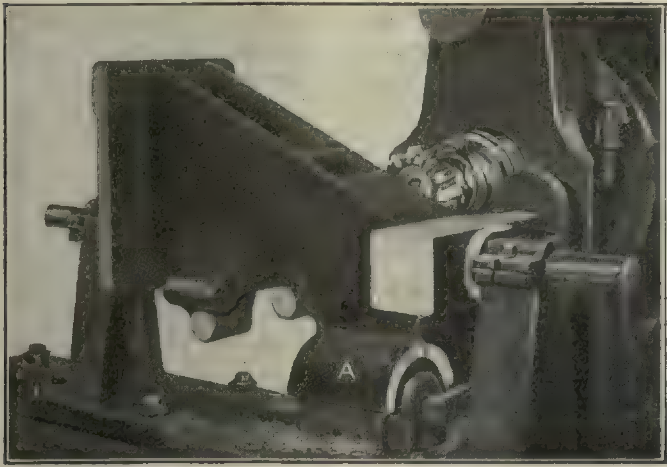


FIG. 6. MILLING THE SIDE BOSSES

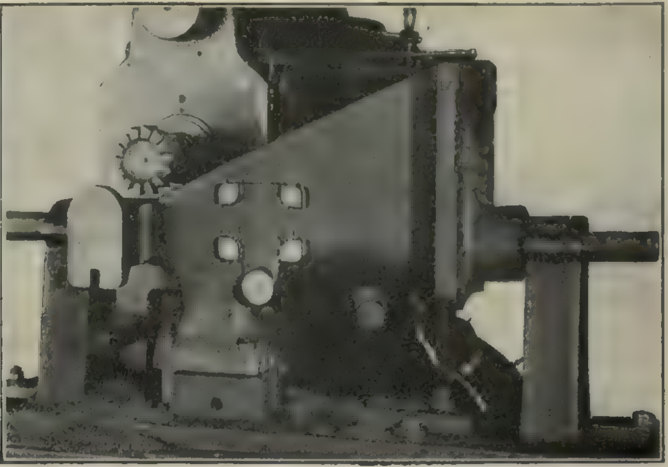


FIG. 7. MILLING BOSSES ON OPPOSITE SIDE

Fig. 6 shows the next operation, milling the bosses on one side on a heavy plain milling machine. The work is held as previously shown in Fig. 3, except that it is supported at *A*, Fig. 6, which brings all parts into register. Fig. 7 is the set-up for milling the opposite side.

We start for distances from the center of *A*, Fig. 1, and by working from this point, all the holes and surfaces in various directions come close to the center of the milled surfaces. In the milling operations there are 23 different surfaces that are the correct distances from the center hole, and when this bracket is bored and milled it is placed in the box jig, and all the drilling and reaming of the 22 holes completed in one operation. We seldom have the slightest difficulty when assembling, because all the surfaces and holes are exact to gage.

Computing the War Excess Profits Tax

By H. M. Norris

The Cincinnati-Bickford Tool Co.

Under the new excess profits tax law, a $1,000,000 corporation that makes, let us say, 37 per cent. in excess profits will have to pay the Government $120,000. To arrive at this figure by the method which first suggests itself entails the following tabulation:

On the amount under	15 per cent.	$0.15 \times 0.20 = 0.0300$
Upon the next	5 per cent.	$0.05 \times 0.25 = 0.0125$
Upon the next	5 per cent.	$0.05 \times 0.35 = 0.0175$
Upon the next	8 per cent.	$0.08 \times 0.45 = 0.0360$
Upon the next	4 per cent.	$0.04 \times 0.60 = 0.0240$
	37 per cent.	0.1200

Twelve per cent. of $1,000,000 is $120,000. While this is the way in which the Government may require the figures to be submitted, the percentage of tax is obtainable much more quickly through the application of the following formulas, in which *P* represents the per cent. of capital and *E* that of excess profits:

From 7, 8 or 9 to 15 per cent	$P = E \div 5$
From 15 to 20 per cent	$P = 0.25\,(E - 0.03)$
From 20 to 25 per cent	$P = 0.35\,(E - 0.07857142)$
From 25 to 33 per cent	$P = 0.45\,(E - 0.11666666)$
More than 33 per cent. of capital	$P = 0.60\,(E - 0.17)$

It will be seen that these formulas entail but one subtraction and one multiplication. The figuring involved in determining the per cent. of capital due under the example cited amounts to but: $0.37 - 0.17 = 0.20$ and $0.20 \times 0.6 = 0.120$.

The income tax can be figured with equal facility. For an income between $40,000 and $60,000 the tax, in dollars, would be equal to $0.16\,(I - 17{,}625)$, in which I represents income less the $2000 exemption for a married man.

Spine Milling in the Screw Machine

By G. H. Goodon

After reading the article on page 207, by Elam Whitney, it would be interesting to know what objections Mr. Whitney had to putting the cutoff tool on the cross slide milling attachment? Looking at the illustration, it is obvious to anyone conversant with automatic screw-machine practice that this is the proper place for the tool in this instance.

Using the method as described, it is necessary to press the component back into the collet in order to cut it off, thus causing a loss of time and excessive wear on the feeding finger and the feeding mechanism of the machine. Now if the milling attachment on the back slide was constructed to carry the cutoff tool, this would be avoided for it is obvious that the milling cutter must clear the component when the cross slide is being advanced into position. Therefore, all that is required after the cross drill is clear is to start up the spindle and advance the back slide carrying the cutoff tool held in the combination cutoff toolpost and milling attachment until the component is cut off.

There will be a slight saving of time on each piece, and more accurate work will result, but what is more important, it will eliminate the excessive wear on the machine.

Appointing Agents for Belgium

By R. A. Monte

The arguments advanced by Messrs. Knowlton and Woods, on pages 140 and 256 respectively, each sustaining the opposite end in the "native son" against the "American" question, recalled to my mind some purely personal reminiscences rather confirming Mr. Woods' point of view.

As Mr. Woods presents a very strong, substantial case, I wish to relate for the benefit of those concerned a story of how it can be very troublesome at times to be an American. Born in this country—out West—of Belgian parents who stayed just long enough on this side of the big pond to let me acquire a thorough grasp of slang and broad Western brogue, I went to England. I can still vividly recall the first days at school there, when the whole class kept roaring whenever I opened my mouth for a choice bit of Yankee precociousness. The attention I received bordered on idolatry, and the superiority of anything American seemed never to be questioned. Proud, I surely was of my American birthright.

Early Experience

As the years went by, I divided my time between England, the United States and Belgium, until in 1905, at the Liege Exhibition, an English concern sent me there as its sole representative, although I had never before done any representing nor shown any marked selling ability. At the time, I took it that my knowledge of French obtained for me that unsolicited appointment; later, I knew better—I do not even think that my employer ever knew or admitted to his innermost self why I was his unconscious selection. The machinery exhibited was complicated and a copy of a high-grade American original, so to complete the picture an American looking gentleman would necessarily have to give it atmosphere.

As the saying goes, I could not sell gold pieces, was short and abrupt of manners, a very long way from talkative, and my poor customers had really to pump me to find out anything about our machine. Nevertheless, I made a good show; the machine sold on its merits, and almost all I had to do was to look happy and write orders.

The Result

But this is only part of the story. The amusing end of it was that, after about two weeks' sojourn in my booth, several local men became interested in my work. The outcome was that I had about a dozen good offers to take lucrative positions with some of the minor local machine-tool builders. The climax was a machine-tool builder of Brussels, who got me to visit his shop, family and other accompaniments in a little side street in the suburbs. He had arranged for my *pension* (boarding house) and expected me to take a permanent position immediately.

On a Sunday morning he showed me over his works, opened his books and proved to me that he, his young son, daughter and wife as office force had managed to make 20,000 francs the past year. Of course, in the coming year they would do at least as well, and the expense of taking in my services would have to result in an adequate increase of earning power, otherwise. . . . Upon my rejoinder that I could not see how I could increase his earnings one red cent, he blandly told me that the big English and German machine-tool importers were using a number of so-called American travelers and other American employees, and that many Germans returned from the States passing themselves as genuine Americans. Thus the acquisition of a really unquestionable American seemed to him a judicious investment to reach a certain class of customers.

Now during that one Sunday morning that I spent at his place, I noticed quite a number of people pottering about the machines for sale, and my host always talked to them in Walloon, Flemish or Dutch. These people were small shop owners, but very small shop owners indeed, mostly consisting of only father and son who had acquired a lathe or other machine of rather nondescript design. These men were in fact only workmen, working at their own domicile instead of in the factory, a system widely in use in Belgium. For instance, I know of a case where the complicated castings for a motorcycle cylinder were entirely molded, cast and finished in a little room in the backyard of a three-room ground-floor flat, man and wife and two children being the entire working force and making a total weekly wage about as much as a healthy office boy in this country would scorn to accept. Nevertheless, these people had machinery of a kind—a regular blower for the furnace, a regular molding machine—and were contemplating the installation of some special grinding machines they had seen. The man got his pig iron and coke in a little dog-drawn vehicle and dispatched his products by the same means.

Another Class

This is the class of people that requires the "native son" to gage their financial rating and unusual needs. However, there are a good many more shops of quite respectable size, where the foreign agent does not stand much of a chance of success. On the other hand, the "native son" will have a hard job when tackling the large-scale manufacturer. Before the war the leading executive was usually a German or one with strong German inclinations, or a man who had been in England or the United States or traveled extensively. Thus the poor "native son," spending his youth in mastering a couple of thief jargons, has not much standing with the big crowd, and there of course the American is preëminent as a model to be lived up to.

Using the Metric System

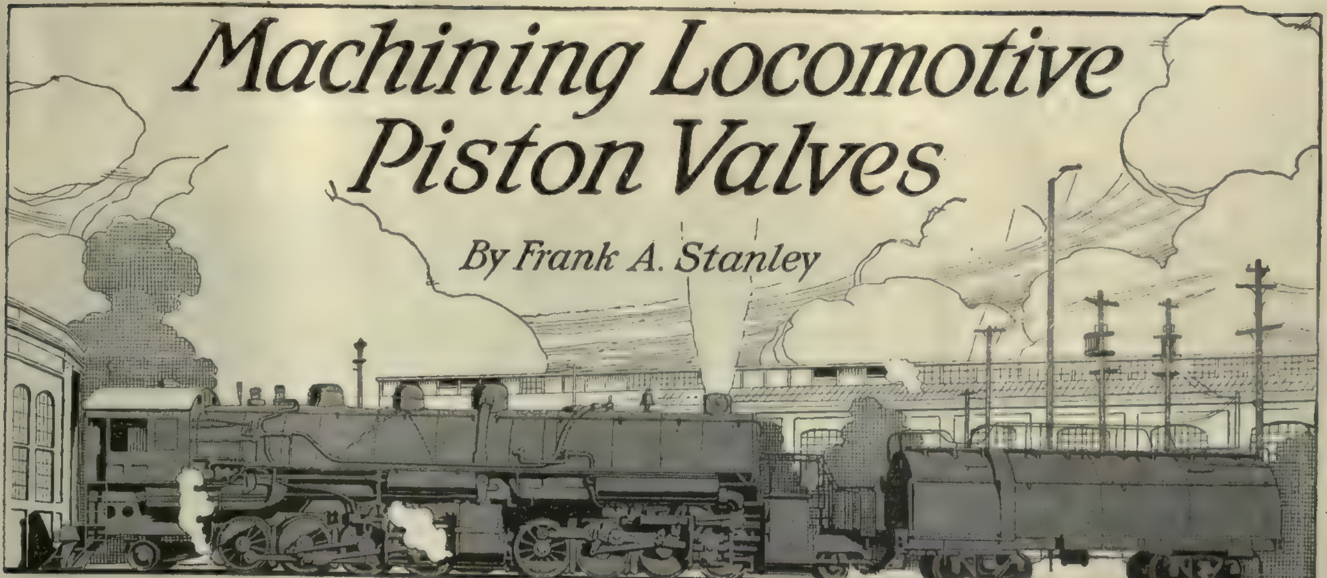
By A. F. Thun

Secretary Textile Machine Works, Reading, Penn.

Commenting on the article, "Why Force Us To Speak a Foreign Language?" by J. P. Brophy, page 330, we wish to state that we are partial to the metric system, for the reason that we have been using it in some part of our work for the last 20 years. We cannot consistently oppose the efforts to introduce the metric system into this country. Our reason for this position is due to the fact that we had to adopt the European standards in order to be able to compete in the world's markets for some of our specialties.

Machining Locomotive Piston Valves

By Frank A. Stanley



Considerable of the valve and valve-cage work is an important item in railroad-shop practice when piston-valve locomotives are repaired. This article describes a number of valve and cage operations as performed in the Southern Pacific shops at Sparks, Nev.

THE valve assembled and a set of parts for another complete valve are represented in Fig. 2. The line drawing, Fig. 4, shows construction details of both valve and cage. As indicated in Fig. 4, the valve proper consists of a cast-iron center 28 in. long by $11\frac{1}{4}$ in. in diameter across the ends. The center, or body, is fitted to a pair of spiders bored out and keyed to the valve rod, the latter being turned to 2-in. diameter at the points where it passes through the hubs of the spiders. These spiders are clearly shown and they carry in each case a bull ring and a pair of packing rings which, like the bull rings, are of cast iron.

The packing rings are finished $\frac{1}{32}$ in. larger and then cut—that is, they are turned to $12\frac{1}{32}$ in. in diameter before sawing through. The bull rings are turned to 11.980 in. in diameter, or 0.02 in. under size. The method of locating the bull rings on the spiders by means of rectangular keys is shown by the detail section in Fig. 4, and the method of holding the packing rings in each bull ring by a dowel pin is also represented by the sketch in the upper right-hand corner of the drawing.

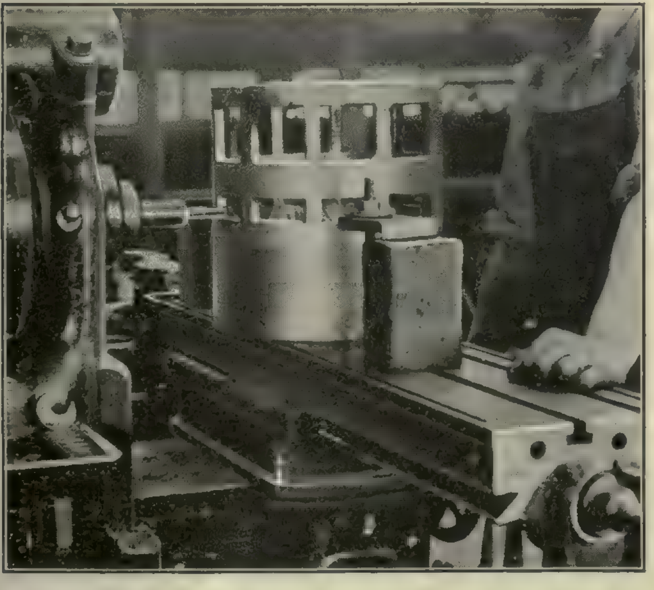


FIG. 1. MILLING STEAM PARTS IN A VALVE CAGE

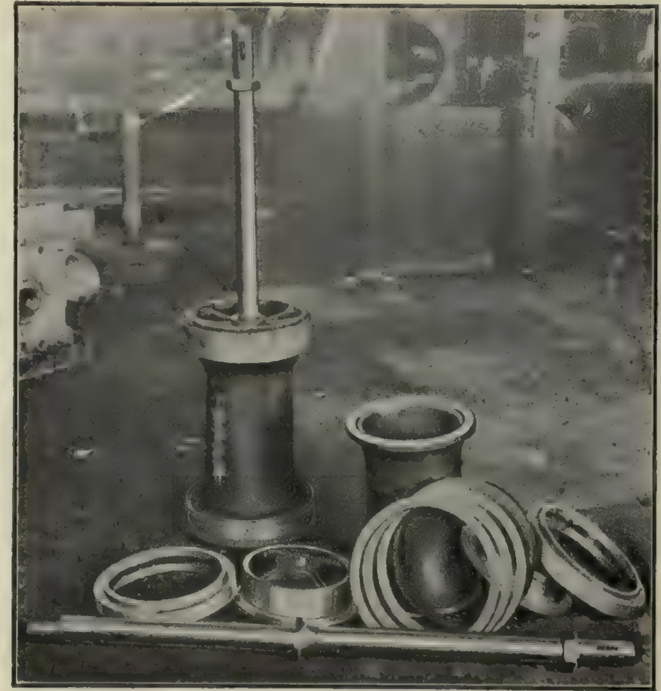


FIG. 2. PISTON-VALVE PARTS—ASSEMBLED AND DISASSEMBLED

In the lower left corner of this illustration will be seen the end view and longitudinal section of the steam-chest liner, or valve cage, in which the piston valve travels. The dimensions of this cage are all given in the drawing, and the form and location of admission and exhaust ports are also shown clearly.

Figs. 3 and 6 show lathe operations in the machining of the valve cage. The gray-iron casting is gripped for the boring operation in a four-jaw chuck, and a heavy bar with inserted tool is used for boring the internal diameter. It is the custom to bore the cage a few thousandths over standard size and to turn the outside diameter large by a corresponding amount to allow for pressing tightly in the steam chest, the slight closing in of the walls of the cage, which are $\frac{5}{8}$ in. thick, bringing the internal diameter to the standard size of 12 in., as indicated in Fig. 4. In turning the cage, as in Fig. 6, the cage casting is placed on an arbor that receives the work on two slightly conical disks, or flanges, which locate the casting true by the bore, as shown by Fig. 5. Here the arbor proper, which is 3¼-in. steel bar, carries the cast body *A* which has the conical flange, or disk, at *B* and a second flange at *C*. The latter carries a headless screw that enters one of the port openings *D* and serves as a positive driving medium for the work. The carrier *A* is forced tight on the arbor and carries the driver *F*, by which the whole arbor is rotated from the lathe faceplate or from one of the chuck jaws. The opposite cone disk *G* is a sliding fit on the arbor and is adjusted inwardly to snug position in the work by means of the nut on the threaded portion of the arbor. The cone bearing surfaces for receiving the cage to be turned are finished true on the arbor centers, and the work when properly secured by the means referred to is turned concentric with the bore by which it is located on the arbor. This arrangement works very well.

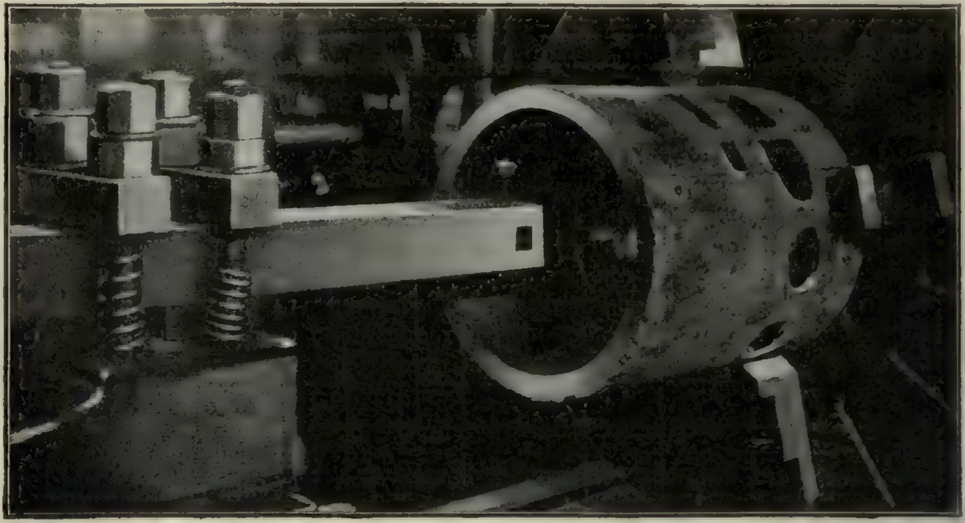


FIG. 3. BORING THE VALVE CAGE FOR A PISTON VALVE

The admission ports in the valve cage have to be machined along their edges to a definite dimension and to provide a clean, sharp, steam line. The exhaust ports do not require finishing in this manner. For the finishing of ports the cage is set up on the milling machine,

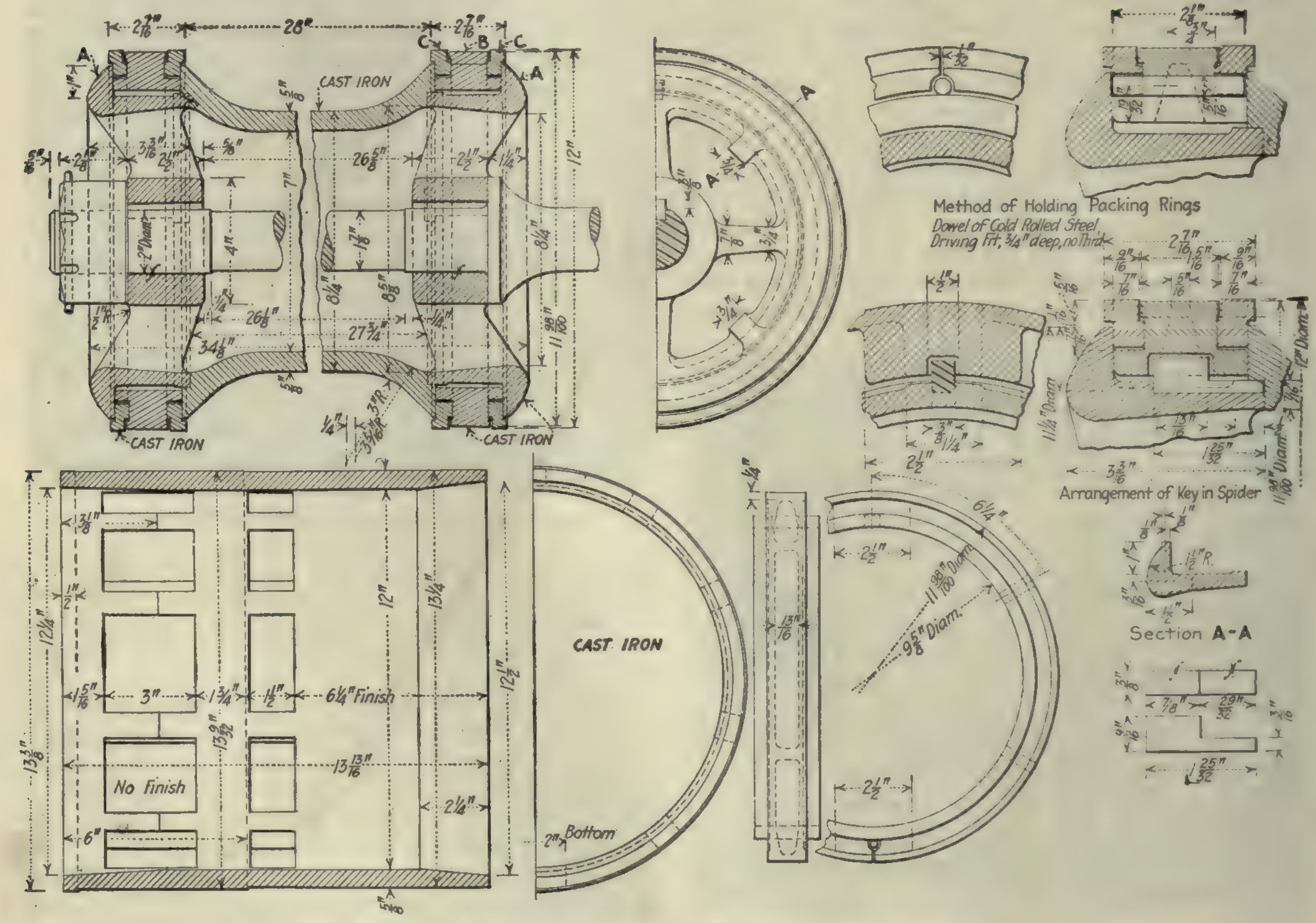

A
C
B
C
A
28"
CAST IRON
12"
CAST IRON
CAST IRON
Method of Holding Packing Rings
Dowel of Cold Rolled Steel, Driving Fit, 3/4" deep, no Thrd.
12" Diam.
Arrangement of Key in Spider
Section A-A
CAST IRON
6¼" Finish
No Finish
Bottom
9⅝" Diam.

FIG. 4. CONSTRUCTION DETAILS OF VALVE AND CAGE

as in Fig. 1, and a small end mill is applied in the manner represented. A separate set-up is, of course, required for each port.

The ports are 1½ in. wide by 2¾ in. long, allowing a ⅝-in. end mill to be used to advantage. The cage is set up on end and secured by a pair of straps and bolts, and the ports are then milled to layout by the operation of the regular table feeds incorporated in the milling machines.

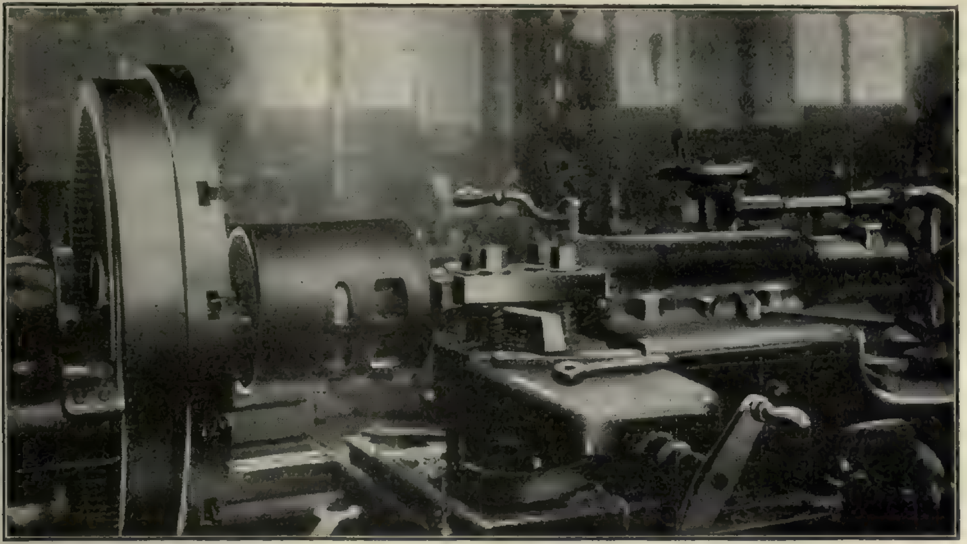


FIG. 6. TURNING OPERATION ON A PISTON-VALVE CAGE

While the walls of the cage are ¾ in. thick, the numerous openings for the ports reduce the section around the circumference to a degree where care and judgment must be exercised in forcing the cage into the chest, in order to avoid the possibility of rupturing the narrow walls between the ports. The cage must be started into place squarely and drawn firmly home without cramping it by unequally applied force at different points around the outer end or edge of the casting.

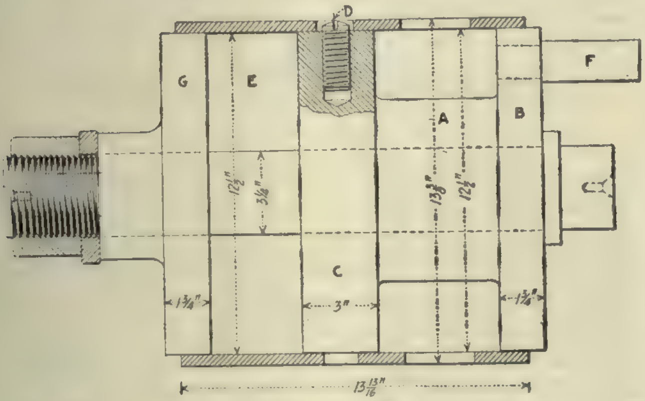


FIG. 5. ARBOR USED IN TURNING A VALVE CAGE

The apparatus for accomplishing this operation consists of a long, heavy, threaded rod or screw carrying at one end a plate to bear against the end of the cage casting, while the nut at the other end of the screw abuts against a plate resting across the end of the steam chest. Suitable means are applied for actuating the nut to draw the threaded rod back and to force the valve cage firmly into its position in the steam chest.

Housing of Workmen

By Entropy

With war upon us, stability of labor becomes of increasing importance. Every man taken from the ranks of industry makes it of greater importance that those who are left shall do their work more efficiently. The longer he stays on the job the less time and money is lost fitting him into the new job. Much time has been spent in compiling statistics to show what we all believed before, that married men living at home stay on a given job much longer and cause much less trouble and worry than single men who have no settled home. Of course, there are exceptions enough to prove the rule, but it is perfectly natural that a man with strong home ties should think much more seriously before throwing up a job than a man who can truthfully say that it is an advantage for him to see all of the world that he can before he settles down.

In order for a shop to attract married men it is first of all essential to have a place for them to live when they come. We have been invading the farms and have induced great numbers of able workers to try city life, but these men are used to commodious, if not very handsome, quarters; and they revolt at bringing their wives and children into factory villages, where the characteristic tenement houses are all that is to be had, or into rows of cottages all made alike, whether by the shop carpenter or poured in concrete in standard forms.

No man in any walk of life likes to live in a house that is not distinguishable from those each side except by a number on the door. The chances for awkward situations may delight a moving-picture scenario writer, but not a workman.

It seems to be generally accepted that a man can afford to pay one week's wages each month for rent and still heat his house or tenement; $20 a week seems to be a fair average to assume for such men as are under consideration. That means that he can afford to pay $240 each year. The owner of the house must get about 10 per cent. on his investment to cover interest on money invested, insurance, repairs, depreciation and so on. This limits our average man to living in a $2400 house, which does not seem to leave much for architectural embellishment; in fact, it does not seem to leave much chance of his living in a house by himself.

In New England there is a type of shelter known as a "three-decker," which is a blot on the landscape, but which serves the utilitarian purpose of housing three families in comfort, one on each floor. Inasmuch as only one roof and one cellar are required for the three, such a house can be built, even in face of the present high cost of materials and labor, well within the limits set, or $7200 for the whole building.

The objection to these houses is that they are necessarily so high in proportion to their width that they appear top-heavy. There appears to be no way of making them architecturally good, though some not so bad as the rest are built in which the third apartment is in the roof or attic and necessarily rents for less money, because it is less commodious and it is hotter in the summer.

IMPROVING THE APPEARANCE

Two of these houses may, however, be built together, using a common entrance hall and stairway, thus making the proportions inoffensive, provided there is the proper massing of windows and not too much attempt at ornamentation. More than that, they are easily salable, as a man can buy one with safety, paying only a few hundred dollars down and using the rent which he gets from the part of the house he does not occupy, to pay not only the running expense, but the principal as well.

If houses can be owned by fellow workmen rather than by the company for which they work, there is much less danger of a feeling of paternalism; and after a time the amount of capital invested by the employer becomes less.

Unfortunately, it does not seem to be possible to build cottages or single-family houses in northern climates, where heat and cellars are necessary, so that they can be rented to men drawing much less than $40 a week, if they are situated where the cost of land is more than nominal. On the other hand, some of the purchase plans in vogue make it possible for a man to buy such houses on terms that make the monthly cost much less up to the point where repairs and repainting are necessary. That time, of course, also depends on the care which the purchaser takes and also, very greatly, on the kind of materials and workmanship which have been put into it. If the company is to finance the sale, it cannot afford to build on the skimpy lines so often adopted by building contractors, but must find it profitable to build for permanence.

THE QUESTION OF ETHICS

The question of ethics is often raised. Is it right for a corporation to build houses and sell or rent them below market rates, either by actually asking a lower price or by building a better house at the same price? The same question can fairly be raised in connection with coöperative stores and every other activity in which the employer gets something of benefit outside of working hours.

As a usual thing, however, all these things are offered to offset certain other disadvantages to which the employees are subjected by accepting jobs. The housing problem is almost invariably one that is caused by the location of the company affected. Contractors might not dare to build the houses necessary, because they are naturally timid; and it is easy for them to fear that the company cannot insure permanence of employment and consequent permanence of tenancy. Under such conditions the company must step in and furnish homes or else put up with the less stable element that flows into, and also out of, a plant that cannot provide suitable homes to which to bring and in which to raise families.

The Why of the Reaction from Oslerism

By Robert C. Heinmiller

There are several reasons for the reaction from Oslerism, as presented in N. E. Hildreth's article on page 407. The chief reason for this reaction is that the employers have found it very expensive to hire and fire their help. Previous to this time an employer thought it to be cheaper to hire a young man at wages lower than those a middle-aged or married man would demand. When the young man became dissatisfied with his wages, it was a more simple matter to let him go than to raise his wages and keep in him in the employ. The cost of hiring and training another man was not taken into consideration.

But some far-sighted men have made investigation into these conditions, and now we know what it costs to hire, fire and train a workman. Some state $25 as the average expense connected with a workman changing from one position to another. That sum is low compared to the estimates of other authorities. It is said that Henry Ford found the cost of breaking in a new man averaged $70. Approximating the number of changes annually in this country at about 50,000,000, which are the figures given by one authority, the labor turnover costs the employers of this country the enormous sum of $1,250,000,000 annually, if we use the low figure of $25 in our estimate. Some concerns have estimated the cost of hiring and training a salesman at $1000 or more.

It is these and similar figures brought to the attention of the employers in this country that have caused them to take steps to reduce the labor turnover. One step in this direction is the employing of more middle-aged and elderly men, men with families, men of experience, men who are steady and dependable—hence the reaction from Oslerism.

Manufacturing Thread Gages

By Josef Bolkovac

In a very interesting article on the manufacture of screw-thread gages, page 265, *American Machinist*, Mr. Suverkrop seems to lose sight of his text in describing the operations that precede grinding and lapping. While he does not exactly say that many gages of the same size and design were produced on one order, he directly implies such, and then proceeds to illustrate and describe in minute detail the identical methods that are in use and have been for generations in the production of one, or a very few pieces of a kind. If the Presto Machine Works, or any other manufacturer is engaged in manufacturing gages, producing many of one kind, why does it not use manufacturing methods instead of the methods known to our fathers' fathers? Why are not these gages brought to the prehardening size on a screw machine or an automatic?

A superstition has existed, and been fostered by interested parties, that metal products are better because of pottering methods, but we cannot suppose the Presto Machine Works, or any other metal worker in America today is guilty. Cannot some one describe gage manufacturing and greatly oblige many of us?

The Inspection of Gearing*

By B. F. WATERMAN
Brown & Sharpe Manufacturing Co., Providence, R. I.

The inspection of gears requires as much attention as the making of them. If the requirements are not severe then the inspection need not be, but if the duty that the gears are called upon to perform is done at high speed and under severe stresses, with quietness an essential factor, then the inspection must be correspondingly severe and strict. In other words the more exacting the gear requirements, the more exacting the inspection, not only in the final inspection, but between various operations to make sure that the gear is not spoiled.

IT IS a practice of the Brown & Sharpe Manufacturing Co. on all gears that are made to customers' specifications to first inspect the gear blank and then, after cutting the teeth, to inspect it again for the running or rolling qualities of the teeth on a hand testing machine, unless it is stated specifically that it must run quietly at some given speed. If this is the case it is mounted on a power testing- or speeding-machine, such as made by the Gleason Works, and run at some speed nearly approaching, if possible, that under which they will run in practice.

Where the gears are to be used in our machine tools some of the intermediate inspections, such as the blank inspection, are not necessary, it being found that any error in the blank that would affect the running of the machine will be found somewhere, or at some time before the final inspection of the machine, which is always made under the belt.

It is also our practice to mark the drawings of gears, where the speed is over 400 ft. per min. with a note to that effect, the note stating simply "Speed 600 ft.," or whatever the speed may be.

This is a warning to the man responsible for the cutting that he may take the necessary precaution to cut quiet gears, and also a warning to the inspector that he may take steps to inspect properly. It is found that this note eliminates misunderstandings as to what the gears should be, or how they should be cut and inspected, and has considerable influence on the time consumed in the cutting operation and the inspection.

TESTING SPUR GEARS

The method of testing the average spur gear is the usual one of mounting on studs at the correct center distance. The most satisfactory way in most cases is to have adjustable studs where one fixture or machine will take care of a wide range of center distances, and there are several such machines on the market. Where gears are too large for such a machine a gear-tooth caliper set to chordal figures is a satisfactory way to get the pitch diameter correct. This test consists of calipering the teeth for size and variation, although on very large gears to cut to correct depth is satisfactory as the center distance is generally adjustable. In testing the gears used on our variable spindle-speed and feed cases we use stud plates where the various gears can be tested at the correct center distance and with each gear it may have to run with. This applies to many of the separate pieces of mechanism we use, but for general work we use our standard spur gear testing-machines. With this machine we use a device, which we call a spur gear indicating attachment, and we have found this very useful for testing runout as well as testing the rolling qualities of the gears together. In using this attachment the gears are pressed and held together by springs while a dial indicator presses against a square stud in the slide so that any tendency of the gears or slide to move away from the mating gear, due either to runout or poorly shaped teeth is shown on the dial. It is found that when the indicator pointer vibrates from tooth to tooth, not over 0.001 in., the gears are usually satisfactory, and when no vibration is shown the shape of the gear teeth is perfect.

Even in the case of spur gears, which are hardened and then ground in the hole, it is good policy to see that they are cut true, for then the inspectors need not make allowances for runout in testing and it keeps up the quality, or tone, of the gear cutting in general.

TESTING TRANSMISSIONS

Transmissions are run off in a test stand of some kind, and tested with a light load or without any load. Usually if a pair of gears, or a transmission, running dry, does not rattle it will run quietly under load.

A test which we use in connection with the grinding of the holes in spur gears for the so-called runout is the ball test. The device for this test consists of a pair of centers under a spring-plunger block. On the end of the plunger is a ball that fits between the teeth of the gears at about the pitch line; and above this plunger is a dial indicator, the point of which rests on the top of the plunger. The plunger block, which is fitted with quite a stiff spring, is used between the indicator and the work to rotate the gear into position, while the indicator shows the runout or variation in the pitch line. With this attachment we test the final runout in the gear. The number of spaces the plunger is set into depends upon the requirements of the gear.

A gear with a runout sound usually causes trouble, no matter how nicely the teeth may be otherwise cut or shaped. There can be, and often is, cause for difference of opinion as to the degree of quietness of a pair of gears, but there is not much chance of this in the case of a runout, because anyone can detect a runout sound and for this reason it is very objectionable.

In the case of cones, when built up of a number of gears keyed and pressed on a shaft, the inspection for runout should be after assembling.

We find that index and lead change gears must be cut true as they are usually meshed closely, and a bad runout in an index gear might prevent the machine indexing properly.

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*Extracts from a paper read before the meeting of American Gear Manufacturers Association, Chicago, Sept. 14-15.

Of bevel gears the ones that require the closest inspection are probably the driving bevel gear and pinion for automobiles. We find it necessary to hold these closely to figures in the blank, and we endeavor to cut them dead true. It is bad practice to let gears of this type, with runout in the teeth, go to the fire expecting that the grinding department will overcome it. An out-of-round sound is usually fatal to these gears.

After cutting the teeth in driving bevel gears we test them in the soft in the hand testing-machine with a hardened master gear, this being done to determine the bearing between the teeth and the feel of the gears. After this we test them on a speeding machine, in the soft, with the same master gear and under some load. After hardening, and with the holes and webs ground for the final inspection, we test only in pairs as we intend to ship them, but not in the particular order in which they will be used in the axle. The procedure is as follows: A gear is mounted and four or five pinions are run with it, when the gear will be removed and four or five other gears will be run with the pinion. In this way every gear and pinion sent out has been run or tested with one or more pinions or gears. In this way we keep our gears interchangeable as near as maybe.

It can be seen that if the final product is tested with the master gears only it would be quite possible, and very probable, that with an error appearing in the cutting the master gears might lend themselves to this error and never show it. When the product is run together the error, which would not show with the master gear, would appear to such an extent that the gears might not be usable. We know that the customer is never interested in how well the gears furnished run with the master gears, but how well they run together and at the same time interchange with the gears sent before.

We have also adopted this method on gears for our machine tools, and we can make repairs readily and surely and know that our inspectors have tested the gears just as they will run together, previous to their going into stock.

TESTING FOR AMOUNT OF RUNOUT

In testing driving bevel gears for amount of runout we use the ball testing fixture mentioned in connection with the runout test of spur gears. This fixture makes it possible to clamp the gear down to a rigid spindle and, with the spring-plunger block, the space of the gear is brought centrally under the plunger. The dial indicator will then indicate the runout. The bevel pinion can be tested in this way for runout by adjusting the plunger block to the suitable angle, and setting the pinion on a stud.

We do not make use of these runout tests in the final inspection unless the gears show a runout in the running test, when we try to find the amount of runout and the possible remedy.

In testing average bevel gears we test by hand on a bevel gear testing-machine, and make it a point to have a full length bearing along the teeth. If the bearing falls short of being full, as it may do owing to the need of some working limit, we expect it to bear heaviest on the inside or small end as the bearing will pull in or extend full length with the least wear and spring of the bearings or shafts.

In testing spiral gears that run at right angles about the only thing that can be done is to see that center distance is correct, with some backlash for oil space, and that the surfaces of the teeth are as smooth as possible. Any test of spiral gears, other than under actual working conditions, is rather unsatisfactory for they are treacherous gears to use except where the pressures are light.

Also with helical spur gears, as they are made only for high speed, the only satisfactory test is under actual working conditions, although it may be possible, of course, to develop a running test at some speed that will serve to show any defects in the gears. We have about concluded that there is no test that can be satisfactorily used in testing helical timing gears by any one other than the user of them, and for this reason we have long hesitated to cut these gears as we feel that the user or motor manufacturer should assume the responsibility of cutting them.

Worm gears, as they are being used today, require closer inspection than ever before as more is expected of them. It was only a short time ago that the worm gear had a doubtful reputation for serviceability, but since the advent of the worm-driven motor truck, it has taken a new lease of life, and now that more is expected of the worm gear, greater care must be taken in the inspection. With the difficulties that arise with the average worm gear cutting equipment it is not enough to know that the hob is marked correctly or that the centers of the spindles of the hobbing machine are the correct distance apart when the gear is finish cut; but the worm and wheel should be mounted at correct center-distance, and in proper alignment to be sure that the bearing between the worm threads and the wheel teeth is correct, a point which increases in importance as the service to which the gears are to be put increases in severity. On large gears where a testing-machine would be out of the question the worm can be laid in the wheel and measurements taken from a straightedge laid across the rim of the wheel to a bar in the hole in the worm or to the worm shaft. If the measurement taken on one side or end of the worm differs from that taken on the other it is evident that the shafts are not at right angles with one another, and if these gears are to be mounted in a gear case where the shaft bearings have been bored square the bearing between the teeth will be a cross-corner one, and how serious this is depends on what the wheels have to do.

TESTING SMALL WORM GEARS

When we stop to consider the pressures that are carried by the teeth of worm gears it is very evident that the bearing should be as full or broad as possible. In testing the average small worm gear we use our bevel gear testing-machine, which is also a worm and spiral gear testing-machine, but for automobile truck driving gears we have fitted up a special machine where we can run the gears under some pressure. This machine is fitted with scale and vernier to read the center-distance.

Probably no inspection operation depends more for its success upon the very operation it professes to inspect than the hardening inspection. When inspecting the machine operations performed on a gear, we can determine the mechanical errors with our measuring tools, and we can feel and hear how smoothly and quietly the gears run, and pass judgment on them without considering what equipment or methods were used in producing the results obtained.

HARDNESS TESTS

When it comes to testing the gear for the quality of its hardness, however, we find we cannot do more than give it a superficial test, which may mean a great deal if we are sure the hardening was done properly, but means very little if the hardening is improperly done. Assuming that we know the proper treatment for a given gear it is essential that the men in charge of the hardening operation should supervise it closely so that no deviation from the best treatment is made, because we know that the slightest lack of attention produces unsatisfactory or weakened gears without our being able to find them until they have broken in service. This satisfactory treatment must be determined by measured breaking tests of gears and an examination of the fracture to determine not only the depth of case, but the condition of the grain of both the core and the case. From a gear having undergone this test the desired Scleroscope and Brinnell readings are adopted.

This breaking test cannot be carried on indiscriminately, of course, owing to the expense of making test gears, but we find it so good a check on our work that we do it as often as we can, or as often as we think the job warrants it. We take gears that have been spoiled, harden them with good gears and then break the teeth either under a drop or with a hammer and examine the fracture. In this way we check the quality of the hardening under the best conditions with least expense.

As a rule we also test every hardened gear with a ball-peen hammer for depth of case, and with a file for hardness.

The Scleroscope and Brinnell machines are used as auxiliaries except where a customer may demand a given reading from either machine when it becomes the decisive test.

OTHER TESTS

Besides these tests for hardness, on driving bevel gears, we test for flatness on a surface plate and for any disturbance of the web in the direction of the axis of the gear. This test is a hardening-room test, for if we find the gears going out of shape in hardening we have to change our hardening fixtures to prevent it.

At times, after every test mentioned has been made and probably after any other test that could be made in testing gears, there is always the question as to whether or not the gears will run satisfactorily under actual service conditions, and we sometimes find it advisable to have gears tested under these conditions before proceeding at full speed to manufacture. When satisfactory, we like to have a pair or set that has been tested out in actual service to hold as master gears, with which we compare our future production of this gear.

In closing, it should be said that the amount or severity of the inspection of any gear depends entirely on what it is used for, maintaining, however, at all times, that quality which represents your work and product.

Correspondence-School Draftsmen

BY BRUCE A. BOGGS

Treasurer Mac-It Parts Co., Lancaster, Penn.

I was very much interested in a recent article in the *American Machinist*, in which the writer states that the worthy young man who has labored nights and spare time through a correspondence-school course of drafting does not know enough. It might also be said that the drafting-room apprentice knows nothing about drafting upon entering the drafting room.

The correspondence-school graduate at least knows how to handle his instruments and has a working knowledge of geometry and trigonometry. Furthermore, the intelligent correspondence school student realizes that he must be content to start in and learn the business from the bottom up, just the same as the apprentice. But he has the advantage over the apprentice in that he knows more about the craft to start with and consequently is more likely to arrive at the top first.

There is nothing to keep a correspondence-school graduate from spending his leisure moments in the shop and foundry just the same as the apprentice, in which case he has the same chances of absorbing practical ideas.

Boys who have enough ambition to spend their evenings, which they might be utilizing for pleasure, studying a correspondence course are usually boys who are always on the lookout for every bit of news concerning their profession; consequently, they read good articles and are prepared to guard against designing parts which the machinist or foundryman will have difficulty in making.

I think that a correspondence-school graduate who has any gumption will make just as good a draftsman as the apprentice and is likely to achieve more rapid success than the latter, because he has the advantage of a preliminary training. Take two boys of exactly the same mental ability and the same determination to make good and let one go into a drafting room as an apprentice and the other take a correspondence course, and ten to one you will find that one will make just as good a draftsman as the other.

A Reaction from Oslerism

BY N. E. HILDRETH

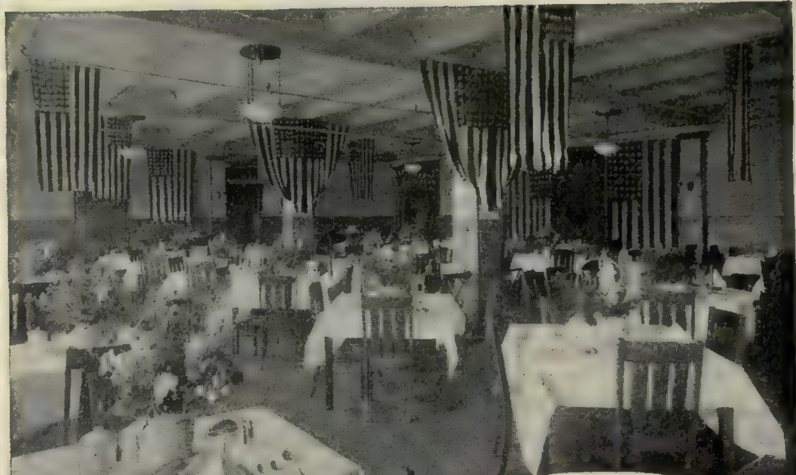
It is to be regretted that the editor did not advise F. H. Jennings that my article entitled, "A Reaction from Oslerism," on page 407, was written not only before the draft law was passed, but also before this country entered the war.

Had Mr. Jennings been so informed, I am certain he would have changed the form of his comments, on page 682, and also regarded as truthful my statement that my conclusions were reached after several years' experience and observation.

Doubtless not the least of the economic changes and benefits growing from the war and the draft will be an early forcing of most employers to a recognition of the correctness of the observations made in my letter. But there were some, and probably more than Mr. Jennings seems to think, who were wise enough and fair enough to take the action indicated before necessity compelled.

CHICAGO MACHINERY CLUB

The present Board of Directors is as follows: C. W. Blakeslee, President—Abrasive Co. F. LeRoy Peterson, 1st Vice-President—Hendey Machine Co. J. D. Powell, 2nd Vice-President—L. S. Starrett Co. N. A. Booz, Secretary—Machinist Supply Co. A. L. Beardsley, Treasurer—Cleveland Twist Drill Co. E. P. Welles—Charles H. Besly & Co. H. A. Stocker—Stocker-Rumely-Wachs Co. O. P. Wodack—Jas. S. Clarke, Jr., Elec. Co. E. L. Bersel—Gardner Machine Co. J. R. Porter—Marshall-Huschart Mchry. Co. A. A. Bowyer—"American Machinist." H. E. Witham—Warner-Swasey Co.



The Machinery Club of Chicago was organized April 30, 1916, with fifty signers, and the meetings in each of the following eighteen months were held in different hotels of the city.

Every possible convenience has been provided for the members, who are solely engaged in the iron and steel industries in and outside of the City of Chicago.

Various forms of entertainment were provided and six o'clock dinners were made a feature.

The entertainments, good fellowship and congeniality prevailing served to rapidly increase the membership to six hundred and to this number new memberships are constantly being added.

At a meeting held July 2, 1917, permanent club rooms were decided upon.

The present quarters in Machinery Hall were leased and dedicated Sept. [illegible]0, 1917.

Series for Executives

Selling Patents Abroad

BY GLENN B. HARRIS

The first inclination of an inventor and patentee, and this applies equally well to the purchaser of an interest in an invention or patent in this country, is to make application for foreign patents. This is done as a rule at considerable expense, and the returns in most cases are not at all commensurate with the outlay. The primary reason for this is the fact that the one interested in an invention developed in this country does not take into consideration its adaptability for use abroad, and its marketability there.

THE fact is that foreign patents on all kinds of devices and contrivances are applied for, when in a great majority of cases there is no use for them abroad. Inventors should bear in mind the fact, if they are in possession of an agricultural invention of any nature and are determined to obtain foreign patents upon it, that the logical points for patenting are those countries in which agricultural pursuits are followed. If engaged in the manufacture of iron and steel and the invention pertains to this line, then patent it in the iron and steel countries. If the invention is a specialty or novelty then with advantageous connections most of the countries abroad will afford a ready and profitable market.

It is one thing to procure a foreign patent, but quite another to affect its disposal, and this is especially true if the invention has not been developed in this country, and a profitable market found for it. Even in this latter event the task is no easy one as the writer knows from extended personal experience. In the first place the Continental countries are not as quick to grasp the possibilities of an invention, and the probable profits to be derived therefrom, as are we of this country; and then again they have been so taken in by oily-tongued promoters of worthless inventions, that they are sceptical regarding most anything, from this country.

A PROPER introduction from someone on this side, occupying a position of standing in the business world to those in a similar position abroad, is an almost absolutely necessary prerequisite to gaining even attention to the proposition to be advanced; and one who is without this essential is almost absolutely certain to meet with dismal failure.

Even with letters to those influential in the financial or business world, it is indeed uphill work to obtain encouragement of any nature whatever. To obtain results it is necessary to have "go and stick-at-it-iveness" and no little capital, and to make up ones mind to a stay of no short duration. Numberless instances of inventors making a trip abroad, sanguine of success, and expecting to accomplish this and return by next steamer are at hand. The success expected does not materialize, and lack of funds leaves them stranded and compelled to apply to our resident consul for immediate aid and return passage to this country where they arrive sadder but wiser for their experience.

It is true that large sums of money have been received for the sale of foreign patents, but these instances are of infrequent occurrence, and in almost all instances where the invention has proven successful it was of the first class and well and favorably known abroad. Anything bearing the name of an inventor, say like Edison, or for that matter one in a class or two below him, would be quickly purchased. In fact it could be sold to the highest bidder, and there would be numbers of them.

MY ADVICE is to secure foreign patents on an invention if, after mature consideration, you deem it worthy of them, and then only in countries where there would be opportunity for a fairly good market. Then establish a demand here, and obtain reliable and energetic representatives abroad, who can and will introduce the product there. Bide your time, when the point is reached where orders are being received and the trade is growing, then is the time to make a trip abroad.

Representatives, if personally not in a financial position to entertain the purchase of patents would be able to advise communication with those that would. The chance of success by following this procedure will be increased one hundred fold.

A number of years ago I became interested in an invention that gave promise of large profits. It was an extremely simple device, cheap to manufacture, and the market for it seemed unlimited. We proceeded to procure patents in this country, and the principal foreign ones, not taking into consideration with the latter whether the invention would apply, or whether there would be any considerable market for it. The prices we had decided upon, we afterward found to be absolutely out of the question, and in later years when I became more fully conversant with foreign patents, absolutely ridiculous. It was decided that one of our organization should immediately make the trip abroad.

I left this country without a single letter of introduction to anyone on the other side, and with no acquaintanceship there and with no well defined idea of just how I was to effect disposition of our patents. Like my associates I had unbounded faith, and confidence in the merit of our invention, and thought to only display it, was to effect an immediate sale. I carried with me a letter of credit, which I deemed ample for my requirements as I did not anticipate my stay to be an extended one. The fallacy of my judgment was afterward proven and I was compelled to resort to the cable for funds to tide me over until I could effect a sale and return to this country.

MY OBJECTIVE point was Paris, and on my arrival there I put up at a hotel very popular with Americans, and engaged quarters in keeping with, what seemed to me, the importance of our project.

After looking around to get my bearings, I obtained a number of addresses that appeared likely, and started in on my campaign to astonish the business world, and to separate it from its money. My first call was on a very large business house that operated in a line closely allied to our own. My knowledge of French was extremely limited. On reaching my destination I presented my card, and requested in English that it be presented to the head of the concern. Back came French to me as though from a rapid-fire gun. I was flustered, but finally made it known that I wished to speak with someone having an understanding of English. After a long wait an individual meeting this requirement was produced, and I made known my desires. My card was taken and I was presented to the head of the firm. Explaining as briefly but clearly as I could the nature of my call, I was pleasantly received, and he examined our device and expressed the opinion that it possessed considerable merit. He then interrogated me as to what I desired and when informed he quickly asked if we had made any attempt at introduction in France, and on receiving a reply in the negative immediately inquired as to our output in the United States. When informed that we were just installing machinery to begin manufacture our interview came to an end, I being informed that his firm would not think of considering the purchase of a patent which had not found a market in this country, that when this had been accomplished he would be glad to negotiate with me.

I BEGAN my quest the following day going from place to place, sometimes receiving a little encouragement, but in the main meeting flat but at all times courteous turndowns, and actually accomplishing nothing but the depletion of my cash resources.

After about a week of effort, without success, I accidentally met a school friend who had attained great prominence with the famous Creusot Ordnance Works. This friend, on ascertaining the nature of my visit to France, took an active interest in my venture, and the invention itself. He took me in charge and presented me to influential financial friends in a most favorable way. Negotiations were entered into, but our price was far beyond what we could obtain. After much cabling back and forth between myself and associates a price was agreed upon, and the sale consummated. While I was not satisfied with the price, I was convinced that under the circumstances it was the best I could obtain, and in view of my experiences it was acceptable. I had spent more than three months abroad, and returned with a considerable sum in cash and a very large amount of experience.

A few years after my visit to France I came in contact with an invention that had been thoroughly tried out here and was a most efficient machine. It had been adopted by the large railroads, machine shops, foundries, shipyards, and in fact was in general use in most all lines of the iron and steel industries. The strongest kind of testimonial letters had been written regarding it, and what was better evidence of its merit was the fact that repeat orders were constantly coming in. Foreign patents had been obtained on the machine, but had been permitted to lie dormant. A few of the machines had been shipped abroad, but no concerted effort had been made tending to its wide introduction abroad.

An opportunity presented itself to obtain an interest in the patents, and I availed myself of it. I did this for the reasons that the machine, as I have stated, possessed great merit, could be manufactured at a low figure and sold at a price which netted extremely large returns. Then, too, I had in mind my experience in France with a machine that had not yet found a market in this country. As this machine met all the objections raised in Paris, I felt that the sale of the foreign patents would be an easy task. I therefore decided on an immediate trip to London, taking with me attractive catalogs, original orders and testimonial letters.

ON REACHING London I began my work by visiting the different machinery houses. I was most pleasantly received in all quarters, and was given the names of a number of parties who might aid me in the formation of a company to manufacture and sell the machine in Great Britain and Continental Europe. In most cases I found these parties to be promoters, and all were most anxious to proceed with the matter of floating the company I had in mind at once. However, in all cases, what might be called a registration fee was demanded. This fee was to cover expenses and incidentals. Inasmuch as I would be parting with good money, and no results were guaranteed, I refused to be taken in.

I chased rainbows in London for two months at which time our patent solicitor advised me of a young man who had been extremely successful in handling the flotation of patents. This man did not require a retainer, or fee of any character, nor did he wish to make charges of any description. He was thoroughly content to take his pay in shares of the company to be organized, contingent upon its success.

However, the parties who had been approached were too slow for me and I left for home. In about three weeks I received a lengthy and urgent cablegram stating that my presence in London was absolutely necessary at the earliest moment possible as Sir E. J. R——, who had been Chief Constructor of the Admiralty and a man of the highest standing, was willing to take hold of the matter immediately, and in a most active manner. I sailed two days later.

On my arrival in London, when I was met by my solicitor, I requested an immediate interview with Sir E. J. R——. At this the solicitor threw up his hands in holy horror, and stated that I must write for an appointment, that it would be a serious breach of etiquette for us to attempt to see Sir E. J. R—— without this very necessary formality. We wrote and a reply arrived inviting us for the following day.

I found him a man most affable and courteous in his manner. We discussed our project at great length, and he was thoroughly impressed with the possibilities of the proposition, and as he stated that he would immediately proceed in the matter an agreement was penciled between us.

AT MY second visit I received the same simple and gentlemanly treatment that had been accorded me on my first. I was advised that Mr. M. D. R——, who was chairman of an extremely large manufacturing concern was working in connection with Sir E. J. R——, and was making excellent progress in the matter. I was advised, however, that it would be necessary for me to proceed to Glasgow and make exhaustive tests of the machines, which I was quite willing to do.

The tests were to be held in the shipyards of the Fairfield Engineering Works, where the "Lusitania" and the "Mauretania" were being built. The tests in the Fairfield Works, were eminently satisfactory, and a report was written to this effect by Sir E. J. R.'s representatives. Tests were then required in one of the large railway repair shops, and as these were given with the same satisfactory results obtained in Glasgow it seemed as though the formation of our company was an assured fact.

On visiting Sir E. J. R—— I found him very much pleased and impressed with the result of the tests, and he suggested that we immediately proceed to Mr. M. D. R.'s office, and talk over our plans. Mr. M. D. R—— was principal owener of the shares in a large shop and this we visited with an idea of determining whether our machine could be made there. We found the plant admirably adapted for our purpose, and submitted our samples in order that estimates might be given as to prices at which the machines could be delivered to us. We now had to go before the banking concern which Mr. M. D. R—— had interested in the project, and who were to underwrite all the capital stock. This concern required a short time to float the five-million-dollar project if everything proved satisfactory.

OUR data finally being complete, a time for meeting between ourselves and the bankers was finally agreed upon. Our facts and figures together with original orders, testimonials and result of tests in Glasgow were all in shape, and were presented. All this data was carefully canvassed and terms of sale agreed upon. It was at this point, that one of the directors suggested that an option of thirty days be given them in which time they could make inquiry as to the standing of our firm on this side, and also confirm the information I had given them. As I had perfect confidence in the proposition I did not demur, but urged, that in view of the fact that I would be compelled to remain for a period of thirty days in London and would be prevented from negotiating with others, it would only be fair that I be recompensed. To this they agreed, and finally handed me a check of two hundred pounds for the option.

I learned that the investigation was to be conducted by two engineers, residing in the city where our most formidable competitor was located, and immediately reached the conclusion that these engineers would apply to our competitor for information, and that it would not be at all in our favor. My powers of second sight proved true, and near the time of the expiration of the option, I was advised that the report had been received, and that they had decided not to go any further in the matter. Our competitors had simply put us out of business.

I had spent six months in a most earnest effort to dispose of good patents on a good machine, and had done everything possible to make a success. No one visiting the other side could have had better connections, and yet my deal was sacrificed on the opinion of two engineers who accepted the word of a competing company as to the merit of our product.

I trust my experience abroad will be of benefit to those owning, or having an interest in, foreign patents and contemplating their disposal by a trip to the other side.

Modern Heat Treatment Laboratory

Industrial applications of physics and chemistry have given rise to a class of highly specialized workers, who devote their whole time to a limited range of phenomena. The heat treatment of metals, for example, requires expert skill in micrography, chemical analysis, pyrometry and physical testing. The student should be familiar with the laws of combustion and heat transmission, equilibrium diagrams, the phase rule, the laws of solution and other facts of physical chemistry. To meet these requirements the metallurgical departments of a number of technical schools have organized extensive courses in chemistry, metallurgy and physical measurements with laboratories for the instruction of students and for investigations in these subjects. Students trained by such courses are fitted to become specialists in charge of metallurgical and heat treatment departments.

The general mechanical engineering student, on the other hand, is being prepared to design and construct machinery in which heat-treated products are, or should be, used. He must, however, cover so much ground; including the strength and resistance of materials applied mechanics, thermodynamics and hydraulics; the rudiments, at least, of electrical engineering, shop practice and the science of management, etc., that he cannot ordinarily become an expert metallurgist within the limits of the ordinary four-year course.

To meet this situation, the Massachusetts Institute of Technology, Cambridge, Mass., is working out a heat treatment course designed to acquaint students of the mechanical engineering department with the leading facts of metallurgy and heat treatment and what results such treatment have on the physical properties of the materials. This course includes lectures on the heat treatment of steel and other metals, and is coördinated with work on the strength of materials.

A special laboratory, shown in illustration, Fig. 1, has been equipped with suitable furnaces, cooling baths and pyrometers. With this equipment, and with furnaces which the students will build themselves, they will heat-treat metals of known composition according to certain schedules, after which samples will be tested for hardness, elastic limit, tensile strength, reduction in area, elongation, etc., in the physical testing laboratory adjoining the heat treatment laboratory. The apparatus already installed includes a cyanide furnace, an oil furnace, a lead furnace, a small muffle furnace and a large muffle furnace with a temperature controller. Alongside of and in connection with each of these furnaces is a Leeds & Northrup deviation potentiometer pyrometer. The deviation potentiometer is designed to be set at some fixed temperature which is to be held in the furnace and any variations from this temperature are continuously indicated in amount and direction by the deflection of the galvanometer needle.

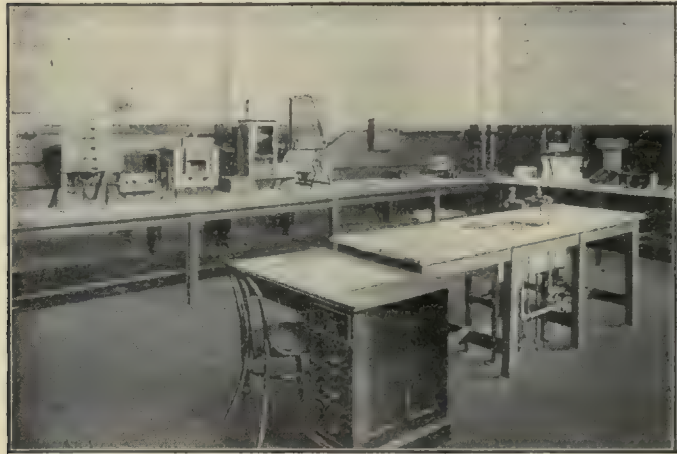


FIG. 1. A VIEW IN THE LABORATORY, SHOWING BENCHES

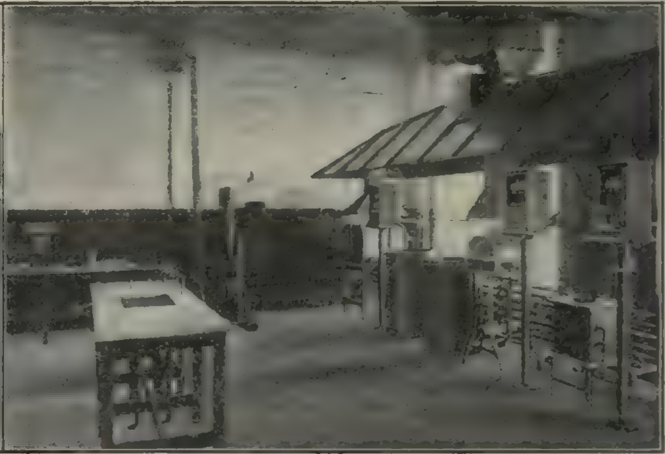


FIG. 2. THE TRANSFORMATION POINT APPARATUS

In connection with these furnaces, there is an oil bath with water jacket and air jets for cooling and agitation, also a water bath with ice water or brine circulation, the latter being served by a motor-driven circulating pump from tanks at the other end of the room, as shown in one of the illustrations.

On the other side of the room are two electric furnaces, one a Hanovia, 23 in. long, and the other a Hoskins muffle furnace. The temperature in these furnaces, and also in the gas furnaces, can be measured by means of a Leeds & Northrup potentiometer indicator located at the end of the room. Since no current flows through the thermocouple and galvanometer at the moment when temperature is being measured, the resistance of thermocouple lead wires and galvanomter do not enter into the measurement, and it is thus possible to use a four-circuit conduit led around the walls on both sides of the room with plug outlets for connecting the one indicator to any furnace. By using lead wires of the same materials as the thermocouples, the cold end is brought back to the potentiometer, where its influence is compensated for automatically. By means of a bus-bar board, any thermocouple can also be connected to a Leeds & Northrup recording pyrometer standing near the indicator. The recorder is a curve-drawing instrument, also of the potentiometer type. As the pen has a movement of 10 in. and the paper travels 3 in. per hr., the curve exhibits the temperature of the furnace and changes of temperature on a large scale.

As is generally known, the most suitable temperatures for hardening and other heat treatment operations bear definite relations to certain fixed critical or transformation points, which are peculiar to each kind of steel or other metal. These points correspond to allotropic and solution changes and are accompanied by absorption of heat during heating, and evolution of heat during cooling. They can therefore be detected by momentary arrests of the needle of a pyrometer measuring the temperature of the material, when the temperature of the furnace is raised or lowered at a uniform rate. As it is necessary to know these points accurately in order to lay out a heat treating schedule intelligently, accurate and unmistakable determinations are desirable. For this purpose the laboratory is fitted with a Leeds & Northrup transformation point apparatus. This instrument draws a line upon a chart exhibiting in a marked manner the transformation points and the temperatures at which they occur.

After having examined and subsequently heat treated a piece of material, the student will test it for hardness by means of a Brinell machine or by the scleroscope, or microphotographs will be prepared, which can be thrown on the screen and discussed by the instructor, or the specimens will be tested on one of the numerous testing machines in an adjoining room.

The course of instruction in this subject is being worked out tentatively by the mechanical engineering department of the Institute, under Professor Miller, and is under the immediate direction of Professor Harrison W. Hayward. Other departments are so coördinated, however, that the services of specialists can be obtained for advice, lectures or demonstrations. The laboratory will be in charge of a physicist, who can consult with Professor Norton of the physics department, with Dr. Fay on matters relating to the chemistry and heat treatment of steel, or with Dr. Sauveur on metalography, or can make use as required of the very completely equipped metallurgical, pyrometrical, physical and chemical laboratories. The course is designed primarily for advanced students and those doing theses work, the purpose being to coördinate heat treatment, metalography and physical testing as accessories to mechanical engineering design.

VOCATIONAL TRAINING for CONVALESCENT SOLDIERS

By F. H. Sexton
Vocational Officer, Quebec and Maritime Provinces Military Hospitals Commission

This interesting article tells what is being done in Canada for soldiers, who have been sent back from the fighting front, to fit them for remunerative work at home. The vocational training they undergo not only assists them in a material way, but it is immensely beneficial to them mentally and physically.

WHEN the day finally comes that the Canadian receives his "blighty," he is sent through the great chain of hospitals back to England to be restored to a semblance of a whole man again. If he cannot be fixed up so that he can go back to the trenches again, he is carried along until he is fit to stand the long sea trip and is sent in a hospital ship back to his native land to finish his convalescent treatment. From coast to coast in the Dominion there are now provided a great string of hospitals, convalescent homes, orthopaedic institutions, sanitoria for the treatment of tubercular men, etc., all devoted to the task of repairing the war damages to the bodies and minds of those who have so nobly served their country. In this new problem it would be the easiest thing for the show of gratitude of the people by persistent exhibitions of sentimental sympathy and emotional adulation to undermine the courage and independence of the wounded soldier. Pity and sympathy are easily aroused at the sight of the broken men in khaki, but had best be restrained, because the man himself must be diverted from brooding on his condition, and encouraged to a cherry optimism.

The business of getting well is slow. Most of us can remember recovering from a severe sickness, or an operation. With soldiers, whose minds and souls have been racked by the hellish experiences of this war, it is a much slower business than it has been with us. The convalescent home is a comparatively new institution in medical treatment. Most of us who have had to go to a hospital have been sent away as soon as we were able to go home, and have finished our recovery there. The convalescent home, or hospital, covers the latter portion of the restoration of the men as far as possible to their normal powers, and when they are discharged they are supposed to take up their task of earning a living in civilian occupations almost immediately. Many of the soldiers in such a home have no medical treatment other than diet and rest, others get massage or electrical treatment for a half-hour each day, others are merely under observation. The men have a good deal of time that is not taken up by the daily routine of their treatment. If they were left entirely alone they might spend most of this time in playing cards, billiards, reading trashy magazines and novels, or simply idling away their time. Such a procedure would not tend to enliven the mind and harden the muscles of a man, who will have to shed his uniform in a few weeks, and hustle for a living again in civilian life. Further than this, the man who idles away his time does not get well as quickly as if he is busy and interested in some kind of work. Work, which is so often shunned, hated and cursed, is really the salvation of the sick man as well as the healthy one.

Accordingly, the Military Hospitals Commission, which is the agent organized to take charge of, and care for, all returned invalided soldiers in Canada, started technical classes in all the convalescent homes. The primary reason was for the therapeutic value of the work. It has since proved of inestimable value to many soldiers in preparing them for positions, when they were discharged from the army with their physical disabilities incurred in the war, than they had as whole men before they enlisted.

Thus vocational training for convalescent men must not be confused with the vocational reëducation of men, who have been so disabled that they cannot return to their former occupations. The former kind of training is supplementary to the medical treatment, and is not as thorough, intensive or extensive as the latter. It is the former that we are considering in this article.

Classes are held every day for two and one-half hours in the morning, and two hours in the afternoon in such subjects as will interest the men and improve their mental and physical power. All of the classes are made as practical as possible, similar to the instruction developed so widely in evening technical and industrial schools.

THE RANGE OF INSTRUCTION

Many of the men have had little or no education, so instruction is given in English, French and arithmetic. Some of the men, knowing that soldiers have the preference in Government employment, prepare themselves for Civil Service examinations. Others, who have injuries that preclude them from heavy labor, take up stenography, typewriting and bookkeeping, and thus prepare themselves for clerical positions. In addition to these classes, instruction is offered in electrical wiring, shoe repairing, woodworking, art metal work, machine-tool operating, industrial drawing, automobile driving and repairing, agriculture, etc. Not all of these courses can be offered in every convalescent home, because the number of men, and the facilities for instruction vary within wide limits.

The special class, which would probably be of most interest to readers of the *American Machinist*, is the class in machine-tool operating. The one in particular, which is shown in the accompany illustration, is carried on in the machine shop of McGill University in Montreal. When approached by the Military Hospitals Commission, the University authorities were only too willing to make the facilities of their shops available for training the returned soldiers. The arrangements for 20 to 25 hours per week were not difficult, because of the great number of engineering students away at the war. The regular shop instructors were only too willing to do their share in this patriotic service. From 18 to 25 men from the convalescent home take this class every day. They are not all the same men from day to day, because the time is broken on account appointments with dentists, doctors, masseurs, etc.; and men are continually being discharged, or are just returned from England. All the instruction is therefore purely individual, and the services of two instructors and a toolroom man are necessary.

THE SHOP COURSE

The course begins with bench work in chipping, filing and scraping a small surface plate about 4 in. square. The edges are then faced up on a shaping machine. Various exercises in plain turning on the lathe are carried out on cast iron and machine steel. Succeeding this, the man proceeds to the cutting of threads and the turning of more intricate machine parts. He is then given some more bench work in the shape of a marking gage and a machinist's steel square. Next comes the making of machine parts, which involves the use of the file, the lathe and drilling, planing, shaping, milling machines. He is then ready to start on a real job, and do his part in the production of a real machine.

THE MATERIAL USED

A public-spirited manufacturing company furnishes all the drawings, castings, steel, brass and fittings for small duplex steam pumps. The purpose and action of the machine is explained to the men and then the jobs are parcelled out as they would be in a shop. Each man understands the relation of his work to the whole effort, and learns how to handle his detail drawings as well as the assembly drawings.

Not all the men finish the work outlined here, because their aptitudes, experience, strength and period of convalescence vary within such wide limits. Not many of the men have ever worked with machine tools before. Their former occupations range over the whole gamut of well-known activities and some that are rarely listed. If they are not fitted for the work they naturally gravitate to some other class after a few days' trial.

This kind of work has proved to be very beneficial to such mental cases as "shell shock." It also helps in cases where there is a stiffening of joints, or loss of muscular power, from the severing of tendons, muscles or nerves in the arms by a bullet or shell fragment. This active physical effort, following massage, limbers up the muscles and brings back the old power to atrophied members. The men suffering from "shell shock" are so interested in the work, that they do not brood over their condition; they gradually get a grip on themselves and slowly become normal again.

WORK AFTER DISCHARGE

When the men are discharged, they easily find work in the munitions plants where they are able to make high pay and thus continue with profit to help defeat the Germans. Some of the men have shown latent ability, which they themselves did not suspect, and after three months in the classes have been able to secure positions as regular machinists on good daily wages, instead of being obliged to take some specialized operation in shell making at a piece price. One particularly satisfactory student had been a member of a family of 25 children, and had never seen the inside of a schoolhouse. He could not read nor write at all, but after four months of study in general subjects he mastered the elements of arithmetic through fractions and had a simple working knowledge of reading and writing. He switched to the machine-tool class and showed a great aptitude for the work. After three and one-half months there he was discharged from the army and he secured a position as machinist in the toolmaking room in a large munition plant at $21.80 per week. In three months more he was a toolmaker earning $5.50 per day. Before he enlisted he was a teamster at $12 to $14 a week.

The whole field of vocational training for convalescents is being developed in Canada for the soldiers and is producing many encouraging and surprising results.

War Problems of Great Britain

BY SIR STEPHENSON KENT*

THE following address was made at the luncheon given by the Editorial Conference of the New York Business Publishers' Association to the Special Mission of the British Ministry of Munitions to the United States:

I gather that you will expect me to once more expound the gospel we have come here to preach. I may say that we have been doing that for the matter of a month or more traveling round your enormous country, and gradually appreciating that we have seen practically nothing of it. I think the impression we all have is that it is so vast that if we stopped here the rest of our lives, we really should know very little more about it than we do today.

Your problems and ours differ. We appreciated that at a very early moment after our arrival in this country, and anything that I or my colleagues may say, I beg that you will take not as advice or suggestions, but simply as a recitation of the experiences that we have had in England.

We recognized in England, after our first few months' very bitter experiences, that the organization of a nation's industries on a war basis is even more important than having an army. The army is as helpless as a baby in its cradle if there is not organization of the industries and if the munitions that are absolutely vital to the success of that army are not forthcoming, and forthcoming without interruption. Continuity of supply, and an ever-increasing supply are vital to the success of the army at the front.

Industrial peace at home is a necessary accessory to the success of your army; without it, it is never going to dare to move. My Government called together, before the Ministry of Munitions existed, capital and labor; federations of employers and the heads, the executive chiefs, of our trade unions. We differ from you in that respect. The labor that is engaged principally in the engineering trade, in the manufacture of munitions, in its widest sense, is very highly organized. The percentage of trade unionism there is very great indeed. I think it is no exaggeration to say that in the engineering trade 80 per cent. of the labor is trade union labor.

My Government had two ideal bodies to negotiate with: The committees of these federations of employers, who were fully representative of capital's voice, and the trade union officials, who fully represented labor's voice.

That conference ended in what is known as the Treasury Agreement. That Treasury Agreement was embodied in the Munitions of War Act. The principal features that I am to worry you with in regard to that act are as follows:

PROFITS LIMITED

In the first place, the Minister of Munitions definitely had power and definitely limited the profit made in any establishment that was engaged in the manufacture of munitions.

In the second place, the wage of the labor in those controlled establishments was fixed; it was made quite clear to the trade union heads and to labor generally that there would be no fluctuation or variation in the wages of that labor, except by express consent of the Minister of Munitions, and that he would not give his consent to any such variation unless an overwhelming case was made to him.

The state then having fixed the profit and fixed the wage, and capital and labor and the Government having definitely agreed on the principle which, I think, is essential, that a nation's need is not the opportunity for capital or for labor to make money out of its country. Having done that, the state realized its duty in regard to the labor, whose wage it had limited.

The Committee on Production was set up, whose function it was to ascertain what, if any, the increased cost of living amounted to and to issue a national award in regard to that labor whose wage had been fixed, so as to meet the increase in the necessities of life that that labor might find. That committee meets three times in a year and has the necessary statistics laid before it, receives representations from trade unions and from any one else who has a voice or should have a voice in the matter, investigates the case very carefully, then gives instructions that this labor should receive so much extra per week to meet that increased cost. That is paid by the employer and is recoverable by the employer from the state. It is the state's charge.

STRIKES ILLEGAL

The third point was the illegality of strikes and lockouts and compulsory arbitration. The same principles underlay that. In peace time a lockout or a strike was a matter between the employer and his employees; in war time it is a matter of national concern. If, through obstinacy on the part of the employer or his employees, a factory which the army was very largely dependent upon for some very definite and urgent munitions, remained out of work for some period, the state could not tolerate that in war time; and so, in this act, it was laid down that any lockout or strike is illegal, and if any one incited the men to go out on strike, or if the employer deliberately locked out his employees, the maximum penalty for any such offense is penal servitude for life.

My Government induced, it required very little inducement, the trade union leaders in my country to agree to waive all the restrictive practices that had been common in the manufacture, on the civil side (what now is the munition side) from the point of view of output or from engagement of labor on war work, for the period of the war. On the Government's side it pledged itself to restore the pre-war conditions in any factory where by that agreement the normal conditions had been varied.

Those, I think, are the principal features of that act. The act has, on the whole, worked well. We have had stoppages, we have had strikes, but they have not been of very great length or of very serious moment. And I think, if you take into consideration the very long period of strain that our workmen have suffered under, it is a very surprising thing. You must remember that in the early days of the Ministry of Munitions we worked these employees in these factories hours that are really disgraceful. I know no better word. One hundred and twenty hours in the week in some establishments. A hundred hours was quite common. That went on for a period of some months. All their holidays, their normal pleasures, the relaxations, horse racing, football, and so on, were all wiped away. These men were required to work and to forget that they were in the world to try and get any little pleasure out of life.

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*Member of the Council of the Ministry and Director General of Labor Department of Great Britain.

That being the case, after all this long period, it will be, I think, easily appreciated that because of war-weariness, a state of mentality that is very apt to magnify grievances, any little, tiny, grievance becomes a matter of very great importance. It is a very fruitful soil for the pacifist, for the professional agitator, for the I. W. W. and so on to work on. And I think that it redounds enormously to the credit of our labor that we have managed to get through with this continued industrial peace.

The Ministry of Munitions set up in the ministry a labor side, of which I have the honor to be the head; and to that labor side is given the solving of all the problems that deal with labor. They are dealt with on a policy that is laid down by the Minister of Munitions or the Government as the case may be.

These matters are not left to the individual employer to deal with as he thinks fit. We do not permit one employer to settle some little dispute in one way, another employer a similar dispute in another way. We try and get some definite, broad policy laid down, and then deal with these matters on that policy throughout the country.

We look upon it as our business, and we have a very considerable staff, whose duty it is to act as the eyes and ears of the Minister of Munitions. It is their function to know of any possible cause of dissension in any industrial center in the country, and to deal with that cause of dissension before is becomes a dispute.

We have the theory that in war time prevention is one million times better than cure, and we look upon it as our duty to prevent the possibilities of dispute even arising. We have, to a certain extent, been successful, but it is a very arduous business today, because of that state of mentality to which I referred.

It is so very easy for what appears to be a point of no importance whatsoever to suddenly become a sort of fiery cross to the whole of my country. And so these eyes and ears, these officers of the Ministry, are a very essential part of our administrative machine.

Universal Economy

We take the view that today, above all other times, it is absolutely vital to exercise economy from every point of view. Economy from the point of view of food, yes; but economy from the point of view of the materials that are essential to the winning of this war, economy from the point of view of the use of man-power.

We look upon it today in England as a very serious crime if steel or copper or lead or iron or any of these raw materials, which we never have a sufficiency of, is used for any purpose other than to help to win the war. We look upon the employer or the army or a Government department who misuses the skill of any mechanic or any citizen really, as guilty of a mistake and a crime that it is our duty to put right.

We have a great number of technical civil engineers of the highest qualifications, whose duty it is to investigate the use made of man-power in these establishments. They report to the Minister of Munitions, and if they find any employer having in his employ a skilled workman, and that that skilled workman is doing work that somebody who possesses less skill could do, we take very serious note of it, and move him on to some better work, work that he should more properly be performing.

That, with us, is absolutely vital, and I think, if I may say so, that you, in no very long period of time, will also find it vital. This war is primarily a war of mechanics. There is no country that is today at war that has a sufficiency of skilled mechanics. We are all lamentably short of skilled mechanics.

If you will remember that today every gun that we manufacture and send to our army, with that gun we have to send some small number of skilled mechanics; that with every airplane a very great number of mechanics, and so it goes with every conceivable article of munitions that we send to the army, we have to deplete the skilled man-power that remains to use in our country.

The better we supply the army, the more difficult our problem at home becomes. And so with you exactly the same problem must arise; and I understand again that one of my colleagues is going to elaborate and give you details on that point.

Controlling Labor Migration

We had an experience that I gather you are having at the moment, and that is the migration of labor, the enticement of labor. We called it the auctioneering of labor. In the early days our employers were loyally anxious to do everything they could to assist the government in getting the biggest output of munitions that was securable at the earliest possible moment. And I think they thought that it would be of assistance to the country if they accumulated as large a number of skilled mechanics as they could in their establishments; that they would then be ready to take on any order that the government might like to entrust to them.

Of course, any such experience as that, any such habit as that, is a very dangerous one. It leads very rapidly to one of the most vicious circumstances that one can picture. The man whose labor is being taken from him has proceeded to rob somebody else; and so it goes, and there is no finality in it. You get unrest of the worst description among your labor. They are always looking round the country to see if they can't find some other employer who will offer them a still higher wage than they are at that moment receiving.

You find that the government attaches the greatest possible importance to the output of a certain type of munitions. Some employer will be doing his best to get that labor that is engaged on that output away from that particular factory onto something of less importance, and it is a picture. We experienced it in the very early days; it leads to a picture of chaos and mismanagement and general stupidities that are very difficult to overcome.

We dealt with that under our very convenient instrument that we have in England which is called the Defense of the Realm Act. Under that Act the Minister of Munitions and a great number of our government officers can draft a regulation which he thinks necessary and publish it and for the time being it becomes the law of the land.

We made it an offense for any employer in the engineering industry to offer inducement to labor engaged on a similar class of work. We also gave the Minister of Munitions power to restrict and regulate the employment of labor in any establishment. If the Minister was dissatisfied with the way any employer was either handling his labor, or was making use of his labor, or generally, he had the power to lay an embargo on the engagement of labor in that particular firm; a very valuable "big stick." It brought things to some sort of state of order, and today we have no trouble from that point of view. In fact, one may say that wages are stabilized, occupation is stable; that we have more or less solved that particular problem. I say it with all reserve, because if there is one thing the war has taught me it is to give no pledge and to make no prophesy. Nobody knows what is going to happen tomorrow.

Talking to our chairman at lunch, I made the remark that I had and still have the greatest possible abhorrence of public life. I had always made it a pledge to myself and to a great number of other people that nothing in the wide world would ever induce me to enter public life or to make any sort of public appearance anywhere. I find myself in America doing nothing else.

Well, that is the war. The war has brought that about. Certainly had my country remained at peace, nothing in the wide world would have brought it about.

I then proceeded to say to him: "If we do that in war time, why don't we do something for our country in peace time?" And he asked me to make mention of that.

I do think it is an old truism—and this does not apply to your country or to my own, but the people have the government they deserve, and I do think (I am a business man when we are at peace) that the business communities of the world have got to take a bigger interest in their government in peace time and not leave it till war time in future.

In conclusion: It is absolutely impossible to exaggerate the importance, the overwhelming importance that labor plays in war. Without labor, without that industrial peace of which I spoke, this war cannot be won. It is the basis of the war. Your man-power at the front, your man-power at home, all turns on labor's activities and the solution of the problems that war brings in regard to labor.

I want to also say this: That on the solution, on your solution, of the problems with which you are faced, a great deal depends in my country, too. Should you fail to solve those problems, it will react, and react very seriously, in England; and we look to you with a great deal of confidence. I think we appreciate how enormous those problems are, but we are happy that you will solve them and solve them on the right lines.

Dilution of Skilled Labor, and Women in Industries

By G. H. BAILLIE*

THE following speech was made at the luncheon given for the Special Mission of the British Ministry of Munitions by the Editorial Conference of the New York Business Publishers' Association:

Your chairman has asked me to give you some particulars of the schemes we have adopted to meet our shortage of labor, a shortage which has been the one factor in restricting our output of munitions from the beginning of the war till the present time. Our two schemes have been the dilution of skilled labor and the substitution of women for men. Both of those schemes were contrary to the trade union customs and practices as they were before the war, and we have been able to put them in practice only on the basis of the agreement between capital and labor.

One provision of that agreement was the abolition of all jurisdiction limits, and another provision had the effect of abolishing all trade union customs and practices during the period of the war. The whole agreement, however, referred to work on munitions only. Our employers made use of those agreements in various ways. First, an unskilled worker was brought into the plant to do any easy job. The man so displaced was put on the more skilled work, and the man displaced was again promoted, and so on until there had been an upgrading of skill throughout the whole shop.

I might give you an instance of that process which occurred recently in a steel works in Wales. The works had put up some new furnaces but the ministry was unable to supply either skilled men or unskilled men for the extension. The firm solved its problem by taking on sixty-seven women. The women, though, did not work the furnace. The process was this: The women took the place of laborers in the plant; they did loading and unloading and wheeling and transporting of material of all kinds and breaking up limestone, and generally all the laboring work in the plant that they could tackle. The men so displaced were put onto the simplest jobs in the works. They were made fourth-hand melters and mixers and those men were promoted to be third-hand melters and mixers, and so the grading-up process was continued on the old furnaces until a sufficient skilled staff had been obtained to work and man the new furnace.

Another method adopted was to draw unskilled men from the non-essential trades, unskilled men who were either over military age or of low medical category. Watchmakers were brought into the tool rooms to do gage making. Our building industry was largely closed down and we took sanitary plumbers from there and trained them up to do lathe turning for our explosive factories. We also drew from the building industry carpenters and joiners and sent them into the shipyards to act as shipwrights and shipjoiners. We took mechanics, textile mechanics, from the textile industries, accustomed only to rough work, and trained them up to the better work of munitions. A third way was by confining the fully qualified mechanic to the highest forms of skilled work. If the mechanic normally had been on a job that could be split up into two or more parts of varying degrees of skill, the mechanic was confined to the part requiring the most skill, and we trained up men and women to do the lesser skilled parts. As an example of that process, I might mention the making of snap gages in the tool room. We commonly employ women to make, harden and grind the gages to within nearly their final limits, perhaps half a thousandth of an inch, and we confine the skilled mechanic to putting on the finishing touch.

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*Chief Technical Dilution Officer of the Labor Supply Department of Great Britain.

Those schemes we called the "dilution of skilled labor," because we made the very little skill we possess go a very long way by diluting it with as much unskilled labor as possible. That dilution helped us to a great measure in dealing with our shortage of skilled labor, but before long practically all the useful men in the non-essential trades had either been drafted into the army or had gone into the munition plants, and to meet our continually increasing demands for munitions, we had to rely upon the women, and we adopted the scheme of employing women for every job which a woman could do or could be trained to do.

Agreement as to Wages of Women

Now, I should refer to a condition which was attached to the agreement between capital and labor, a condition affecting the wages of women. It was agreed that a woman undertaking work which previously had been done by a skilled mechanic, should receive the same day rate as the skilled man; if she was on piece work, she was to receive the same piece rate. It was only when she was on unskilled or semi-skilled work that the woman's wage could differ from that of the man, and then her wage was regulated by an order which fixed a minimum wage, a wage, roughly speaking, two-thirds that of the unskilled man. Those wage conditions may not appear of great advantage to the employer, but indirectly they have proved extremely useful.

As a result of the good wages that women have been able to earn on munitions work, we have never been short of applicants for any kind of work, and our employment of women at present is limited only by our facilities for training them. In another respect, too, those conditions have been useful. They have had the effect of attracting to munitions work a good class of woman who has had a fairly good education, and we have found that she is capable of far better work and can more easily acquire skill than the type of woman that previously had been common in our textile and other factories employing women.

Our women have done very much more than anybody believed would have been possible. We have now on munitions work only, over a million women. Every one realized that we should have no difficulty in introducing women on the simple repetition jobs of a light character, but since the Minister of Munitions began to urge the employment of women—and that was about two years ago—the development of their employment on munitions has been most striking, both in the extent to which machine shops are staffed by women and in the difficulty of the work on which they are engaged. Operating work on shell and fuses and grenades is obviously women's work, although two years ago 12- and 15-in. shells would have been regarded as on the heavy side for women, but now women are doing very much more than merely operating the machines. We have a shop on 5-in. shells in which only 6 per cent. of the hands are men; and in the machine shop all the tool setters and all the charge hands are women. And we have another shop on 6-in. shells in which the proportion of skilled mechanics is one to every fifty women. I mention that shop because for output it is one of the best shops in the country.

Classes of Work Women Have Done Successfully

Taking shell and fuse and that class of munition work as a whole, on the average, about 80 per cent. of the hands in the plants are women. And that is a very important result from the point of view of man-power.

And there is another class of munition work in which the same obtains. That is in the explosive manufacture and filling. In our largest explosive factory, making cordite, gun-cotton and certain other explosives, we have 15,000 hands, and of those 11,000 are women. On filling work, on the small shell, and on fuses and similar articles, we reach percentages well over 90 per cent., and on the larger shells the percentages are, of course, lower.

Coming to more highly skilled work, the percentage of women employed is, on the average, a good deal lower. But there are individual cases in which our percentages reach very high figures. We have a shop engaged on breech mechanism for howitzer guns in which every machine tool is operated by women who set and grind their own tools, and the tools themselves are hardened and ground by women.

And, to take another example from tool room work, we have women making screw gages, and the only skilled assistance they receive is that a toolmaker checks the setting of their chasing tools. For that class of work training is required. In the work I previously mentioned, the simple repetition work, we have found that no training, no special training, at least, is necessary. But the plants engaged on skilled work have found considerable difficulty in the earlier stages of the training of women. Frequently they have but little work of a simple character on which the women can gradually acquire skill. And to meet that difficulty, the Minister of Munitions has equipped a number of training schools and constructional factories, who train the women and then supply them to the plants. In those training establishments we do not attempt to give any general instruction. The women do have a two weeks' course of general work, in which they are taught to use the foot rule and the micrometer, but then their training is specialized and they are taught to do a specific job on a specific type of machine. And in that way, by confining their work to quite narrow limits, we find that they can acquire considerable skill in from six to eight weeks' training.

But the larger proportion of the training has been done in the plants themselves, and we have had an interesting example of that in certain of our machine tool makers. They have started schools in their own works in which they have trained women in the use of types of machine and then when they supply a machine to a customer, they are prepared to send with the machine as an item in the list of accessories one or two women who have been trained to use it.

And now a word as to the results of the women's work. In 1915 all our employers regarded the introduction of a woman into a machine shop as one of the horrors of war—about on a par with Zeppelin bombing and the shortage of sugar. Nothing has been more striking than the change of our employers' attitude toward women in the past two years.

If there is now a question between taking on a woman or an unskilled man, the employer has no hesitation at all.

The woman has been found to be a better and more conscientious worker than the unskilled man; at least, the type of unskilled man that is available in our country now. And the woman has been found better able to acquire skill rapidly. On skilled work, when it is a comparison between a woman and a fully qualified mechanic one cannot, of course, expect the woman to be so valuable an asset as a man who has been four or five years at his trade. But now the only skilled men we can scrape out of the less important munition factories are of so poor a quality that it is not uncommon for an employer who requires extra staff to take on women and train them himself rather than apply to the Minister of Munitions for the poor quality of man that he knows is all he will be able to get.

I am afraid, gentlemen, that these results of our experience may seem rather far off for conditions now obtaining in your country. But in England the difficulties of the shortage of labor came upon us very suddenly and unexpectedly; and I believe that you are no better off for skilled men than we were at the outbreak of war, because you have adopted the policy of the unskilled operative to a far greater extent than we did in England. And I believe that you will in a question of a few months find yourselves following our experience and faced with a serious labor shortage; and then I hope that the results of our experience may prove of some service to you.

Enlisted Men's Insurance Law

By W. G. McAdoo

The Secretary of the Treasury, Washington

To the Officers and Enlisted Men and Women of the Army and Navy of the United States and Their Relatives:

The Secretary of the Treasury, through the Bureau of War Risk Insurance, has been charged with the administration of the War Insurance Law enacted by the Congress as a measure of justice to the men and women who have been called to give their lives, if need be, in the service of their country.

I wish to acquaint you with the benefits and privileges which your Government has placed at your disposal. It is essential that you and your families at home should know of your and their rights under this law in order that full advantage may be taken of them.

To care for the wife and children of the enlisted man during his service, the War Insurance Law compels him to contribute up to one-half of his pay for their support. The Government, on application, will generously add to this an allowance of from $5 to $50 a month, according to the size of the family. Moreover, if the enlisted man will make some further provision himself for a dependent parent, brother, sister, or grandchild, they may be included in the Government allowance.

If, as a result of injuries incurred or disease contracted in the line of duty, an officer or enlisted man or an Army or Navy nurse should be disabled, provision is made for compensation of from $30 to $100 a month to him, and, should he die, compensation of from $20 to $75 a month will be paid to his wife, his child, or his widowed mother.

In order, however, fully to protect each person and family, Congress has made it possible for every soldier, sailor, and nurse to obtain life and total-disability insurance. This insurance applies to injuries received while he or she is in the service or after he or she shall have left it.

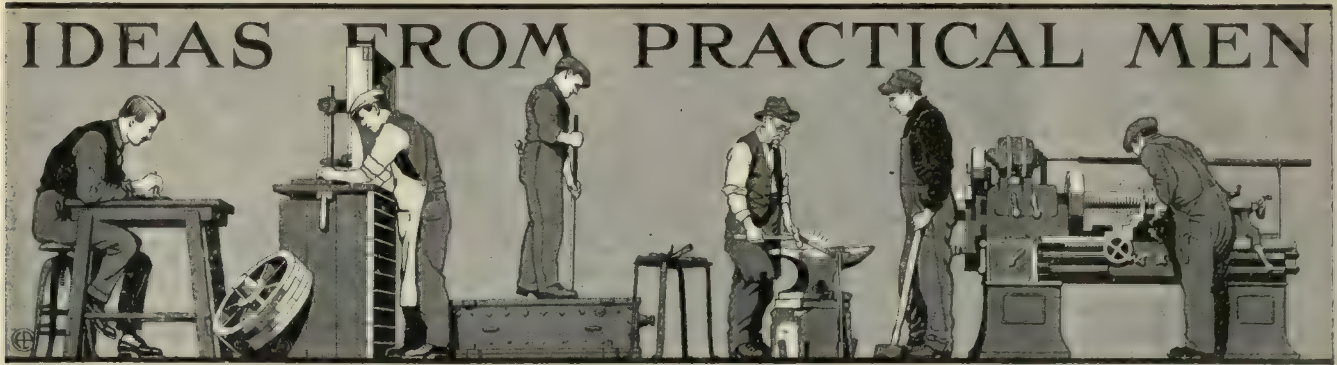
Exposure to the extra dangers of war makes the cost of life insurance in private life insurance companies prohibitive. It was, therefore, a plain duty and obligation for the Government to assume the risk of insuring hundreds of thousands of our soldiers and sailors who are making the supreme sacrifice. Under this law, every soldier and sailor and nurse, commissioned and enlisted, and of any age, has the right, between now and Feb. 12, 1918, to take out life and total-disability insurance up to $10,000 at very low cost, with the Government without medical examination. This right is purely optional. The soldiers and sailors are not compelled to take insurance, but if they desire to exercise the right, they must do so before the 12th of February, 1918. The cost ranges from 65c. monthly, at the age of 21, to $1.20 monthly, at the age of 51, for each $1000 of insurance. This is a small charge on a man's pay—small in proportion to the benefits it may bring. The premiums will be deducted from his pay, if he desires, thus eliminating trouble on his part.

To provide adequate protection until Feb. 12, 1918, during the period when the soldiers and sailors are learning the details of this law, the Government automatically insures each man and woman, commissioned or enlisted in the military service of the United States. It pays the man $25 a month during total permanent disability; if he dies within 20 years, it pays the rest of 240 monthly installments of $25 each to his wife, child, or widowed mother.

I desire to call the provisions of this just and generous law to the attention of our officers and enlisted men and women so that they may not be deprived of their rights through lack of knowledge. Full information may be obtained from the Bureau of War Risk Insurance of the Treasury Department, Washington, D. C. I earnestly urge that the officers of the Army and Navy give to the men under their command all possible aid in helping them to understand fully the benefits that this insurance may bring to their families and the small cost at which it may be obtained.

This is the greatest measure of protection ever offered to its fighting forces by any nation in the history of the world. It is not charity; it is simply justice to the enlisted men and women and to their loved ones at home, and each and every one of them should promptly take the benefits of this great law.

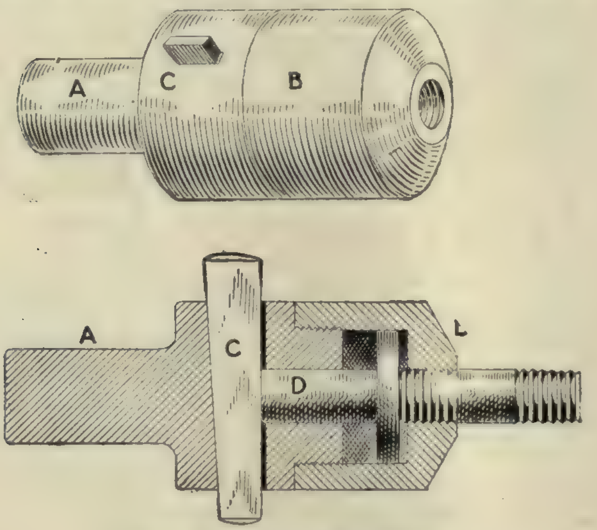
IDEAS FROM PRACTICAL MEN



Chuck for Nipples and Studs

By William Forray

The accompanying illustration shows an efficient chuck for nipples and studs. The body *A* is threaded to a shoulder to receive various sizes of nipple holders *B* and is slotted and bored for the wedge *C* and the plunger *D* respectively. The shank of the body *A* is turned down to facilitate chucking when the pipe machine is used.



NIPPLE AND STUD CHUCK

In operation, the wedge *C* is first driven home, thereby forcing the plunger *D* against the inner face of the nipple holder; the nipple is then screwed into place and the thread cut. To release, the wedge is loosened by a light blow, thus taking the pressure off the plunger, when the nipple can be easily removed by hand.

Truing Milling-Machine Centers

By Frank Lang

In reference to the article on truing dividing-head and tailstock centers, on page 322, is the head center of such peculiar design that it cannot be bridled on a lathe center, run in the steadyrest and ground with an ordinary center grinder?

For the tail center, a split bushing may be used in the steadyrest, provided the tail center can roll a true circle. The flat and keyway in the center would prevent grinding in the above manner without the use of a bushing. I have ground various makes of centers in this manner with satisfactory results.

Making a Special Side Pin Wrench

By Frank C. Hudson

Side pin wrenches are extremely handy for either tightening or loosening nuts that must be flush with the part into which they are screwed, but they are not easy to make in a thoroughly substantial manner without more or less trouble, particularly in the repair shop.

As the metal of the wrench itself is usually quite thin, the only way in which the pins can be securely located is to turn a shoulder on them and butt this shoulder thoroughly against the plate. The back end can be riveted as shown in Fig. 1.

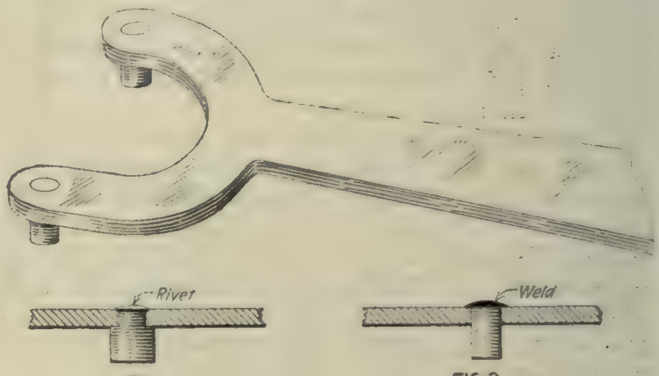


FIG.1 FIG.2

FIGS. 1 AND 2. TWO WAYS OF MAKING A PIN WRENCH

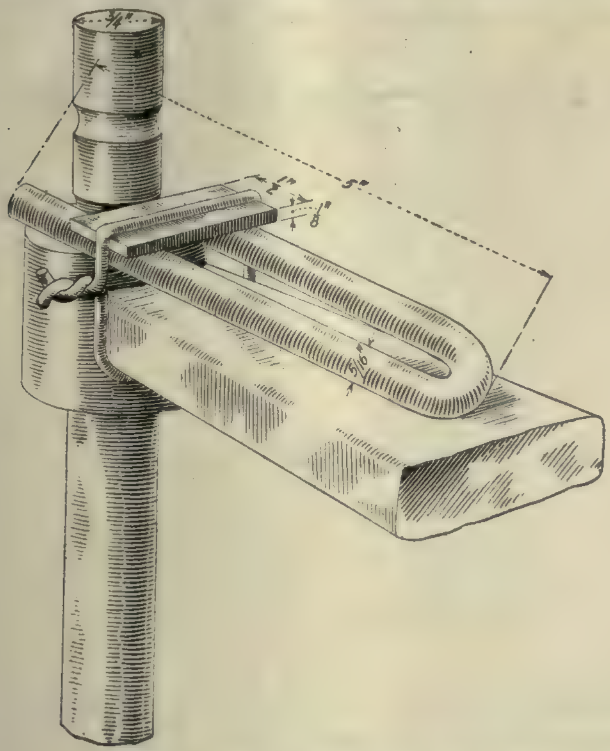
In order to remove a nut of this kind while repairing an automobile of a somewhat unusual make, I tried another method of making the wrench, and it worked out quite successfully. Two short pieces of drill rod of the proper size were selected, and holes, of such a size as to make a drive fit for the pin, were drilled at the proper place in the plates. The pins were then driven through the plates so as to project about $\frac{1}{16}$ in. on the back side. About 3 min. exercise with the oxyacetylene flame welded the pins in place by running metal on the back side of the plates. In this way the pins were held firmly, and the necessity for turning any sort of a shoulder on the pin was avoided.

Positive Stop for Shifter Rod

By M. Jacker

On page 988, Vol. 46, E. N. Gillis shows a positive stop for machine-tool shifter rods. I believe my method of getting at this is simpler than any I have yet seen.

For a $\frac{3}{4}$-in. diameter shifter rod I have used $\frac{5}{16}$-in. diameter bessemer rod about 12 in. long, bent cold, as shown below. With a round file, this is notched about $\frac{3}{32}$ in. deep to fit the shifter rod. It is then sprung shut sufficiently to grip the rod and placed in position against the rod bearing. A wire is twisted around it and the bearing to hold it in place. It is advisable to use the flat piece, twisting the wire, over it, so as not to hamper the free motion of the spring. The shifter rod might also be notched at the stopping point as shown in the illustration, but in most cases this is not necessary.

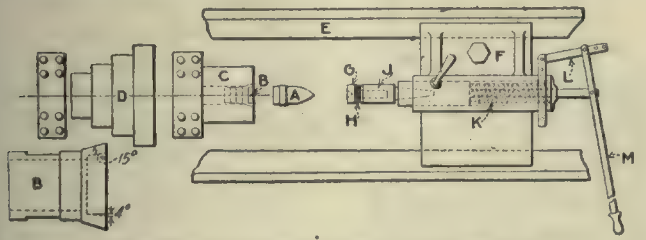


POSITIVE STOP FOR SHIFTER ROD

Holding a Shell While Turning the Band

By E. W. Burchell

The illustration shows the details of a fixture that we have used to good advantage. We were having a lot of trouble turning copper bands on 1-lb. shells, so I designed this fixture. The spring collet *B* is made to float in the hood *C*, and the tension spring *K* in the tailstock forces the shell and collet back into the hood *C*, causing it to grip the shell.



FIXTURE FOR HOLDING 1-LB. SHELLS

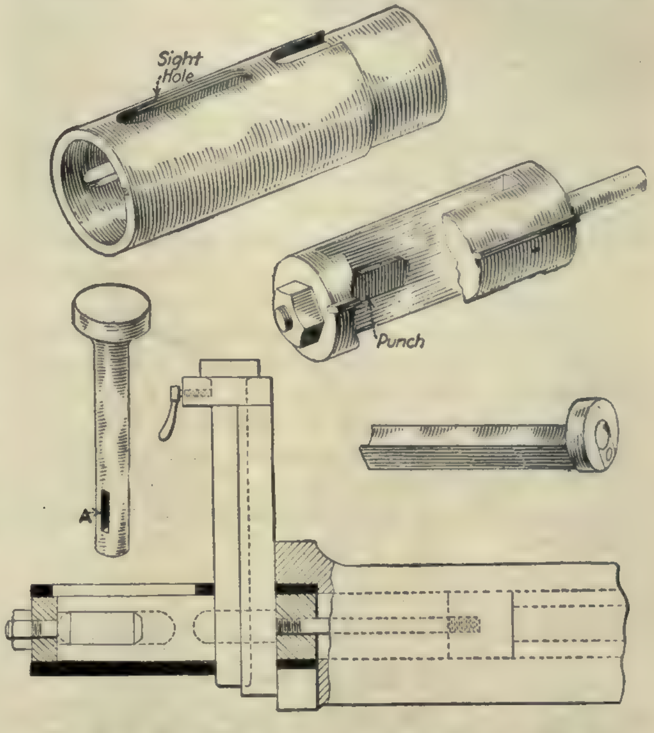
In turning the band, the cross-slide on a standard engine lathe with a stop was used and the compound slide set on an angle to coincide with the bevel on the band to be turned; then another stop was set for the compound slide to go against. With this device we never stop the machine to put in or take out the work, and we have increased our production in the neighborhood of 150 per cent. on this operation.

In the illustration, *A* is the work, *B* the spring collet, *C* the hood, *D* the lathe cone, *E* the latheways, *F* the tailstock, *G* the center to fit the nose, *H* the ball bearing, *J* the holder fitting in the tail spindle, *K* the coil spring, *L* the adjusting link, *M* the lever.

Punching on a Broaching Machine

By F. W. Shulver

We had a large number of king pins to slot as illustrated at *A*. After drilling four holes in a jig, the job was to get the web out between the holes so that the broach would go through. Having no punch, we tried a big arbor press. First, the pawl chewed up, then the ratchet broke, and the keyway gave out. Therefore, we made this rig for the broaching machine, and a boy did about 80 in an hour.



RIG FOR PUNCHING ON A BROACHING MACHINE

Making Drawings for the Patternmaker and Machinist

By R. C. Heinmiller

The method of making drawings for the patternmaker and the machinist as suggested by J. H. Lonie on page 341, has a feature that to me appears objectionable. According to his method, the patternmaker's dimensions are added to the tracing containing those for the machinist, after a vandyke print has been made of this tracing. If the piece to be made is a simple one, say a cast-iron pulley, it matters very little whether a few additional dimensions are put on the drawing. But if it is a complicated piece, like a lathe bed or apron, the patternmaker would be confronted with a mass of dimensions and notes, many of which do not concern him, but would most likely tend to confuse him.

A way that proves very satisfactory is to make the drawings for the machine shop in ink on tracing cloth, and the sketches for the patternmaker on pencil tracing cloth. The ink tracing has only the dimensions for the machinist, while the pencil tracing contains those for the patternmaker alone.

The pattern sketches are made full size whenever practicable, so that the patternmaker can if necessary scale the blueprints made from the pencil tracings. The drawings for the shop can be reduced to scale, all the machinist's dimensions being put on so that no scaling will be necessary. By this method each workman has the dimensions and notes he needs, and no others to confuse him. The pattern sketches are made directly on the pencil tracing cloth, thereby saving the time for tracing, while for the ink tracings a pencil drawing is first made and then traced on the cloth, unless the piece is simple; in that case it is drawn directly on the cloth in pencil and then inked. Sometimes it is not necessary to make a pattern sketch, because the patternmaker can work from the machinist's blueprint.

Drawings for gages, jigs and fixtures can be made on pencil tracing cloth and the blueprints sent to the shop. This is an easy and rapid way. A pencil tracing is sufficient, because only a few prints will be made. It may, in fact, be used but once, and it is therefore not wise to spend time to make an ink tracing.

Another method is to make the drawings on drawing paper, the drawing then being tacked on a light board and shellacked. When dry, it is ready to be sent to the shop. When returned to the drawing room, the surface is scrubbed with soap and water, the drawing removed from the board and filed away. The pencil tracing method is by far the better of the two for gages, jigs and fixtures.

How Would You Make This Casting?

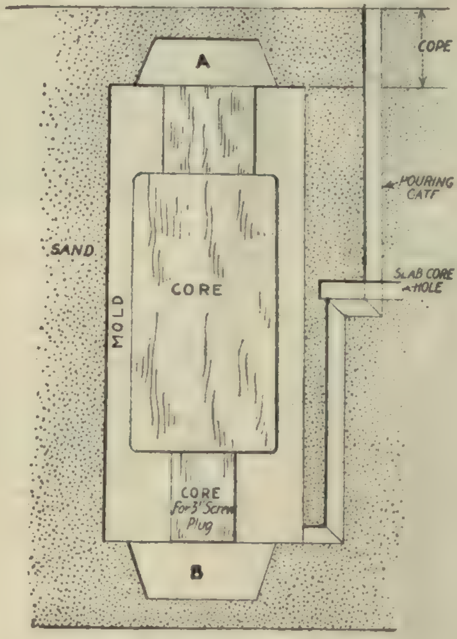
By M. E. Duggan

A casting was illustrated on page 164, with a request for a way to make it. The editor makes reply, illustrating and describing a possible method of molding and pouring the casting. The method is a very good one and is used in the production of a great many castings, round and otherwise. However, it possesses the objectionable features of guesswork in the setting of the core—namely, working in the dark—and a possibility of a tilt, little or much, in the setting of the core *A*, which would displace proportionally the suspended chamber core. I have yet to meet the patternmaker or molder who can show me a practical method for producing this casting.

There is another side to this question. Was it necessary to make this casting with the end closed? This query applies not only to this one job in particular, but to a great many jobs that are being made every day.

Now, would a casting made with a cored hole through the solid end tapped and filled with a screw plug, finished flush with the end face of the casting, answer the purpose as well as a casting made with a solid end? True, this means extra work in the machine shop, but this is of least importance if the method will aid the molder to produce a satisfactory casting. The altered method is clearly shown in the sketch.

The metal enters the mold at the bottom. The pouring is done through a "step" gate. The method is not a common one; the purpose of the step gate, or deflector, is to prevent the metal from striking on the bottom of the gate passage and washing the loose sand into the mold. Notice the sizes of *A* and *B;* they are large enough to support and secure the core in its place. No guesswork with this method.

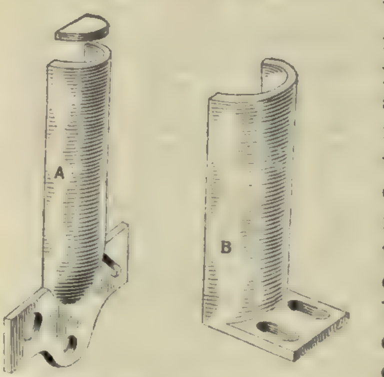


ALTERNATIVE CASTING

Improved Flask Pin for Plate Pattern Work

By F. Thornton

As we use a great many aluminum plates for small castings, we have experienced much trouble with the old V-shaped flask pin, as it is essential that there be no side or rocking motion in drawing the plate. With the V-shaped pin, unless it is drawn up so tight that the flask is hard to operate, there is a rocking motion caused by the slide slipping up over the side of the V-pin, if the molder does not draw the plate or cope up perfectly true or if he exerts any side pressure. The result is that the mold is spoiled and much time is wasted.



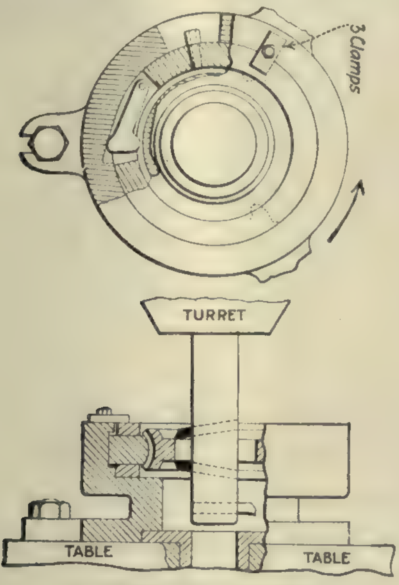
IMPROVED FLASK PIN

I have found by making a pin and slide half-round, as *A* and *B* in the drawing, this rocking motion is entirely eliminated. With the half-round pin, the slide grips the two straight edges and cannot slip up over the sides of the pin, as in the V-shape. This pin gives us more perfect molds and a larger production per man.

Production Chuck for a Boring Mill

By William A. F. Millinger

The chuck shown in the illustration was designed for a boring-mill job. The piece to be machined is a cast bronze wormwheel, the only machining being in the hole and the two side faces. The fixture as shown was built for rapid production. The sketch is only tentative and not to scale, but it illustrates the idea.



BORING-MILL CHUCK

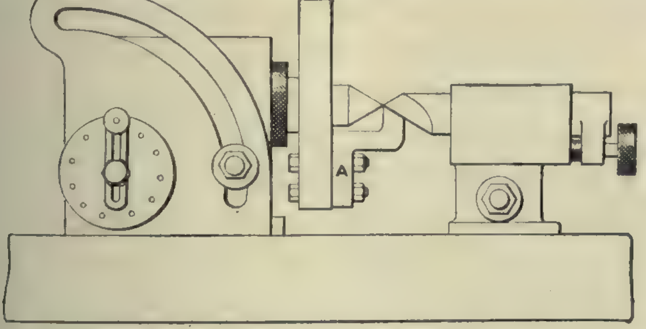
The holding jaws work on a cam action tightened and released by a lever. The jaws are made to fit on the pitch diameter of the wheel. The cut in this case is light, and of course the heavier the cut the tighter the jaws wedge.

Truing Milling-Machine Tail Centers

By C. M. Conradson

William T. Slider's method of truing tail centers for milling machines, on page 322, seems to me unnecessarily involved, expensive and inaccurate. The sketch herewith shows a method I used while working in the toolroom, many years ago.

The cutter *A* was forged from a piece of Jessop's steel and finished on a tool-grinding machine as shown, and clamped to the dog plate by two ⅜-in. bolts. The heads were set on the table, and the tail center was turned by rotating the headstock center by hand. Feeding the tool to the cut was effected by turning the knurled head on the tailstock screw. Care was taken to have proper angle and relief on the forming tool, and the tool was located at the precise center.



METHOD OF TRUING MILLING-MACHINE TAILCENTER

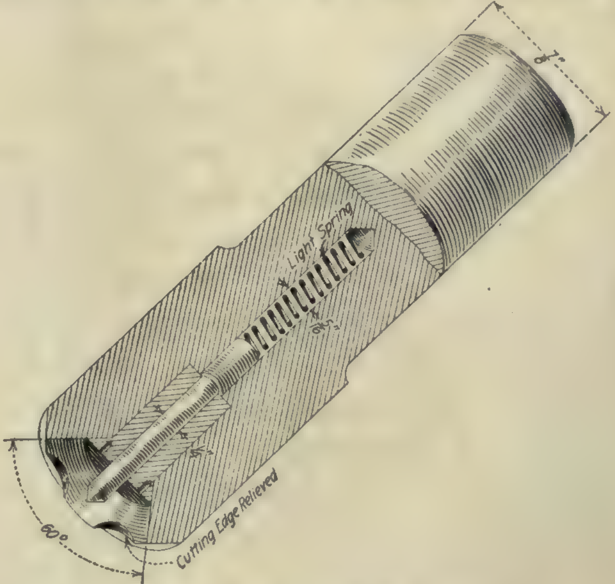
The time required for the actual truing was but two or three minutes, and the work was extremely well done, being perfect as to angle, surface finish and concentricity. The center was carefully hardened and showed no distortion.

Ring-Marking Center Punch

By T. R. Charlton

The article by Hugo F. Pusep on page 1087, Vol. 46, on the "Transfer Center Punch," reminded me of the practice in constructional works. Punches such as he describes are used to mark the centers of holes in plates, angles, etc., from templets; but as drills do not always follow the center as they ought to, there used to be continual friction between the department responsible for "marking off" and that responsible for drilling, in the works of one large firm of constructional engineers. To insure holes being drilled correctly according to the center produced by the transfer center punch, a ring punch was used.

The illustration will explain itself fairly well. The center bit is kept extended by means of a light spring at the back. When the tool is used, this spring allows the cutting edge of the ring to mark a circle around the center. It was found in practice to be advantageous to relieve the cutting edge of the ring in four places. The diameter of the ring was made about ⅛ in. larger than the hole, so that it was visible when the hole was drilled. Then the fault, if any, could be brought home to the right department. Tools of this sort have a great moral influence. They prevent poor work as the mechanic knows his work will be appreciated if well done and the reverse if it is not.



RING-MARKING CENTER PUNCH

Perhaps the foregoing may be of interest, as many years experience with the transfer center punch has proved its limitations; hence, the ring punch to complete the marking.

Are We Doing Our Bit?

THERE is one unfortunate feature in having the war so far away. We do not realize what it means, do not really know we are at war, and in too many cases take no action except to wail at the increase in prices and in taxes. We have not yet sensed the immensity of the task we have undertaken; the task which we must carry forward to the finish, and the right finish, until the dreamers of Pan-Germanism, or world domination, shall have been shorn of all power. For unless this is done the conflict will only have been postponed, and we must endeavor to make its repetition impossible.

□ □

Too many of us look to General Pershing and his men as the only factors in our part of the struggle. They are the vanguard, nothing more. Theirs to meet the enemy face to face, to shell and be shelled, to be gassed and to reply in kind, to fight, to suffer and to die if need be—but we are the real army on which their success depends. If we fail they cannot possibly win, no matter how brave they be or what the sacrifice. Although battles are being fought three thousand miles away they must be won here in the United States by keeping our valiant vanguard supplied with all the munitions they can use, all the weapons they need, with transport, with food, with clothes and other necessaries of modern warfare.

□ □

Nor is this all. We must supply much of the food for our allies, both soldiers and non-combatants and we must see that they have coal and metals and munitions to the best of our ability. Unless we do this, unless we make sacrifices if need be, to supply our old-time and present Ally, France, with as much food as possible, her soldiers cannot fight most efficiently. And more fighting and dying must fall to the lot of our own troops. France is not giving up the fight; far from it. She wants to free herself from the invader, but she must have many things which we produce, even if we go without them ourselves. We must remember that every sacrifice we make may save the life of a soldier, perchance a son or a near relative, while an extravagance may condemn him to a lonely grave.

□ □

We must win this war. Unless we do, none of our industries, institutions or ideals will amount to much more than the "scraps of paper," which marked the beginning of the German war of conquest. But in order to win in the shortest possible time and with the least loss of life, every one of us must feel a personal responsibility of conduct.

Whether our lot lies in the office or the shop, or in neither, we are a part of the vast home army that must stand behind our boys in France. And everything we do affects their welfare. They cannot win the war without our help. We, the main army, must support them loyally at all points. We must get the knowledge of our personal responsibility firmly fixed in our minds and never lose sight of it. For no one can shift this responsibility any more than a soldier can shift his duty to a comrade.

□ □

What can we do?

□ □

Anything that increases the output of the shops. Not by overtime or crowding, which is not a permanent increase, but by better planning and better cooperation.

By adjusting difficulties before they arrive at the stage which affects output. A day lost can never be replaced, and a single day's output of shells may easily decide a battle. This is no time for profiteering by either employer or employee, it is equally unpatriotic on either side.

By designing and making better and more efficient tools.

By taking better care of machinery so as to require fewer repairs. This not only reduces repair costs and saves labor but prevents loss of productive time.

By reducing the percentage of spoiled work. This can also be helped by seeing that the specifications do not call for closer tolerances than are actually necessary.

□ □

Study the accompanying supplement carefully; it is for us all. Whether we be manufacturer, dealer or workman, our boys are facing the foe on the other side.

This is our war, whether we wish it or not. And not a day must pass without our feeling this responsibility. It is not a matter of choice now, and the question is not even debatable until the war is over. Then personal differences of opinion can have full sway.

But now our one duty is to help win the war in the shortest possible time. Anything that delays action; anything that holds back the making of arms and ammunition, of airplanes, of clothes, of blankets, or of any needed supply, lengthens the war and is responsible for many lives. Useless protest or discussion retards our work of preparation, and every delay takes its toll in the needless sacrifice of men.

□ □

Nor must we delude ourselves as to the war's being near its end. For while we sincerely hope it may be, there are no indications which warrant our slackening our preparations for a single instant. Italy's reverses are likely to add a year to the length of the war—nor must we blame them any more than ourselves. For months we have let their pleas for ammunition and for coal go unheeded. A few day's output from our mines might have prevented the whole Italian retreat. We must not only talk of cooperation, we must practice it. Anything which helps an ally play its part in the struggle, helps to shorten the war and to save the lives of men in all armies.

□ □

We must work together in all things. Personal interest must give way to the common good. For without this cooperation the best that is in us cannot be secured. Let each one ask himself at night, before he sleeps, what he has done during the day to help uphold our boys "over there."

SHOP EQUIPMENT NEWS

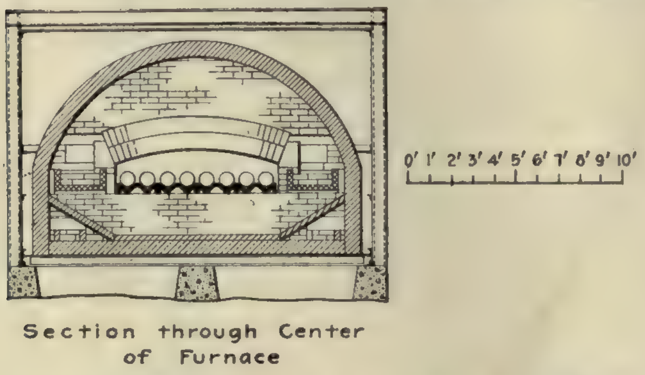
This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Automatic Electric Shell-Heating Furnaces

The automatic electric furnace equipment for heat treating shells shown in Fig. 1 is an adaptation of furnaces of similar size that have for years been used for the heat treatment of steel parts for railway and motor car equipment. The furnaces are identical with equipments of similar size that have been in use for years.

The quenching mechanism is modified over the industrial type equipments, so that the shells may be sprayed instead of quenched. They are held in a vertical position, and rotated during the spraying period to produce even cooling.

The equipment consists essentially of two furnaces; the quenching mechanism, and the automatic control shown in Fig. 2, by means of which all operations, or movements, of shells are accurately timed and executed.



The final control of the movements of the shells, however, is centered in several contact making pyrometers. They are so adjusted and calibrated that when the shells in the discharge part of the first furnace have reached their temperature and soaked for a predetermined time to insure their being heated through, the special pyrometer controlling that furnace closes contact thus setting in motion, through a radial dial switch, the various motor control valves for pushing in a new row of shells, simultaneously discharging the fully heated shells, allowing them to clear the furnace and drop into the quench. At this same time the pusher of the furnace is backed out and the doors closed. Meanwhile, the shells that have just dropped into the quenching mechanism have commenced to rotate, and the spraying water, not only from the pipes supplying the spray from the side, but from those spraying on the base and nose are turned on and allowed to flow for a definite interim, which, in turn, is controlled by a motor operated time element on the automatic control. At the end of this time-period the water is automatically shut off, and the shells just quenched are moved up by the forks in each shell nose connected to the long radial arm. The movement of this arm delivers the entire row of shells in front of the pusher of the second furnace, and then returns to its position of rest at the bottom of the quenching mechanism, ready to receive the next lot of shells to be quenched. When the shells in the second furnace, or drawing furnace, as it is sometimes called, are fully heated to the required temperature, a similar operation takes place, wherein the shells that have just been received from the quenching mechanism

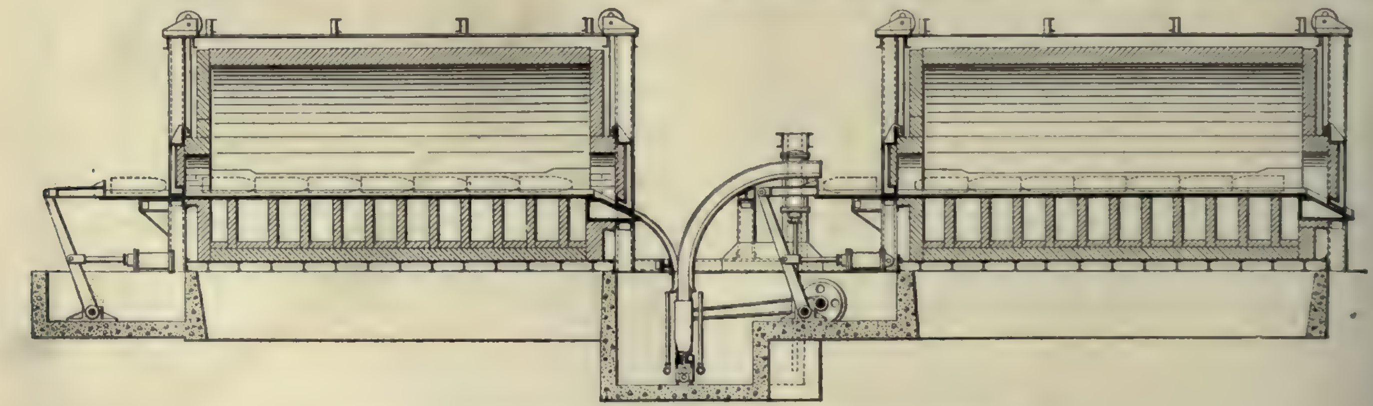


FIG. 1. AUTOMATIC ELECTRIC SHELL-HEATING FURNACES

are pushed into the second furnace, in turn pushing out the shells in the discharge end under the contact making pyrometer tubes, which have by this time reached the temperature to actuate this equipment.

The illustrations show the size of an equipment used for heat treating 45 8-in. American high-explosive shells per hr., which is equivalent to 3½ tons per hr. of any other size of shells, shrapnel or high-explosive.

The principal advantage of these electric furnace equipments over the ordinary types of furnaces is, primarily, greater precision and certainty in obtaining the required temperatures and quenching conditions. It is apparent that an equipment of this character will produce shells in the largest quantity without any variation in the treatment; the human element being entirely eliminated, with the exception of placing the shells to be treated on the charging platform of the first furnace, and subsequent operations being controlled by the automatic part of the equipment.

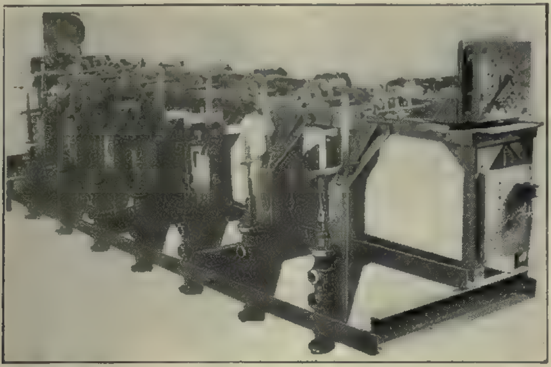


FIG. 2. AUTOMATIC AIR-VALVE CONTROL

The second advantage of importance is the great saving of labor. One man on the charging end, and one man on the drawing end of this entire equipment is all that are required for a production of 40 shells per hour. This advantage at the present time is a big factor from a commercial standpoint, and it eliminates the necessity of procuring additional men for furnace operation.

Reliability is another matter of prime importance. It is a common thing for an equipment of this character to operate continuously for a campaign of six or eight months at full capacity without an hour's delay.

It is believed that these automatic equipments have a place in the production plans for the large quantity of shells that must shortly be produced. Their first cost is large in comparison with non-automatic fuel fired equipments, and it must be borne in mind that the labor savings are large, but where electricity may be had at the usual commercial rates the actual cash saving by these automatic equipments will enable them to be paid for out of these savings during the life of a contract of any considerable size.

These automatic furnaces are built by the Electric Furnace Co., Alliance, Ohio.

"Costimeter"

The Costimeter Co., Detroit, Mich., is now marketing the machine illustrated in Fig. 1, which is known as the "Costimeter." Its function is to stamp times on suitable cards for the purpose of determining the time spent on various jobs. The Costimeter is applicable in any case where a job or operation ticket, or a daily time card is used; and, together with the wage chart, forms a method of ascertaining the time consumption of any job or operation and the wages paid for this time. The instrument is constructed for shop or factory use, and has but one operating handle and is electrically controlled. In order to prevent the card being inserted in any but the correct position, a device operated by the clipped right-hand lower corner of the card is incorporated. The clock is provided with a program device that may be adjusted to any working schedule, thus automatically cutting out the idle hours. The program clock can be arranged so that the starting period will be 0.0 or the card can be so made that the final time recorded will show the total accumulated time for the entire working period. On the specimen card shown in Fig. 2 (this card has been punched once) it will be noticed that there are small markers outside the dials and arrows inside. The small markers indicate the time of day and the arrows indicate the elapsed time. It will also be noticed that the arrows at any point correspond with the 0.0 points of the dials on the previous stamping. The dial at the left indicates hours and the one at the right tenths of hours. Cards are made up in a variety of forms to suit the needs and methods of different concerns. On the card shown, the lower left corner is clipped. A small piece is clipped at each stamping, this being the method used for positioning the card for successive stampings. After the card is finished the elapsed times are marked in the time column at the right.

A wage chart is used to quickly convert the time items into their money equivalents. The card is placed on the chart with its edge against a guide rule, and is slid up or down the guide until the time for which the money equivalent is required appears just above the upper edge. Directly opposite this time figure are a series of money figures for various rates as noted across the top of the card. Thus it will be seen that when the time figure appears above the top of the card, the money equivalent for any given rate appears

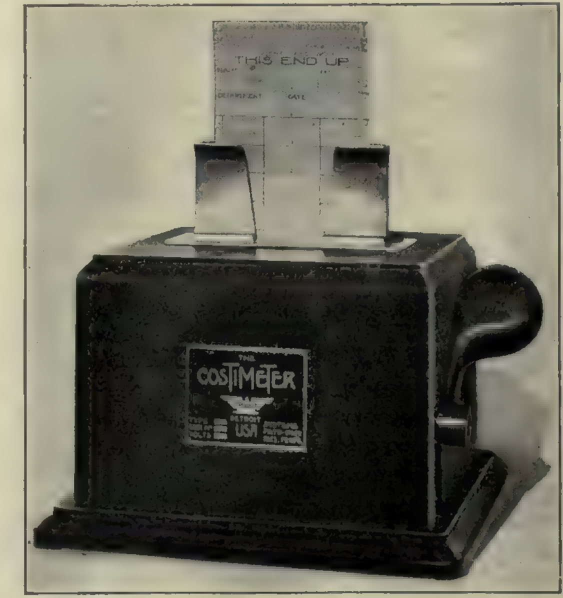
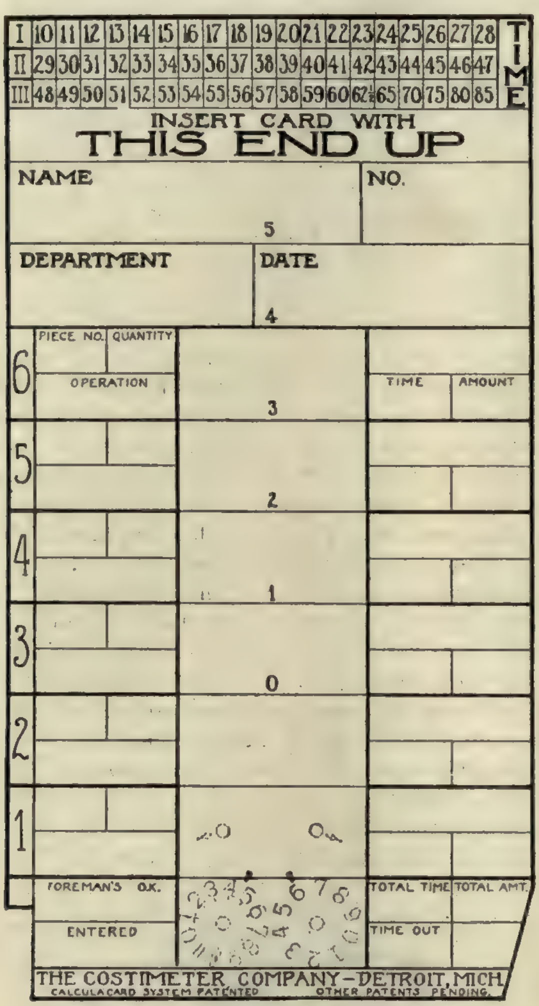


FIG. 1. THE COSTIMETER

just above the figure for that rate on the top of the card.

The program clock may be arranged for intervals for any desired frequency from one minute up, the standard interval being $\frac{1}{10}$ hour. The device is rugged in construction in order that it may withstand any abuse to which it is likely to be subjected.



I	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
II	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
III	48	49	50	51	52	53	54	55	56	57	58	59	60	62½	65	70	75	80	85

TIME

INSERT CARD WITH
THIS END UP

NAME NO.

DEPARTMENT DATE

PIECE NO. QUANTITY

OPERATION

TIME AMOUNT

FOREMAN'S O.K.

ENTERED

TOTAL TIME TOTAL AMT.

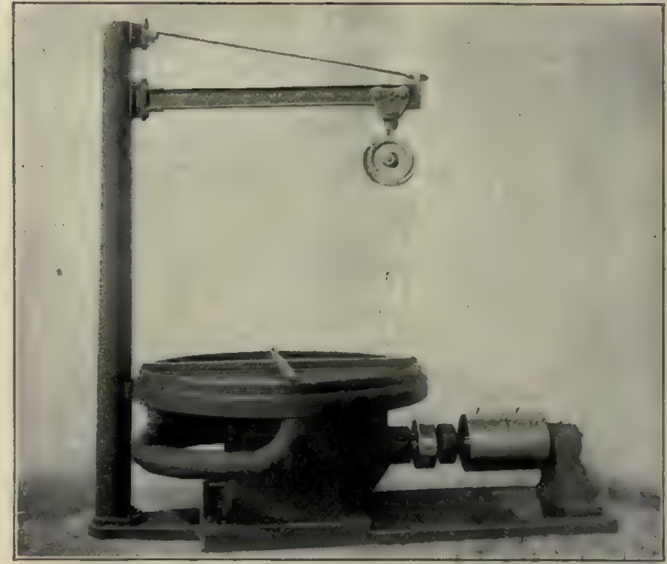
TIME OUT

THE COSTIMETER COMPANY—DETROIT, MICH.
CALCULACARD SYSTEM PATENTED OTHER PATENTS PENDING.

FIG. 2. ONE STYLE OF TIME CARD

Gardner Vertical Spindle Disk Grinding Machine

The vertical spindle disk grinding machine illustrated is being built by the Gardner Machine Co., Beloit, Wis. It is intended especially for heavy work, and for this reason is equipped with a hoisting attachment as shown. This hoisting attachment consists of a 500-lb. chain hoist mounted on a trolley and a swinging jib, the jib being supported by a column fixed to the base of the machine. Another feature of the machine is the exhaust system, which is claimed to practically eliminate dust. A channel is cast in the base of the machine just below and around the edge of the disk wheel. Above this, and just over the edge of the disk, is a detachable guard ring. Four openings are provided in the bottom of the dust channel, and these are connected to the exhaust manifold. The illustration shows the belt-driven machine, but in case a motor drive is desired the motor is placed directly on the outer end of the base, and connected to the main shaft by a flexible coupling. The spindle is mounted in two self-aligning radial ball bearings, and the end thrust is taken by a thrust bearing with balls 1⅛ in. in diameter. The spindle is driven at 500 r.p.m. through a pair of hardened steel bevel gears having a ratio of 2.4 to 1. A dust-protected housing is used for the gears and lubrication is provided for.

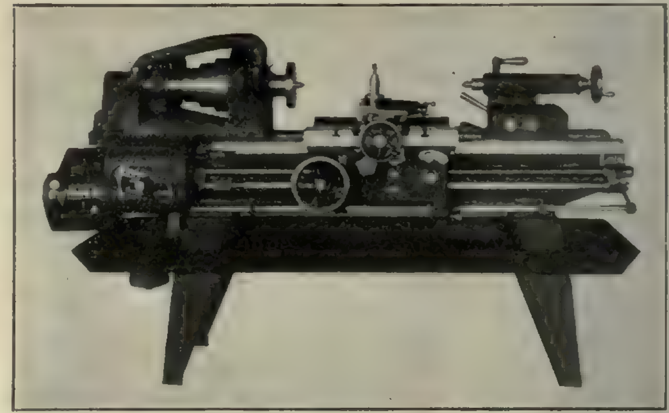


DISK GRINDING MACHINE

Diameter of disk wheel, 53 in.; diameter of spindle, 3⅝ in.: cast-iron flange supporting spindle, 20 in. in diameter by 1⅜ in. thick; diameter of balls in thrust bearing, 1⅛ in.; spindle runs on self-aligning ball bearings; spindle speed, 500 r.p.m.; ratio of bevel driving gears, 2.4 to 1; weight, 4600 lb.

Crawford Toolroom Lathe

The illustration shows the latest type of a 15-in. toolroom lathe manufactured by the Joseph Crawford, Jr. Co., Erie, Penn. The gear and feed box has been entirely redesigned, and has an enlarged capacity for instantaneous gear changes. The screw-cutting mechanism has been made independent of the feed mechanism, there being a feed rod which was not incorporated on the former type of machine. The parts are so arranged



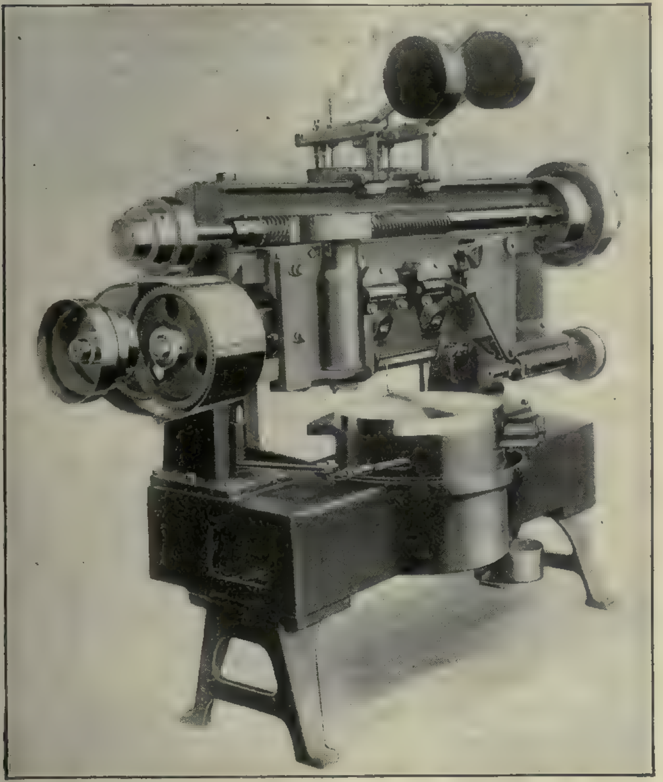
ENGINE LATHE

Swing over ways, 16½ in.; swing over carriage, 9½ in.; distance between centers, 34 in.; diameters of cone pulley, 4, 5½, 7, and 8½ in.; width of belt, 2¼ in.; hole through spindle, 1¼ in.; front bearing, 2⅝ x 4½ in.; rear bearing, 2¼ x 3¼ in.; diameter of tail spindle, 1⅞ in.; travel of tail spindle, 6 in.; carriage bearing on ways, 21 in.; countershaft pulleys, 3 x 10 in.; capacity of toolpost, ⅝ x 1 in.; capacity of center rest, 4½ in.; ratio of back gears, 8½ to 1; threads cut, 2 to 120; centers, Morse No. 3; center spindle sleeve, Morse No. 5; net weight, 1900 lb.

that metric gears and lead screw may be easily substituted where metric threads must be cut. Equipment includes countershaft, large and small faceplates, steady and follow rests, wrenches, centers, etc. If desired any of the following extras can be furnished: Lubricant system, taper attachment, draw-in collets, relieving attachment, metric thread attachment or metric lead screw. The lathe is known as type D.

Moline Milling and Drilling Machine

This machine was designed primarily for milling and drilling work on automobile steering knuckles, both operations being performed at one setting in order to insure proper alignment. The machine is of the continuous-operation, six-station type, having a revolving table that enables the operator to feed the work while another piece is being operated on by the cutters. Other operations of a similar type may be handled. The travel of the four spindles can be adjusted within a certain range. One spindle is for milling and three for drilling, all four being interconnected by means of spiral gears. The spindle feed is by means of a cam mechanism, the throw of which may be varied to suit the work being handled. The spindles are also adjustable to allow for wear of the tools. All of the fast-running bearings are bronze bushed. The Moline Machinery Co., Moline, Ill., is the manufacturer.



MILLING AND DRILLING MACHINE

Number of spindles, 1 milling and 3 drilling; diameter of work table, 22 in.; horsepower required, 5½; floor space, 96 x 36 in.; maximum height, 6 ft.; distance from floor to top of table, 36 in.; shipping weight, 5900 lb.

"Ever-Ready" Gas Furnaces

The gas furnace illustrated is now being manufactured by the Capital Die Tool and Machine Co., Columbus, Ohio, being one of a considerable line. These furnaces are operated without a blower, and are claimed to be very economical in gas consumption. They are made in a number of sizes from 4 x 6 x 12 in. with a gas consumption of about 30 cu.ft. per hour, to 6 x 12 x 20 in. with a gas consumption of about 90 cu.ft. per hour. The illustration shows the smallest machine which is known as their No. 2.

GAS FURNACE

Holyoke Transfer Truck

The Holyoke Truck Co., Holyoke, Mass., is now building the elevating truck illustrated that is known as their type RL-10. It is considerably larger than any truck they have previously manufactured having a capacity of 5000 lb. The wheels are fitted with Hyatt roller bearings. The elevating mechanism is of the roll-

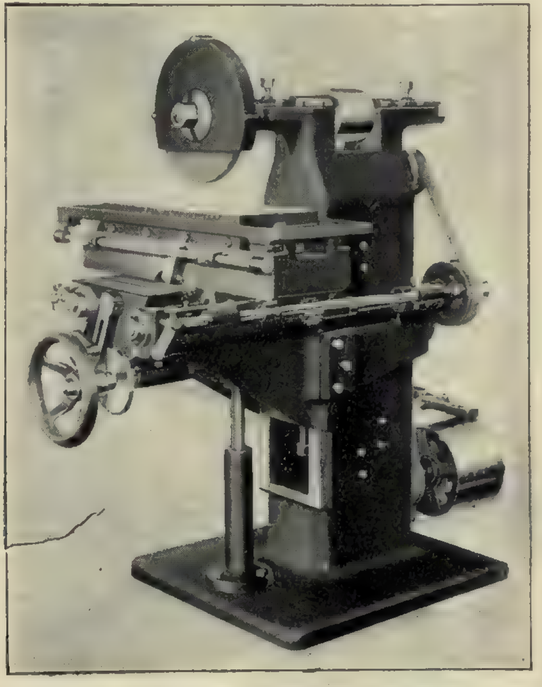
HOLYOKE RL-10 ELEVATING TRUCK

Capacity, 5000 lb.; extreme length with handle raised, 60 in.; length of truck platform, 40 in.; extreme width of truck, 27 in.; height of platform lowered 10 in., raised 12 in.; two front wheels, 8¾ x 2½ in.; rear wheels, 10 x 3½ in.; wheel base, 48 in.; size of platforms accommodated, 33 x 32 in. to 52 x 40 in.

lift type being entirely free from springs or other complicated parts. Metal is used throughout the construction, the axles being made of heat-treated steel. Another truck known as type RL-11, with a platform 24 x 40 in. with 9 x 3½-in. wheels in the rear, and two wheels in front, is also being added to the line being manufactured by this company.

Noble and Westbrook Surface Grinding Machine

The surface grinding machine illustrated is now being marketed by the Noble & Westbrook Manufacturing Co., Hartford, Conn., being known as their No. 2 automatic. In designing the machine one of the ideas has been to make all working parts dustproof. All feeds are graduated in thousandths of an inch, and the slides and spindles have adjustable bearings. A ball thrust bearing is used on the elevating screw for the table. An automatic stop is provided for motion of the cross-slide in either direction. The platen can be moved by means of the hand lever without affecting the motion of other parts of the machine, and can be furnished either with or without magnetic chuck.

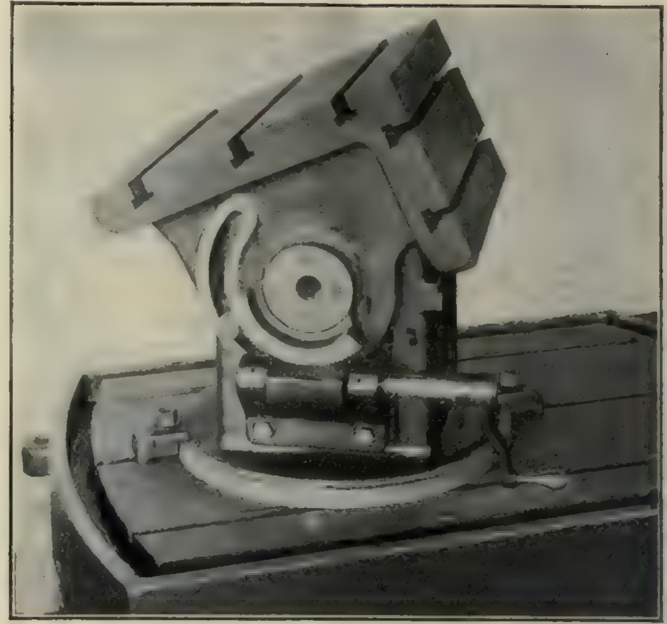


AUTOMATIC SURFACE GRINDING MACHINE NO. 2

Capacity, work up to 8 x 20 in.; distance between bottom of 12-in. wheel and top of platen, 7½ in.; diameter of spindle, 1$\frac{9}{16}$ in.; diameter of spindle between flanges, 1¼ in.; wheel used, ¾ x 12 in.; size of bearings, 1$\frac{9}{16}$ x 6 in.

Universal Tilting Table for Drilling Machine

The Morris Machine Tool Co., Cincinnati, Ohio, has placed on the market a universal tilting table intended for use on the base of a drilling machine. The table may be tilted to any angle, being controlled by a worm and worm wheel segment, the latter being graduated in degrees. The base of the machine is cylindrical so that it may be readily swiveled in a horizontal plane on the base of the drilling machine to any required angle. When the top of the table is horizontal, the adjustable portion rests on positive stops. The upper working surface of the table measures 18 x 18 in. while the side measures 11 x 18 in. The T-slots are ¾ in., there being three on the top, and two on the side, by means of which work may be clamped.



UNIVERSAL TILTING TABLE

Card-Indexing Articles

By Joseph Calcaterra

A plan that I have found of great value is to outline briefly and card-index alphabetically the articles that appear weekly in the *American Machinist*. Oftentimes when I have not time to thoroughly study out an article, I outline it and file it for future reference. Then later, when a problem crops up similar to the one treated in detail in the magazine, I am able to find that article quickly and use it to the best advantage. The card contains the main idea of the article alphabetically expressed, the full title of the article, any notes on it, the name of the magazine, the volume number, page and date. These notes give a means of future reference to articles when needed, and also something to look through at regular intervals and see where certain articles or ideas may be used to the best advantage. Now, some people do not have time to do even this, so I thought it would be a great help to the majority of subscribers if the *American Machinist* would print, for instance, in each monthly issue a page or two devoted to an alphabetical list and data concerning all articles that have appeared in the magazine for that year up to that issue.

[The table of contents in each issue is arranged for the purpose of enabling those who so desire to clip the various items and paste on filing cards for future reference. It will be noticed that each item has the name *American Machinist*, the volume number and the page number. These follow the name of the article and the author. In case of the more important articles, a brief synopsis is also given.—Editor.]

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Nov. 24, 1917—There is a noticeable improvement in the coördination of various activities and a general air of getting down to business, which is the result of organizations being completed and working programs being put in force. No one chafes at the delays that have occurred more than those directly connected with the work in hand, but when we consider the various handicaps that have been placed about the different departments, either by tradition or by congressional limitations, there is much less cause for complaint than appears on the surface. And, before criticising these delays too severely, we should remember that the average man moves in more or less of a rut, and that it is not always easy to upset previous methods and take short cuts, even in an emergency.

But the time has come when it is necessary for us to look all the facts squarely in the face and to realize that we must assume an entirely new attitude in many ways. We must put the welfare of the United States of America before all else, not only in theory and in patriotic speeches, but in actual practice. And this means sinking many of our previous ideas as to individual rights, privileges, and profits, and to realize, as fully as we may, that each one of us is simply a small part in a huge machine. And further, that unless we all realize our part and play it to the best of our ability, there is bound to be unnecessary friction in the whole machine, and we are not going to secure the best results in the shortest possible time.

Coöperative Machine Building

One of the concrete indications of the obliteration of individualism that has become necessary is clearly shown in the machine-building field. There are a number of cases where certain types of machine tools have become increasingly necessary in the production of many kinds of the munitions of war, including artillery, airplanes and other equally important implements. The manufacture of these was necessarily limited during peace times, and, as a consequence, the shops that are best known in the production of this particular type of machine, while sufficient to supply the normal demands, are entirely inadequate for the building of the number of machines now required. Nor is it an easy matter for them to double, treble or quadruple their output, no matter what the necessity may be. To begin with, it is extremely difficult for them to secure men, owing to the many disturbing influences at this time, so that the increase in output, which is absolutely necessary, becomes a very serious problem.

There seem to be but two methods of solving the problem. One is to enlarge the existing shops as much as may be possible, placing this increase above normal on the same basis as the emergency plants which have been and are being erected for the manufacture of guns and similar materials of war. The other, to have similar machines built by shops already in existence, but which, owing to the nature of their product, are not particularly busy at this time.

The latter seems to be the easier solution and the output can be more rapidly increased by this method. With this in view the Priority Committee is now working along this line, and is securing plants which can manufacture some of the much needed machines and so increase the desired output in the shortest possible time.

This is a decided departure from our existing practice in connection with the building of machine tools, and shows, among other things, how vital the machine tool industry is to the conduct of the war.

How This Is Done

In the cases cited, the builders of these machines are asked to supply drawings or patterns if possible, so that their machines may be built by other parties, and, although it probably goes against the grain in some cases, there is every indication that this method of procedure will become a part of the plan for supplying the needed machinery.

There are, of course, many points to be considered, such as the reputation of the concern which originated the machine, and the profits accruing from its manufacture. Generally speaking, it is probably safe to say that the first consideration is the more vital to any of the well-known concerns that are likely to be affected by the change. And this difficulty might, it seems, be overcome by the use of a nameplate, or better yet, some permanent means of showing that the machine, although of a particular well-known design, was built by a different maker.

The question of profit does not seem to be as vital in view of the fact that the original builder of the machine is already swamped with work, and presumably earning much larger dividends than he ever dreamed of in ordinary times. This should help to offset the feeling that there should be a profit or royalty paid on each machine, for it must be remembered that every additional cost of this kind must go into the cost of maintaining the war, and that it must be paid at some future time.

I am pleased to be able to state that in a number of cases the original builders of the machines in question have shown a hearty spirit of coöperation, and have cheerfully sent their patterns and drawings to the shops designated by the Priority Committee. This seems to be a very practical solution of the difficulty, assuming, of course, that suitable shops can be found in which to build high-grade machine tools such as are needed in the present emergency.

There is another consideration that has a bearing on the future output of munitions. This is in the selecting of tools for the work to be done, not only with a view of the work itself, but also of the limited supply of machine tools and the bearing on other work which is to be done in the future.

If, for example, it is possible to make airplane-motor cylinders on two types of machines with approximately the same efficiency, the selection of the machine to be used for this work should depend, not only on the motor cylinder, but on other work which is likely to be done in other lines in the near future. To be more specific, if it is determined that airplane-motor cylinders can be machined on either horizontal or vertical machines, but that shells can only be satisfactorily done on horizontal machines, it would be a mistake to select horizontal machines for the cylinder work, and by so doing to prevent these machines being supplied for work on shells.

These instances serve to show some of the many problems and how it is impossible to decide wisely on any vital question without knowing how the decision may affect some other equally important problem in another department. It is the time for the closest coöperation, not only in theory but in fact, and the final judgment should only be made by those who are in a position to see all sides of the case.

On the whole, however, it is very gratifying to be able to say that greater coöperation is in evidence all along the line.

Personals

Fred J. Miller, for the past nine years general manager of the factories of the Remington Typewriter Co., has resigned his position.

Louis A. Freedman has been elected secretary of the Aëronautical Society of America, with headquarters at 29 West 39th St., New York City.

W. F. Trenary now represents the Harrison Safety Boiler Works, and has headquarters at 419 Brown-Marx Building, Birmingham, Ala. Mr. Trenary succeeds **W. R. Jennison,** whose connection with the company has terminated.

L. R. Brink, superintendent of Barnhart Bros. & Spindler, Chicago, has resigned to accept the position of general manager of the Fort Dearborn Manufacturing Co., Sterling, Ill., manufacturers of special machinery, gears and metal stampings.

New Publications

Saws — Their Care and Treatment — By Harry W. Durham, 268 pages, 4¾ x 7¼ in., plus 4-page index, 155 illustrations, and a number of tables. Published by D. Van Nostrand Co., 25 Park Place, New York City. Price, $2.50.

This is a very complete treatise on the various types of saws and their selection, care and upkeep, and is the result of over 25 years' experience with saws in a large number of saw mills, gathered personally by the author, from expert workers, users or from makers. As the author says in his preface, the object of the book is to provide a reliable book of reference for those who are learning the art of saw fitting, or who may be interested in the proper methods of sharpening and keeping saws in order.

The book is written in a clear, understandable way and the author covers his points without any undue verbosity. The book is also free from the usual disfiguring historical chapters which so often merely add to the bulk of a book. Altogether, the book is a pleasure to read from a mechanical standpoint, and will make a valuable reference book for anyone interested in woodworking saws. It is strictly confined in its scope to the three types of saws: reciprocating, circular and band. Metal-cutting saws are not touched upon.

The 16 chapters are headed as follows: I. General Introductory Notes on Saws. II. Particulars of Reciprocating Saws. III. Particulars of Circular Saws. IV. Sharpening Saws by Hand Filing. V. Saw-Sharpening Machines. VI. Setting the Teeth of Saws. VII. Hammering and Tensioning Circular and Reciprocating Saws. VIII. Sharpening Large Bandsaws. IX. The Saw-Sharpening Room. X. Small and Narrow Bandsaws. XI. Wide Bandsaws. XII. Tensioning, Leveling and Hammering Bandsaws. XIII. Doctoring Bandsaws. XIV. Miscellaneous. XV. Saw Packing and Saw Guides. XVI. Power to Drive Sawing Machines.

The Design of Machine Elements—By W. G. Dunkley, B. Sc. Two volumes, with 4½ x 7½-in. pages. Vol. I, 123 illustrations and 16 tables. Vol. II, 122 illustrations and 15 tables. Published by D. Van Nostrand Co., 25 Park Place, New York City. Price, $3 for the two volumes.

These little books are a part of the Broadway Series of Engineering Handbooks. In presenting the main principles on which the design of machine elements is based, the author has used as illustrations many practical examples which have come within his experience as machine-tool designer. There is little that is new, or presented in a new way, as the material used is very similar to that in various other books on design of machine elements. Considerable of the matter has been published in technical magazines or other publications. The general arrangement, however, is very good and the matter is put in convenient form for ready reference, which after all was probably the main object in view.

The contents of Vol. I are: I. Conditions for Equilibrium Between Forces Acting on a Body. II. Stress, Strain, Twisting and Bending Moment. III. Shafts and Studs. IV. Bearings, Pedestals, Hangers, Wall Brackets, and Swivel Bearings. V. Ball and Roller Bearings. VI. Keys and Couplings. VII. Springs.

The contents of Vol. II are: I. Screw Threads, Bolts and Screws. II. Belts and Pulleys. III. Driving Clutches. IV. Gearing; Spur Gears with Involute Teeth, Helical Gears, Worm Gearing, Spiral Gears, Bevel Gears, Elliptic Gears. V. Driving Chains, Lifting Chains, Wire Ropes.

Trade Catalogs

Wood Screw Machinery. The Asa S. Cook Co., Hartford, Conn. Catalog. Pp. 36; 6 x 9 in.; illustrated.

Optical Pyrometers. The Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Penn. Bulletin No. 860. Pp. 8; 8 x 10½ in.; illustrated.

S R B Maximum Silent Type Annular Ball Bearings. Standard Roller Bearing Co., Philadelphia, Penn. Bulletin No. 52. Pp. 14; 8½ x 11 in.; illustrated.

Tinol Solder Products and Epicassit, which is a rustproof metal coating, are described in new pamphlets issued by Hess & Son, 1031-33 Chestnut St., Philadelphia, Pennsylvania.

Milled Screws. Standard Pressed Steel Co., Philadelphia, Penn. Catalog. Pp. 16; 5 x 7 in.; illustrated. The "Standco" hollow safety setscrew is shown in addition to complete line of setscrews.

Cincinnati Planing Machine. The Cincinnati Planer Co., Cincinnati, Ohio. Catalog No. 17. Pp. 72; 8½ x 11 in.; illustrated. This shows complete line of planing machines manufactured by this company, together with improvements recently developed.

Stock List of Milling Cutters. The Cleveland Milling Machine Co., Cleveland, Ohio. Booklet. Pp. 36; 3½ x 6 in.; illustrated. This contains list of cutters from which immediate shipment can be made. A similar booklet will be issued on the fifteenth of each month.

Woodworking Precision at High Speed is the title of a catalog issued by the SKF Ball Bearing Co., Hartford, Conn., in which the application of the SKF bearings to various types of woodworking machines are shown. Pp. 48; 6 x 9 inches.

Methods of Cutting Metal. Simonds Manufacturing Co., Fitchburg, Mass. This is the title of a booklet which illustrates and describes various styles of solid and inserted-tooth metal saws, and contains information on the uses of each saw. Pp. 64; 4 x 6 in.; illustrated.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

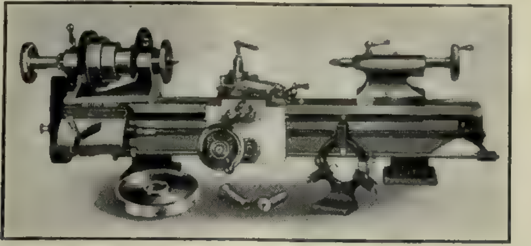
The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Feb. 7, 8 and 9. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Lathe, Precision

Walter H. Wade, Boston, Mass.

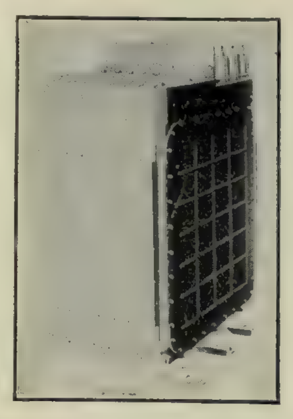


"American Machinist," Nov. 8, 1917

Made for toolroom work, its over-all length being 45 in. Swing, 8½ in.; maximum distance between centers, 24 in.; bearings, cone type; tailstock, set over; diameter of lead screw, ¾ in.; thread pitch of lead screw, 8; thread cut by means of gear box, twenty-four, 12 to 120 per in.; feeds obtained by feed rod, 2.9 times finer than threads; weight, 450 lb.

Generator, Electric Oxygen-Hydrogen

International Oxygen Co., 115
Broadway, New York City

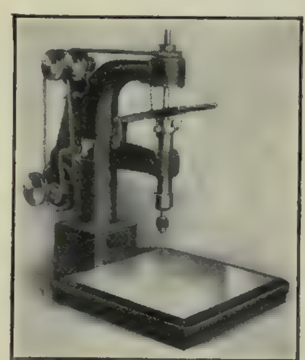


"American Machinist, Nov. 15, 1917

For generating oxygen and hydrogen gas. The generator is quite compact, the dimensions of one unit being 3½ in. thick, 3½ ft. wide and 6 ft. high. The capacity of this cell with a current of 1000 amperes is approximately 200 cu.ft. of oxygen and 400 cu.ft. of hydrogen in 24 hr. The units are so arranged that they may be assembled in a battery as indicated. Operates on any current from 200 to 1000 amperes

Drilling Machine, High-Speed

Fenn Manufacturing Co.,
Hartford, Conn.

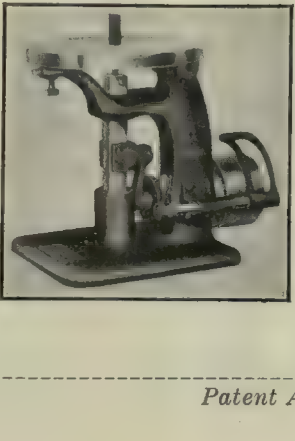


"American Machinist," Nov. 15, 1917

Bearings, SKF ball; maximum distance from chuck to table, 5¼ in.; distance from upright to center of spindle, 6½ in.; working surface of table, 13½ x 13½ in.; length of feed, 3 in.; speeds, four, 7735 to 15,000 r.p.m.; diameter of tight and loose pulleys, 4¼ in.; net weight of bench machine, 140 lb.

Filing Machine

Newark Engineering and Refrigerating Co., 476-482
18th Ave., Newark, N. J.

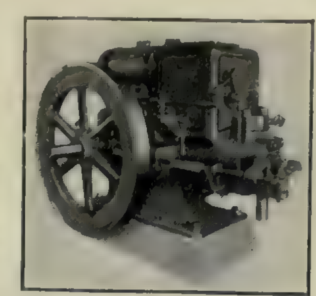


"American Machinist," Nov. 15, 1917

Diameter of platen, 8 in.; height from bench, 10 in.; width, 8 in.; length, 12 in.; diameter of pulleys, 3½ in.; width of belt, 1 in.; weight, 22 lb. The machine is driven by a simple crank and connecting-rod motion, the file being carried by a square shaft supported in two babbitt bearings. Other bearings are of bronze. The angle of the platen is adjustable

Engine, Oil

Evinrude Motor Co., 326
Walker St., Milwaukee, Wis.

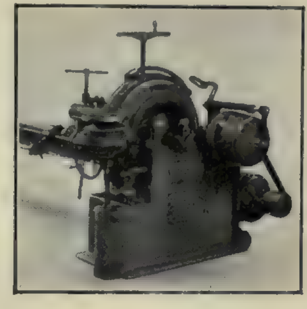


"American Machinist," Nov. 8, 1917

Built in two sizes, 1½ and 3 hp., but other sizes may be added in the future. Operates on fuels such as kerosene, fuel oil, solar oil, crude oil, stove oil and coal oil. Pure air only is compressed, the fuel being injected into a small fuel cup and ignited at the end of the compression stroke. This forces the fuel into the main cylinder in an atomized state, and the combustion proper takes place. A governor and forced-feed lubrication are used. Fuel consumption claimed not to exceed 7/10 lb. per hp. per hr.

Cutting-Off Machine

George Gorton Machine Co.,
Racine, Wis.



"American Machinist," Nov. 15, 1917

Capacity, 4½ in. rounds, 3¼ in. squares, or any other size or shape that can be contained within a 4½-in. circle; net weight, 1900 lb.; floor space, 48 x 66 in.; height, 60 in. Ten cutters are used, being held on the inside edge of the bore of the blade which rotates around the work. The cutters are alternately wide and narrow, the narrow cutters projecting a slightly greater distance toward the center of the work

Call and Fire-Alarm Systems

Standard Electric Time Co., Springfield, Mass.

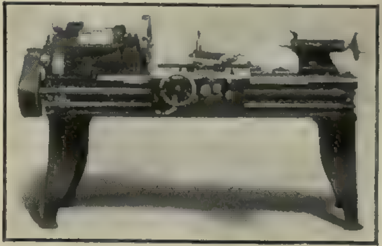
"American Machinist," Nov. 15, 1917

This company is now marketing two new types of electric specialties; namely, a fire-alarm system and a calling system. On the operating board of the calling system, the selector fingers are of the type used on telephone boards and are arranged on a wood case. The operation is accomplished by pressing down the proper keys to secure any desired code number, and starting the instrument by depressing the key at the extreme right. This key has a red handle while the code keys are black. A small telltale lamp flashes the code signal to the operator at the same time the signal is rung. The system is supplied for various voltages and types of current. The mechanism is absolutely silent in operation.

The fire-alarm system consists of a master selector which will ring any desired code either three rounds or indefinitely as desired. It is designed for use with either a regular break-glass fire-alarm station, or for push-button operation. It is furnished for various voltages and currents. The selectors for both systems are very similar; the mechanism being operated by a strong spring wound by means of an electro magnet, operating through a rack and pinion and suitable gearing. The main difference in the selectors is that in the calling instrument a series of contacts are used which come into alternate contact with a revolving flat spring, while the fire-alarm selector has a definite code actuated by teeth cut on a cam

Lathe, 14-In. "Amtew"

American Machine Tool Engineering Works, Chicago, Ill.



"American Machinist," Nov. 15, 1917

Swing over bed, 14⅝ in.; swing over carriage, 7 in.; distance between centers with 6-ft. bed, 36 in.; diameter of hole through spindle, 1 5/16 in.; taper of centers, No. 3 Morse; front spindle bearing, 2⅜ x 4 in.; rear spindle bearing, threaded, 2⅛ x 7; back gear ratios, 3 to 1 and 8 to 1; number of spindle speeds, 18; weight with a 6-ft. bed, 1600 lb

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Nov. 23, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	....	$20.00
No. 2 Northern Foundry, Chicago	33.00	$33.60	26.00
*Bessemer, Pittsburgh	36.30	....	29.95
*Basic, Pittsburgh	33.00	36.30	25.95
No. 2X, Philadelphia	33.75	33.75	25.00
*No. 2, Valley	33.00	33.00	25.00
No. 2, Southern Cincinnati	35.00	....	22.90
Basic, Eastern Pennsylvania	45.00	45.00	26.00

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Nov. 23, 1917	One Week Ago	One Year Ago	Nov. 23, 1917	One Year Ago	Nov. 23, 1917	One Year Ago
Structural shapes	$4,195	$5.25	$3.50	$4–4.035	$3.60	$4.195	$3.35
Soft steel bars	4.095	5.00	3.50	4–4.035	3.60	4.095	3.35
Soft steel bar shapes	4.095	5.00	3.50	4.135	3.60	4.095	3.35
Plates, ¼ to 1 in. thick	4.45	10.00	4.25	4.385	4.10	4.45	4.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Nov. 23, 1917	One Year Ago
Pittsburgh, mill	$3.50	$2.75
Warehouse, New York	4.25	3.50
Warehouse, Cleveland	3.95	3.45
Warehouse, Chicago	4.50	3.35

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Nov. 23, 1917	One Month Ago	One Year Ago	Nov. 23, 1917	One Year Ago	Nov. 23, 1917	One Year Ago
*No. 28 black	5.00	6.445	9.00	4.50	6.35	3.90	6.445	4.10
*No. 26 black	4.90	6.435	8.90	4.40	6.25	3.80	6.435	4.00
*Nos. 22 and 24 black	4.85	6.295	8.85	4.35	6.20	3.75	6.295	3.95
Nos. 18 and 20 black	4.80	6.245	8.80	4.30	6.15	3.70	6.245	3.90
No. 16 blue annealed	4.45	5.645	8.20	4.45	5.55	3.95	5.645	4.00
No. 14 blue annealed	4.35	5.545	8.10	4.35	5.45	3.85	5.545	3.90
No. 12 blue annealed	4.30	5.495	8.05	4.30	5.40	3.80	5.495	3.85
No. 10 blue annealed	4.25	5.445	8.00	4.25	5.35	3.75	5.445	3.80
*No. 28 galvanized	6.25	7.695	10.50	6.50	7.60	5.50	7.695	5.60
*No. 26 galvanized	5.95	7.395	10.20	6.20	7.30	5.20	7.395	5.30
No. 24 galvanized	5.80	7.245	10.05	6.05	7.15	5.05	7.245	5.15

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Nov. 23, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Nov. 23, 1917	One Year Ago
New York	$14.00	$6.00
Cleveland	15.30	6.30
Chicago	15.00	5.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00 @ 30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

* Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
1/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Nov. 23, 1917	Cleveland Nov. 23, 1917	Chicago Nov. 23, 1917
Tire	5.00	5.00	4.50
Toe calk	5.70	5.50	4.75
Openhearth spring steel	7.50	8.25	8.00 @ 8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Coppered bessemer rods	9.00	....	....

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	37.9%	23.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	41.9%	26.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Nov. 23, 1917	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	35.00
Tin, in 5-ton lots	77.00	62.00	45.00
Lead	7.25	8.50	7.00
Spelter	7.88	8.50	12.50

*Government price.

ST. LOUIS			
Lead	7.13	8.00	7.00
Spelter	7.63	8.25	12.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Nov. 23, 1917	One Month Ago	One Year Ago	Nov. 23, 1917	One Year Ago	Nov. 23, 1917	One Year Ago
Copper sheets, base	35.00–37.00	35.00	37.50	35.00	38.50	35–36	36.50
Copper wire (carload lots)	36.00	38.50	35.00	31.00	33.00	33.50	37.00
Brass pipe, base	38.50	43.00	47.50	41.00	46.00	42.00	46.00
Brass sheets	35.75	40.00	45.50	34.00	43.00	35.00	38.00
Solder ½ and ½ (case lots)	40.50	39.25	28.50	40.00	27.00	38.00	34.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Nov. 23, 1917	One Year Ago
Mill	$29.00	$42.00
New York	30.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Nov. 23, 1917	One Year Ago	Nov. 23, 1917	One Year Ago
New York	20.00	18.00	20.50	19.00
Cleveland	21.00	16.75	21.25	17.50
Chicago	21.00	17.00	21.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Nov. 23, 1917	One Year Ago
New York	14.00	13.50
Cleveland	16.00	13.00
Chicago	16.00	13.50

Manufacturer: Before you fix that price–
Dealer: Before you add that extra profit–
Workman: Before you strike–*Ask yourself*—

Is this MY boy?”

THE MANUFACTURE OF THE LEWIS MACHINE GUN

By Frank A. Stanley

This foreword is presented to give a general idea of the character of the Lewis gun, and of the workmanship involved in manufacturing it upon a strictly interchangeable basis. All parts are subjected to one hundred per cent. inspection, and each and every piece manufactured will interchange absolutely so that guns will assemble any time, anywhere, from parts of any date made under this most complete system. The gun may be assembled or stripped without special tools of any kind, and in the briefest period of time. A further proof of the high character of workmanship and material is found in the fact that a gun has fired over 300,000 rounds and still functions perfectly. Certain parts, such as the barrel, were changed on account of the necessary wear.

IT RECENTLY has been my privilege to spend some little time at the plant of the Savage Arms Corporation at Utica, New York, where every opportunity was afforded me for examining manufacture, inspection, assembling and testing of the Lewis machine gun.

The production of this gun forms one of the most interesting systems of manufacture ever employed in a machine plant. It is a clean-cut manufacturing proposition from the start to finish with no hidden processes and no secret operations. The gun is absolutely interchangeable in every respect. This is saying a great deal, but it is strictly true in every sense of the word. In the first place a schedule of limits has been carefully worked out for every member of the gun. There is in these tolerances no overlapping of the dimensions of two parts that are to fit together and the parts as produced to the limit gages, therefore, assembled properly. The tool equipment is of itself of such character, and the order of operations is such, that each operation checks the accuracy of preceding processes, and there is 100 per cent. inspection of the product.

FIGS. 2 AND 3. THE AMERICAN MODEL LEWIS GUN

The machine operatives gage the parts as produced by the tools, and while these parts are still on the bench every one of them is gaged by an inspector before it leaves the department. Following this shop inspection all parts are later gaged in the general inspection room. After the harding, bluing and browning processes the parts are reinspected, and after the guns have been assembled a considerable number of shots fired from each in the gallery to test the functioning of the mechanism with the gun placed at all angles and bottom side up. After

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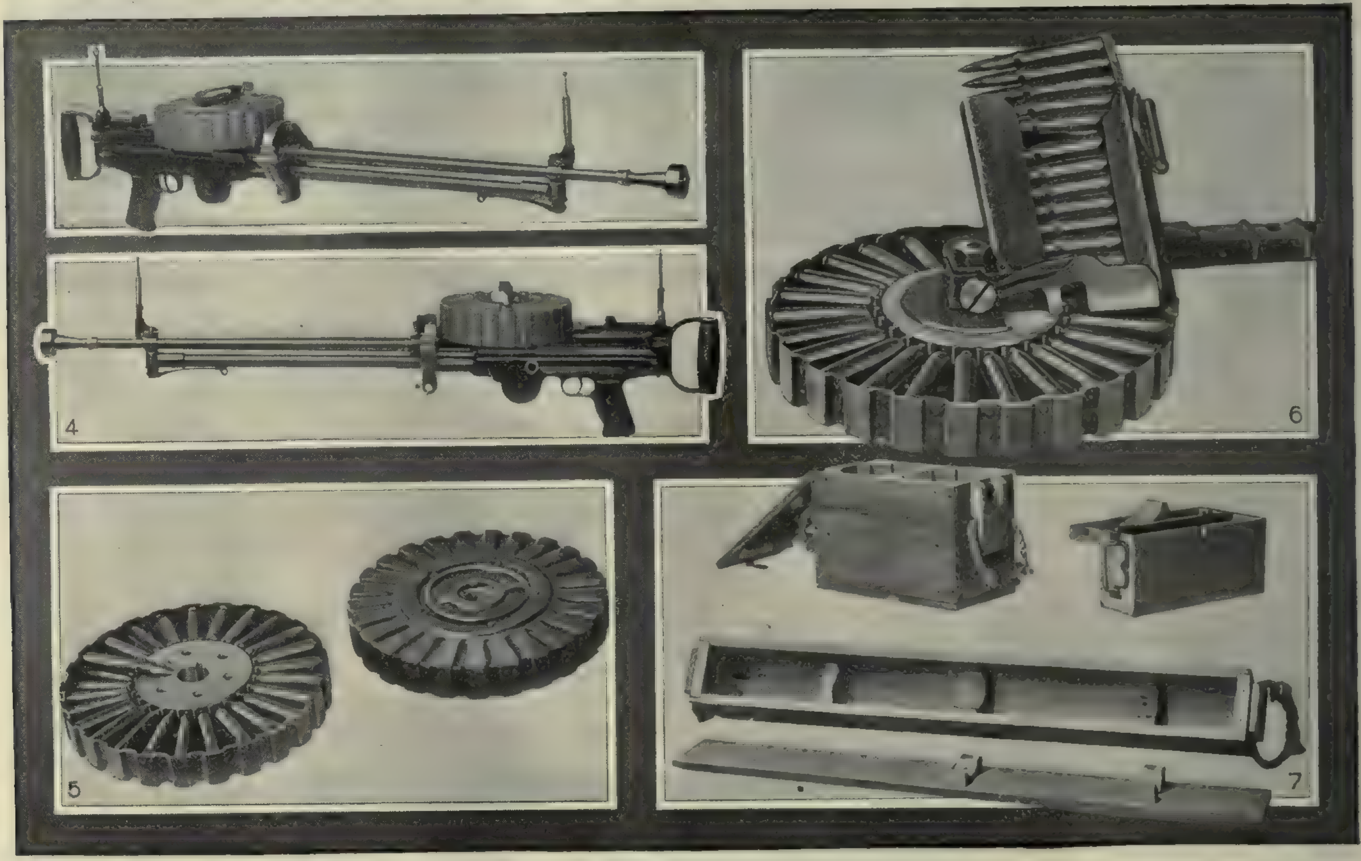
*Copyright, 1917, McGraw-Hill Publishing Co., Inc.

this the guns are pulled down and the parts again gone over by another group of inspectors. They are then reassembled ready for the final official inspection. This involves the taking apart of each gun for examination, the mixing of the parts from a group of guns and the assembling again from parts taken promiscuously from these groups so that each completed gun is composed of members taken from ten or more different guns as originally brought into the department.

The above brief outline of the course of procedure followed does little more than emphasize the salient features of a shop system that has been so highly developed and thoroughly applied to the attainment of the desired end, a truly interchangeable firearm. In articles to follow, various features of manufacture and inspection will be elaborated upon to show what has been found essential to the successful carrying on of this line of manufacture.



FIGS. 4 TO 7. A NUMBER OF PARTS OF THE GUN

Fig. 4—The airplane model. Fig. 5—The magazine. Fig. 6—The magazine loader. Fig. 7—The gun box and magazine containers

The Lewis gun has already been described in these columns, and no detailed account of its features of design and operation is here required. It may be well, however, to call attention to certain points in the make-up of the gun in this preliminary article in order to show clearly the problems involved in the manufacturing process.

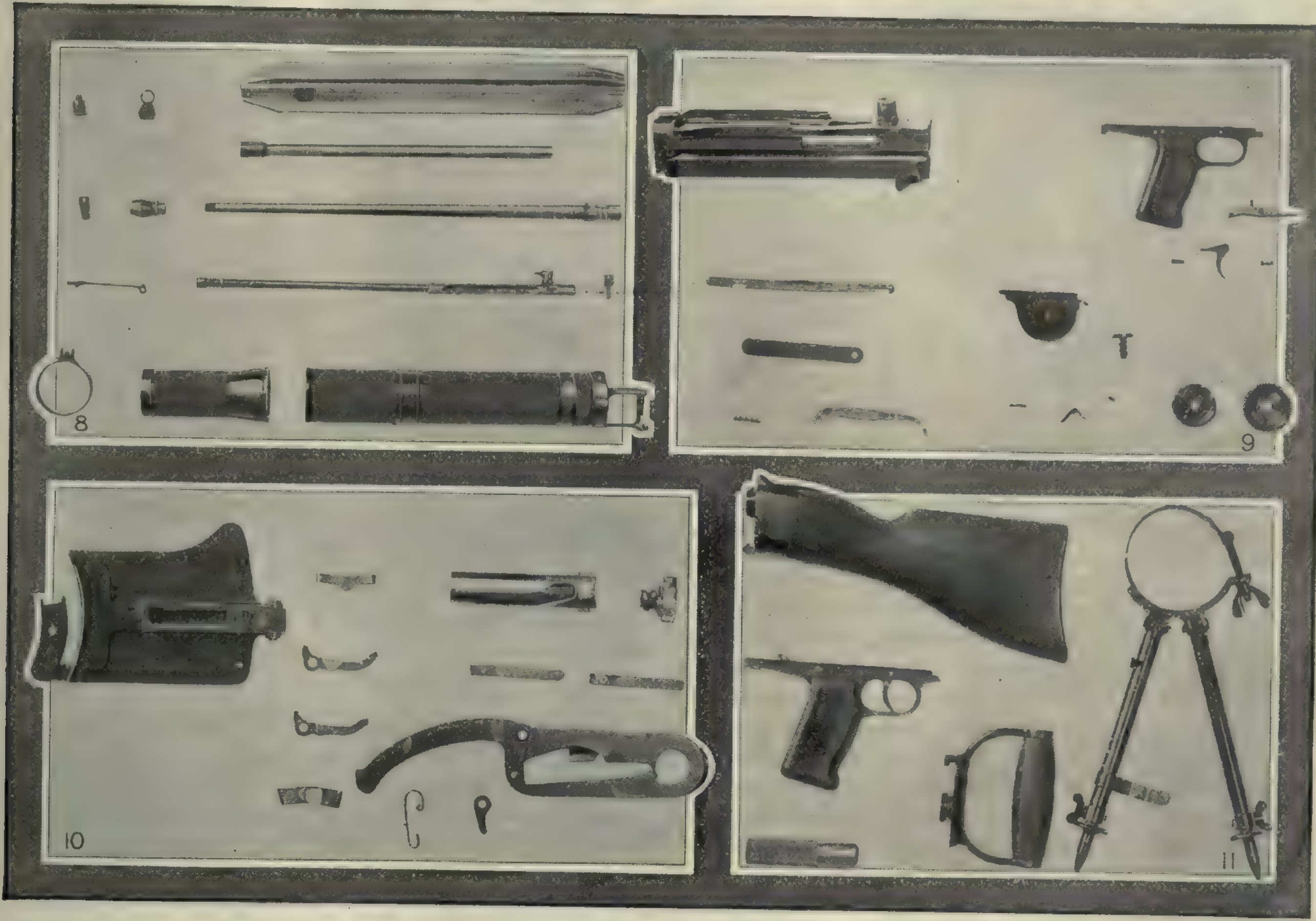
Some interesting general views of the American standard gun are presented in Figs. 1, 2 and 3, while Fig. 4 illustrates the new airplane gun with functioning parts exactly the same as those of the standard model. The radiator is not required on the airplane model, and the magazine is deeper and holds 97 cartridges where 47 only are carried in the standard magazine. In the guns proper there are no differences; in fact, the parts of one gun will interchange with those of the other.

Two magazine illustrations are reproduced in Figs. 5 and 6, and Fig. 7 shows the gun box and the containers for carrying the magazines. In passing it may be stated that the manufacture of the magazines is a press process of high order, which will be discussed later. The steel shell with its corrugations is drawn up in an ingenuously designed die, the rivet holes for the ribs are punched with a radially operated set of tools, and the magazine center of aluminum is milled around the periphery to form a spiral groove, or feed channel for the cartridges, by means of multiple spindle machines carrying a series of formed end mills.

The cartridges, which are the same as used in the Springfield rifle, are loaded into the magazine in the manner shown in Fig. 6, where the magazine is seen upside down with the loading tool attached. A clip full of cartridges is placed in the top of the chute with the bullets toward the center, and as the cartridges are pressed down to strip them from the clip, the magazine is rotated to the right so that the bullets are engaged by the spiral groove or thread in the magazine center and the cartridges thus fed down into the magazine.

The parts of the gun are shown in detail in Figs. 8, 9, 10 and 11, the first of these illustrations representing the barrel and piston group, while Fig. 9 shows the receiver group and trigger mechanism, Fig. 10 the feed mechanism and bolt parts, and Fig. 11 the buttstock loading handle, spade grip and bipod mount. The gun proper contains all told, some 60 parts, and one of the striking features is that only 1 screw and 4 pins are used in its make-up. This means that the taking down of the gun and its reassembling require nothing in the way of tool equipment except a small spanner for the barrel mouthpiece and a drift for the pins. Aside from the specific uses mentioned for these two tools all operations in stripping the gun and putting it together are accomplished with the aid of a cartridge, the point of the bullet being introduced in the various channels and holes where parts lock together. So readily are the stripping and assembling operations performed that a man blindfolded can take the gun apart and reassemble it without difficulty.

Of all the parts entering into the gun construction, the most interesting one from a mechanical point of view is the receiver seen in the upper left-hand corner of Fig. 9. This is manufactured from a vanadium steel drop-forging weighing in the rough 18 lb. and cut down on the machining operations to a finish weight of 3⅓ lb. only. It will not be attempted in this article to describe in detail the series of operations on this intricate piece of work, these will be dealt with, however, in articles that are to follow.



FIGS. 8 TO 11. VARIOUS SMALL BUT IMPORTANT PARTS

Fig. 8—The barrel and radiator group. Fig. 9—The receiver and trigger mechanism. Fig. 10—The feed mechanism and bolt. Fig. 11—The butt stock, loading handle, spade, grip and bipod mount

Some idea of the extent and nature of the different shop processes followed in the manufacture of the receiver may be gathered from the following data: In carrying the vanadium steel drop-forging through from the rough to the finished receiver there are over 150 distinct operations. Of these 26 are performed on power milling machines, 18 on hand milling machines, and 38 on profilers, so that practically one-half of the total number of operations are accomplished with milling, and profiling cutters of one kind or another. Some half dozen or more operations are handled on turret lathes and about the same number on shaping machines. It is interesting to note that the drilling machine is used in only about 6 operations on this particular piece. Reaming, grinding, and lapping processes are included to the extent of a dozen or more in the series of machine operations, and all of this work, whether on a milling, profiling, drilling or some other machine, is accomplished with the aid of most carefully designed fixtures and complete sets of gaging apparatus.

It will be understood, of course, that while the mechanical means for completing all the gun parts have been developed to a remarkable extent to eliminate hand operations so far as possible, there must necessarily be a few surfaces where hand work at the bench is required in bringing certain points accurately to gage, and where these hand operations are applied as in finish filing occasional cuts, the same important class of gaging and testing apparatus is employed for assuring interchangeability as is provided for the machine operations.

The character of the gages referred to, in connection with both machine and hand processes, is such as to justify a detailed account that will be given in subsequent articles. It is obvious that the system of tolerance, and the gaging system must form the basis of this most remarkable piece of interchangeable gun manufacture.

(To be continued)

Tests of Cork for Friction Clutches and Other Similiar Purposes

BY G. G. BECKNELL AND C. N. WENRICH

The data on cork tests here given were obtained in the laboratory of the University of Pittsburgh, and the conclusions should be of interest,

FOR SOME time past, the question of the use of cork products for clutches and other friction purposes has been given considerable study and discussion. In this connection it was found desirable to make tests to determine the coefficient of friction of various cork products.

Since these tests have been made with a view to covering the subject in a technical manner for the benefit of engineers, a few prefatory remarks may be of value to salesmen, for interpreting the significance of the figures. The following definitions are quoted from Kent:

"Friction is defined by Rankine as that force which acts between two bodies at their surface of contact, so as to resist their sliding on each other, and which depends on the force with which the bodies are pressed together."

"Coefficient of friction is the ratio of the force required to slide a body along a horizontal plane surface, to the weight of the body."

In other words, the higher its coefficient of friction, the more valuable a product becomes for overcoming slippage. Therefore, the tests which follow seem to prove conclusively that cork (in almost every case) is a better substance than leather for clutch work and other frictional uses. A brief explanation is given after the actual data.

The coefficient of friction was taken in the same manner as the coefficient of leather, metals and other substances given in the 1916 edition of Kent, p. 1221, or 1912 edition, p. 1197, and if these values are used in the formulas given on p. 1229 of 1916 edition, or 1205 of 1912 edition, comparative data can be obtained.

Value of θ are calculated to the nearest ½ deg. These values of "f" are the average of five values obtained by varying the normal pressure applied to the cork. In most cases the values are practically the same, with the following exceptions: The coefficient of friction of various cork products on glass, increases in direct proportion to the normal pressure. This is accounted for by the fact that charges of static electricity are obtained which produce a holding force. In the case of wet surfaces, the tendency of the coefficient is to decrease in proportion to the normal pressure applied. The steel used for these tests was ordinary, smooth, pickled steel.

RESULTS OF TESTS

	Angle of Repose θ Degrees	Coefficient of Friction f	Reciprocal 1 : f
Leather:			
On oak	15 to 19½	0.27 to 0.38	3.7 to 2.86
On steel (dry)	29½	0.56	1.79
On steel (wet)	20	0.36	2.78
On steel (greasy)	13	0.23	4.35
On steel (oily)	8½	0.15	6.67
243 Fine Cork Composition:			
On cork	40	0.838	1.19
On pine with grain	30½	0.584	1.71
On glass	44½	0.987	1.01
On steel (dry)	27	0.514	1.95
On steel (wet steel)	38½	0.794	1.26
On steel (cork soaked in water)	40½	0.849	1.18
On steel, greasy (steel oiled)	29	0.549	1.82
On steel, oily (cork soaked in oil)	28	0.527	1.90
On steel (steel hot enough to char cork)	32½	0.640	1.56
Acco Composition:			
On pine with grain	23½	0.430	2.32
On glass	50	1.172	0.85
On steel (dry)	22½	0.417	2.40
On steel (wet steel)	30½	0.584	1.71
On steel (cork soaked in water)	36	0.723	1.38
On steel greasy (steel oiled)	24½	0.451	2.22
On steel, oily (cork soaked in oil)	25	0.458	2.18
On steel (steel hot enough to char cork)	32½	0.637	1.57
Natural Cork:			
On cork	30½	0.592	1.69
On pine with grain	26	0.487	2.06
On glass	27½	0.517	1.93
On steel (dry)	24½	0.452	2.22
On steel (wet steel)	35	0.694	1.44
On steel (cork soaked in water)	29½	0.565	1.77
On steel, greasy (steel oiled)	24	0.447	2.24
On steel, oily (cork soaked in oil)	23	0.419	2.38
On steel (steel hot enough to char cork)	33	0.645	1.55

SUMMARY OF COEFFICIENT OF FRICTION

	Steel Dry a	Steel Wet b	Steel Greasy c	Steel Oily d	Steel Charred Cork e
Leather	0.56	0.36	0.23	0.15	.....
243 Fine cork	0.514	a0.794 b0.849	0.549	0.527	0.640
Acco cork	0.417	a0.584 b0.723	0.451	0.458	0.637
Natural cork	0.452	a0.694 b0.565	0.447	0.419	0.645

a. Cork products on wet steel (water poured on steel slab each time).
b. Water soaked cork products on dry steel (all surface water wiped off).
c. Greasy tests were made. Cork products on oiled steel.
d. Oily tests, cork products were soaked in oil.
e. In charred cork tests, steel was heated enough to char cork.

Bringing these figures down to the plane of the average layman, who may not be familiar with engineering phraseology, the following conclusions (taking leather as a basis) may be drawn:

No. 243 Fine Acco Cork is	0.91	times as efficient as leather on dry steel
No. 243 Fine Acco Cork is	2.20	times as efficient as leather on wet steel
No. 243 Fine Acco Cork, wet, on dry steel is	2.36	times as efficient as leather on wet steel
No. 243 Fine Acco Cork is	2.39	times as efficient as leather on greasy steel
No. 243 Fine Acco Cork is	3.51	times as efficient as leather on oily steel
Acco Cork is	0.74	times as efficient as leather on dry steel
Acco Cork is	1.62	times as efficient as leather on wet steel
Acco Cork wet on dry steel is	2.01	times as efficient as leather on wet steel
Acco Cork is	1.96	times as efficient as leather on greasy steel
Acco Cork is	3.05	times as efficient as leather on oily steel
Natural Cork is	0.80	times as efficient as leather on dry steel
Natural Cork is	1.92	times as efficient as leather on wet steel
Natural Cork wet, on dry steel is	1.57	times as efficient as leather on wet steel
Natural Cork is	1.94	times as efficient as leather on greasy steel
Natural Cork is	2.79	times as efficient as leather on oily steel

The tests of charred cork were made with heated steel, to determine the value of cork in dry clutch work where intense heat may be developed. In these tests the cork, even though charred on its surface, maintained a satisfactory coefficient of friction, and did not seem to lose its gripping powers through being charred.

It will be observed from these results that cork and cork products are better materials than leather for the prevention of slippage, except with dry steel. In the great majority of cases, however, either moisture, oil or grease is present, and under those conditions cork is much more desirable. This in itself would imply that before long cork should find a wider and wider use for friction purposes.

The cork products used were furnished by the Armstrong Cork Co.

Some Recollections of the Langley Airplane

An Interview with CHAS. M. MANLY

Now that the airplane has been developed to the point where it has become such an important, if not a deciding factor in the battles of this world war, it is extremely interesting to look back at some of the early experiments and see their bearing on the present development.

IT IS generally admitted that the theories of Prof. Langley are now proven to have been perfectly sound even though his experiments were not as successful as might have been desired. These apparent failures, however, were in no wise due to any fault of his theories or of his conception of the airplane itself, as the original machine has since been flown by Glenn H. Curtiss over Lake Keuka. The entire difficulty was with the method used in launching the plane, and even here the theory was sufficiently correct to have made a successful flight possible, had not unforeseen defects developed in the launching apparatus itself.

After determining from many successful flights with steam engine-driven models of considerable size that a machine large enough to carry a man could be successfully flown if a suitable motor was secured, Prof. Langley made a most thorough search for a builder competent to construct a gasoline engine for such a machine. Upon finding such a builder in New York, who was willing and appeared to be able to build a gasoline engine to furnish 12 hp., and to weigh not more than 120 lb., he accepted the allotment of $50,000 which the Board of Ordnance of the War Department had made available for his use, for building such a man-carrying machine.

THE MOTIVE POWER

The contract called for the completion of this engine on Feb. 12, 1899, and all the parts were completed at that time, but the engine, which was a 5-cylinder $4\frac{3}{16}$ x 5-in. rotary cylinder type, did not develop anywhere near the required power. About $1\frac{1}{2}$ years were spent by the engine builder in unsuccessfully trying to make the engine develop the power. Finally, the case appeared so desperate, as the machine was otherwise ready for its first test, that in June, 1900, Prof. Langley and I went to Europe to secure the aid of the best gasoline engine building experts there. We consulted representatives of the Napier, the Daimler and the DeDion plants, as well as all others in England, Germany and France, whom it appeared might be able to aid us, but we could find nothing suitable, nor could we get any encouragement as to such an engine being possible. Count DeDion, in whom we had the greatest hope, told us that he had spent $70,000 developing the single-cylinder, air-cooled motor, which he was then building for motorcycles, and he said that such a proposition as ours was preposterous, and that if he thought it possible to build such a light engine, he would certainly not build it for us, but for himself.

Sir Hiram Maxim, who for a few years before had quite extensively experimented with his multiplane machine, offered the use of some of his draftsmen, whom he thought might be able to design such a motor, but this seemed to involve an indefinite amount of delay and experiment.

Finally, I undertook to build the engine, and immediately returned to Washington, and began the construction of it in the Smithsonian Institution Shops, and in February, 1901, by using some of the parts of the revolving cylinder motor, which the American builder, S. M. Balzer, had bankrupted himself in his unflagging efforts to bring to a success, I had this motor developing 21 hp. for a weight of 125 lb.

As this engine was, however, somewhat of a patched-up affair due to having had to put water jackets on the cylinders after they had been completely finished, as well as modify other parts to suit the new conditions arising from the fact that the operation of the engine was revised, holding the cylinders still and revolving the crankshaft, instead of running it as a revolving cylinder engine, we decided to build an entirely new engine, and this was completed before the end of 1901. It had 5 stationary cylinders, 5-in. bore by $5\frac{1}{2}$-in. stroke, and showed in repeated tests on a water absorption dynamometer 52.4 hp., for 10 hours at 930 r.p.m. with a weight of only 125 lb.

MANUFACTURE OF SMALL PARTS

In the earlier part of the work with these engines, it was necessary for us to make our own spark plugs, and spark coils, as none that were suitable were obtainable. We also had to make all of our own ball bearings, and this, with the limited facilities which we had in the Smithsonian Shops, proved one of the greatest obstacles and causes of delay which we experienced in the whole work.

As our funds, given by the War Department, had run out before the end of 1901, and the Board would not even consider granting us any further funds, on account of public criticism and derision, which was being published in the press of that period, regarding Prof. Langley's work, it was impossible for us to buy all of the equipment which we wanted for the shops.

In case hardening the races for the ball bearings, I used an improvised furnace, consisting of a 12-in. clay pipe with 2 holes in the bottom of which I inserted gas blowpipe torches, with a piece of fireclay slab for a cover. The steel parts were packed in bone and leather in a steel box in the usual way, and the pyrometer consisted of a piece of $\frac{1}{4}$-in. steel poked down through a hole in the cover, the temperature of the furnace being judged by the color to which the bar became heated. By running the furnace for about 18 hours, we were able to get a depth of casehardening slightly over $\frac{1}{64}$ in. on the ball races. The best steel balls we were able to find were had by buying them in lots of 1000 from a dealer in New York, and sorting out those which were not more than 0.001 in. out of round, and with no greater inaccuracy as to uniformity of size; the percentage thus selected usually ran about 10 per cent.

As will be remembered, by those who have followed the Langley experiments, a houseboat was used for launching the machine as it had proved highly successful as a starting place for the launching of the model planes. These had all been made from the houseboat, and there had been about 35 successful flights with the small machines; the latest one of these was a 50-lb. model, on which every detail of the larger machine was first tried out. It also had a 5-cylinder gasoline engine, which weighed 10 lb. and developed 3 hp. at 1800 r.p.m.

The track on the houseboat was about 60 ft. long, and the car used for launching, about 20 ft., this launching outfit costing about ¼ of the entire $50,000.

The track was so designed as to drop out of the way at the end as soon as the car was fairly started, and so allow the plane to ride off without catching.

In order to give the car a good start, 24 springs were provided as a catapult. These were stretched to about 1½ times their length when the car was at the extreme end and were figured to give a thrust of about 1000 lb. This was multiplied by suitable tackle to give the car a speed of 36 ft. per sec. at the end of the track.

All necessary precautions seemed to have been taken and all contingencies allowed for, but the final accident was undoubtedly due to using a guide pin on the lower end of the guypost to prevent side stresses and a lifting of the machine from the car due to the wind under the wings. This guide pin failed to release from the guide on the car and as the track dropped when the car reached the end of its run, it caused the front wings to be twisted downward and pointed the airplane down and effectually prevented it getting into the air before striking the surface of the Potomac. This failure to release was partly due to the leather of the shock absorbers becoming dry so as not to check the speed of the car before it struck the support that held up the end of the track.

The second attempt was in December of the same year (1903). It was a cold day with strong wind, and there was ice 5 in. thick in the river. The wind blew the tail around against the railing on the boat as the car ran down the track and cut off the rear wings of the machine so that the machine when released tried to climb vertically in the air and finally turned over backward as we struck the water.

It is impossible to describe the bitter disappointment, not only to Prof. Langley, but to all of us who were intimately conected with the experiments. Nor was it without excitement and considerable danger, for as before stated, there was quite a heavy wind and the water was at a decidedly unpleasant temperature for the plunge. Fortunately, I was able to escape from all the entanglements in both instances, or I should not be alive today to tell the tale.

The sad part of the whole story is that these failures undoubtedly hastened the death of Prof. Langley, who was extremely sensitive to criticism, and who above all men deserved to live to see his work brought to a successful conclusion. In reality, he was far ahead of his day in the proper conception of the problem of mechanical flight and many of his formulas and observations are the basis of present-day airplane theory. That the machine was successful is very clearly shown by the fact that the original machine has since been flown by Mr. Curtiss. To Prof. Langley is undoubtedly due a large measure of credit for the wonderful work which is now being accomplished by the airplane of today.

An Echo from the Backwoods

By W. Osborne

HE HAD been in, of and around machine shops so long that the name of "The Old Man" had been applied to him for some time. There are advantages attached to being called "The Old Man." Some young and inexperienced people think that he knows a lot, and some older ones think that he has been lucky. A number of folks come to him for advice, or when they are dissatisfied with their job and are in search of others.

One evening a young man called to see the "Old Man." This young man had been working in a machine shop for some time and felt that he was not progressing as fast as he would like to. He was without much education and after getting into the shop he had begun to feel his lack of it and began to brush up on arithmetic. One of the first of his home-made problems was how long it would take him to be a first-class mechanic at the rate he had been going. The answer that he got rather discouraged him. He was not sure that the answer was right for he had to make up the problem and did not have any book with the answer for such a problem in it.

"You have been around a good bit," he said, "and you have seen a lot of shops, and I would like to know what to study so as to get along."

"How much do you know about the drilling machine that you have been running?" asked the "Old Man." "Your drilling machine does not have speed and feed-plates on it. Can you tell the revolutions that you get on the different speeds, and the number it takes to feed an inch with the different feeds, and the reason that clamps will not hold for some fellows and will hold for others, or why some fellows break more drills than others?"

The young man admitted that he did not know any of these things, and that he had never thought anything about them.

"My first advice would be for you to cultivate an inquisitive disposition with regard to your drilling machine and everything connected with it."

"That may be all right. I know that it would be if I intended to run a drilling machine all of my life but I feel that I have wasted too much time there already," said the young man. "I want to study something so that I can get and hold a better job and make more money. I might want to get married some day. I would like to get a lathe to run. It would be a lots easier job with lots better pay. What should I study so as to get along if I do get the chance?"

Here was a young man, just such an ordinary young man as can be met any day. He did not come from a mechanical family. He had worked around at various jobs and had drifted into the shop and had rather liked it and had stayed until he began thinking of a future for himself, as young men will, and without being consumed with any towering ambition he had a desire to better his condition. What was the answer to his request for such information?

THOUGHTS OF THE PAST

The "Old Man" thought of the shops of his past and of his fellows in them. In all of them and in every grade he could divide the men into two classes. They consisted of workmen and mechanics. To his mind the laborers were divided into these two grades as distinctly as were the more skilled employees. Some few of the men it was hard to put definitely into either class but most of them were easy to classify as soon as one was acquainted. The mechanics were interested in the underlying principles of the work, and understood them to some extent, and it was safer to trust them on a strange job than it was to trust the men who were not mechanics. Most of the foremen were mechanics.

In following his thoughts this idea came: Is a man a mechanic from being interested in mechanical principles and combinations, or is he interested in these things because he is a mechanic? Are mechanics born that way and so naturally reach out after the education that they find that they need or does the education along certain lines make them what they are? He did not know, but the young man was waiting and had not been answered.

THE BOOK RECOMMENDED

The "Old Man" was a mechanic and had been for more years than the young man had lived. He turned and looked over the books in his bookcase that stood the nearest and reached out and got a book. It was not a big book and it was not a new book. Its exact age was not made to appear but in the front was "Entered according to Act of Congress, in the year 1870, &c." On the back it said "Natural Philosophy. S. A. Norton."

"I think that this is the kind of a book that you need," said the "Old Man" as he handed it over.

The young man looked at it rather doubtfully. "I havn't much money but I have enough to buy some books, if I only knew what to buy, but I would like to get the very best and up to date that there is."

"That reminds me of a young man who came to this country from Ireland and applied for a job of one of our local merchants as bookkeeper. Everything seemed to be going along nicely in the interview until the merchant asked him where he had worked and the answer had been 'Dublin, Ireland.' The merchant shook his head. 'I want a man who is up to date.' 'Why! Isn't two and two four in this country?' asked the applicant.

"Some knowledge never grows old just as the alphabet never grows old. Listen to this: 'A machine is an instrument by means of which a force, applied at a certain point, is made to exert force at another point, more or less distant'; and to this: 'No machine can create power'; and to this: 'All machinery can be reduced to six elementary forms, called simple machines.'

"As long as the earth remains these things will continue to be true. All correct machine shop practice is founded on them. I have had that book since I was young and wish that I always remembered the things that it contains."

The look of doubt did not vanish from the face of the young man as he replied, "You see, I am not a boy any more and I must get going right away. Is there anything in that book that will help to run a lathe? Some men have told me to take the *American Machinist* or some other paper, and some have told me that I cannot learn such things from a book but that the only way is to get at and do the work."

NATURAL PHILOSOPHY

"A knowledge of the elements of natural philosophy should be useful to you everywhere. How useful the knowledge would be depends upon yourself. I do not know you well enough to say. When a cow eats hay the hay turns into cow, and when an elephant eats hay the hay turns into elephant. Should a cat eat hay it would have indigestion. Perhaps hay would delay starvation in a cat. I do not know how your mind would treat the things that you read. One thing is sure, and that is that if you are in earnest about wanting to get along you will get along better than if you are not in earnest. You may get along by cultivating your memory for the things you are working with, or you may get along because you cultivate your reasoning powers about them. If you are long on memory, and short on reasoning powers, it will come more natural for you to be a workman than it will for you to be a mechanic. In any case this book or others like it, and the mechanical papers will be useful to you far above what they will cost you if you will make use of them."

The young man went away and the "Old Man" continued to think about the past. Since he had begun to read the *American Machinist* many changes had taken place in shops, tools and methods. Its pages had furnished a panorama of them. It would take volumes to enumerate them even. What is there that had not changed? About all that is left are the truths of natural philosophy and human nature.

A TYPE OF INVENTION

Many an inventor has devised a contrivance that has set at naught the laws of mechanics up to the point where it was necessary to run the thing, and many an expert has devised a system that would have been perfect if it had not been for the human nature that it had to deal with.

In the innumerable complications of mechanical varieties how many times have the simple elements been forgotten? In the intricasies of human activities how often has human nature been forgotten?

The mechanical device that displaces another one does it because it gives more to the world for what it receives than did the one that it displaces, or in other words it is more efficient. Of course, advertising and a skilled selling force may do wonders with a poor thing for a time; but the gas engine is here because it is cheaper than the steam engine, and the telephone is cheaper than message boys.

Is it possible that human success is founded on rendering the most service for what is received instead of on the ability to get the most for the services rendered?

Believing as he does, that the horror in Europe is primarily the result of wrong thinking, the "Old Man" regards this as a good time to try to think back to the first principles that were instilled in his mind at the time when he purchased the book on philosophy and was known as a boy.

The Bureau of Standards and the Machine Building Industry

AN INTERVIEW WITH DR. S. W. STRATTON, DIRECTOR

THE important work of the Bureau of Standards which, in many indirect ways, touches the machine building industry, is in many of its phases of such a fundamental character that its relation to the industry is not fully appreciated. The metallurgical researches of the Bureau, for example, involving investigation and standardization of bronzes and ferrous and non-ferrous alloys generally, relate to machine construction in very important ways. And yet, the nature of the Bureau's work is often such that it is intimately known only to the manufacturers' technical expert, metallurgists and chemists, who use the scientific publications of the Bureau in a number of the various details of their work.

Properties of particular alloys are ofttimes of the utmost importance in these industries. As an example may be mentioned the extremely low coefficient of expansion of the alloy "invar," a most valuable material, which is now almost universally used in the measuring tapes used in precise survey work. The employment of "invar" is frequently of great convenience in the construction of measuring machines, as for example, in the case of watches and clocks where the invar balance wheels and pendulums make compensation for temperature changes quite unnecessary.

Other important applications of expansion measurements are coming to be appreciated, as, for example, in the dimensioning of valve seats, pistons for gas machines, and other bearing surfaces where unusually close fitting is required. In the gas engine spark plug, for example, the expansion of the imbedded lead-wires relative to the porcelain which surrounds it, is a determining factor in the matter of cracking of the porcelains, which are closely related to the life and dependability of the spark plug.

CASTINGS AND MATERIALS GENERALLY

The importance of the pouring temperature on the quality of castings is such that the Bureau has undertaken an investigation to the end of determining the best pouring temperatures. If these values can be determined, a more uniform product will result and machine work can be undertaken with greater assurance and knowledge of the machineable properties of the materials. Similarly the presence of internal stresses in the cast metal affects the accuracy and permanence of the results of machining, for the removal of material often permits the release of such internal stresses to distort and deform the casting. This effect is now being exhaustively investigated at the Bureau, and important recommendations regarding the manufacture of certain bronzes have already resulted.

Much has been, and is being added daily, to the engineers' knowledge of the strength of materials by the work done in the materials testing laboratories of the Bureau of Standards. One of the most precise and best constructed testing machines anywhere employed for this work is available in these laboratories.

The question of design of screw threads and of establishing tolerances defining the measurement of screw threads is especially at this time under careful consideration by experts of the Bureau, who are working in coöperation with a committee on screw thread tolerances of the American Society of Mechanical Engineers. Closely related to this type of standardization is the work of the department of the Bureau which verifies the measurements of master gages used in the manufacture of munitions of all kinds, already mentioned in the columns of the *American Machinist*. This department is being enlarged and equipped with the best measuring apparatus obtainable, and is constructing, from time to time, such new and special instruments as are required by the development of the work.

THE MAKING OF OPTICAL GLASS

The successful manufacture of optical glass, which is so urgently needed in the manufacture of telescopes, range finders, binoculars, and military optical instruments of every sort, has recently resulted from the researches of the Bureau of Standards in this field. Optical glass of all grades is now being manufactured in fairly large quantities for direct use in the manufacture of material on War and Navy Department contracts. The ability to obtain optical glass in this country has had a distinct effect in stimulating the manufacture of the instruments in which this material is used. Around this development there will undoubtedly grow up an important industry, namely, the manufacture of precision scientific instruments of every sort in which, unfortunately, this country has in the past occupied a relatively unimportant place.

Important researches looking to the determination of the qualities of steel by magnetic measurements are showing high promise of important results, and it is believed that in the near future manufacturers of machine tools will find in this field of investigation a powerful aid in the examination and inspection of machines and tools.

One department of the Bureau is devoted exclusively to the testing and investigating of aëronautic instruments. Determination is made first of the suitability of new types of instruments for war-time production, and, second, of serviceability and accuracy of individual instruments submitted by manufacturers in fulfillment of contracts with the military departments. In this work the closest analysis is made of the sources of error in various types of instruments; new methods are devised for improving and simplifying construction and for employing the instruments in service in such a way as to enhance the accuracy of the results. In this laboratory a large collection of contemporaneous European instruments is maintained for examination and comparison and necessary information relating as well to the service application as to the mechanical construction of such instruments is continually collated by correspondence, and by visits to the manufacturers and to the aviation fields. The performance of instruments under actual flight conditions is also observed.

The following comprise the principal instruments under consideration by this department: Altitude measuring instruments, engine speed and air speed instruments, airplane pressure gages, inclinometers of various types, gasoline depth gages, bomb sights, mercurial barometers, weather and surveying aneroids, and sphygomanometers, including in any case both indicating and recording instruments.

STIMULATION OF INSTRUMENT MANUFACTURERS

The effect of the Bureau's study of this subject has already been to encourage and stimulate production in the lines of instrument manufacture. Particular instances of this kind are found in connection with aneroids, tachometers and similar instruments used on airplanes. The allied governments have generously provided photographs, drawings and samples of successful instruments to assist in the important work of aiding American manufacturers to produce these new, and to them unfamiliar, devices.

It is the earnest desire of all connected with the Bureau to have the manufacturers of this country realize that, while it is of necessity a highly scientific institution, its highest service must be in the advancement of the industries of the United States. New suggestions as to how it can be of real, practical service, and any problems concerning materials, measurments, and standardization that the machine builder may care to submit, are at all times welcomed.

Machining Adjusting Collars

BY F. P. TERRY

I have read the comments and description of improvements of your correspondent on page 297, referring to the interesting milling fixture described by me under the above heading on page 230, Vol. 46.

I admire Mr. Groocock's frankness in putting forward his ideas as suggested improvements to my own, also his candid admission that if had he the job to do then, and only then, would he test its claims. At the same time it would have been most interesting to know how he did the job fourteen years ago so that a comparison on output could be taken. Although somewhat apart from the question I cannot concur with his first principle of production, "to cut out all idle machine time," as I might find myself producing a hundred dollar milling jig to save fifty dollars in machining time, including all the idle time I could scrape together.

Before discussing Mr. Groocock's improvements I would like to point out that the objects aimed at and obtained with my device were a positive indexing and locking arrangement combined; the avoidance of damaged or spoiled work, should the operator accidently move two or even three spaces instead of one (this was particularly pointed out in the original description, it comes at the end of the description and a moment's study of the movement should calm the feelings of terror expressed by my critic in this direction); and also something that would produce the goods to give a profit to the firm that looks after my income.

THE QUESTION OF OUTPUT

To return to the feasibility of Mr. Groocock's suggestions. An identical arrangement was suggested, by an assistant, while mine was in progress, but was promptly turned down by me because we had no motor at hand suitable to do the work. This point will be best understood by a moment's consideration of my critic's suggested output of 100 per hour. This entails loading and unloading twelve and a half times; lifting the platform, eight wormwheels, eight screws, eight collars, and indexing eighty-seven and a half times, which means "going some," not to mention the cutters, which have to jump across a like number of times while the operator rests himself, all in an hour. This must be kept up the whole ten hours if the promised output is maintained, and it is evident that some sort of double-acting automatic reversible motor timed to the moment would be necessary.

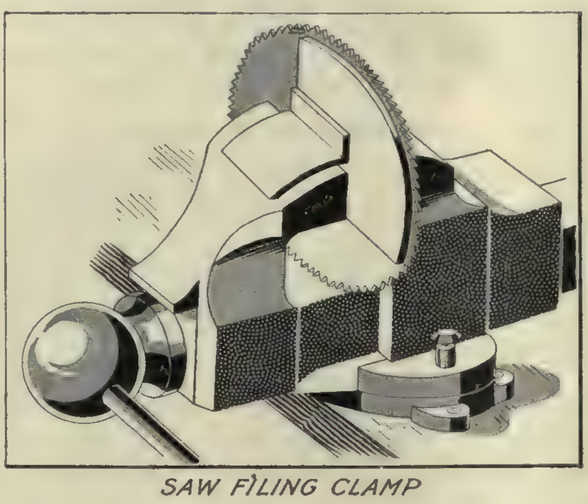
Another strong point in jig and fixture design, which Mr. Groocock evidently forgets, is rigidity. This is particularly true if dealing with milling cutters which are to operate with speed and accuracy. In the device shown eight wormwheels are left to backlash, eight vertical screws to wobble, and a pendulum to swing. Consequently, a good deal of buck-jumping is likely to be displayed by the cutters, and probably very few collars would be found to have slots complying with the limits of accuracy laid down by the war office, even if ordinary everyday feeds were used instead of the eighty-seven and a half seven-inch cuts per hour necessary for the output given.

MULTIPLE OPERATION

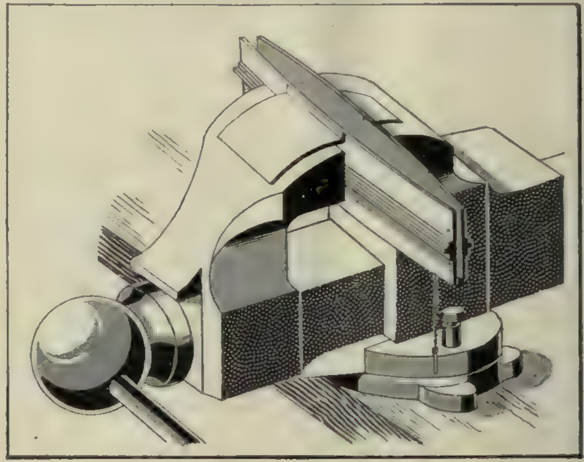
Mr. Groocock's ideas on "the stringing of a lot of pieces one behind the other as something satisfactory only to the uninitiated," must get a lot of us machine-shop men "in the neck." Personally, I am wondering why we go hunting through the advertising columns of this journal for milling machines with tables eight or ten feet long and continuous type milling machines, if to string a lot of things one behind the other is a matter for the wise machine shop man to shun, instead of spending our time looking for some "illigant divil" of a machine that drives the cutters through mild steel at a feed of ten and one-half in. per min. all during a day's work. Twelve hundredweight of collars are handled twice, 1000 screws are locked and unlocked, and a worm that turns 875 times and a like number of quick returns have to come in somewhere even if they do come in too quick to be seen.

From a Small-Shop Notebook

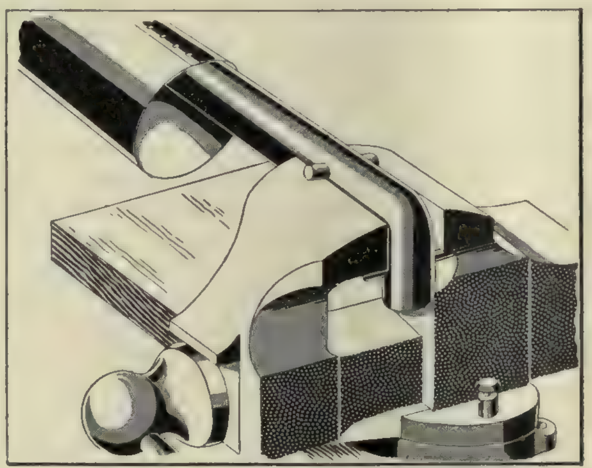
BY J. A. LUCAS



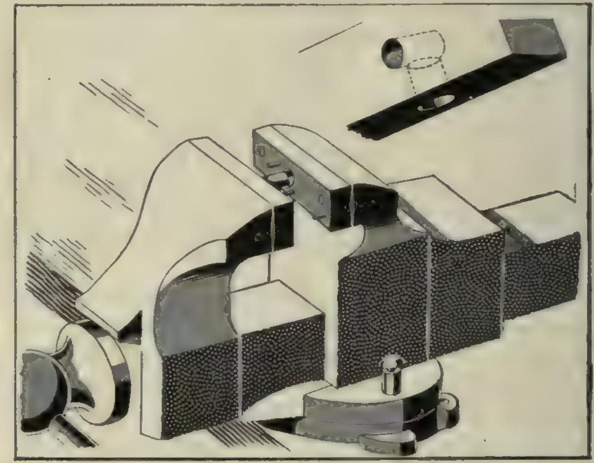
SAW FILING CLAMP



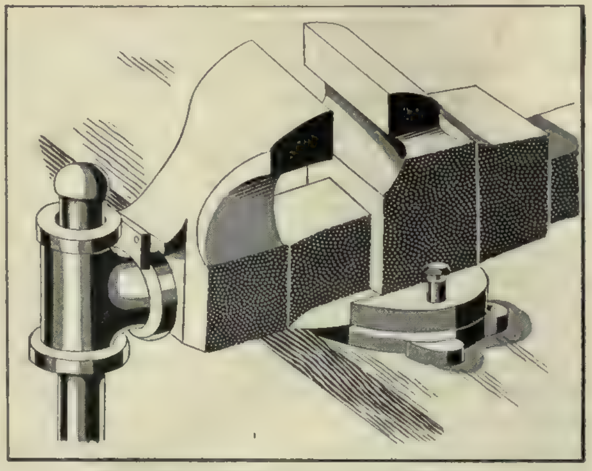
SHEET METAL FILING CLAMP



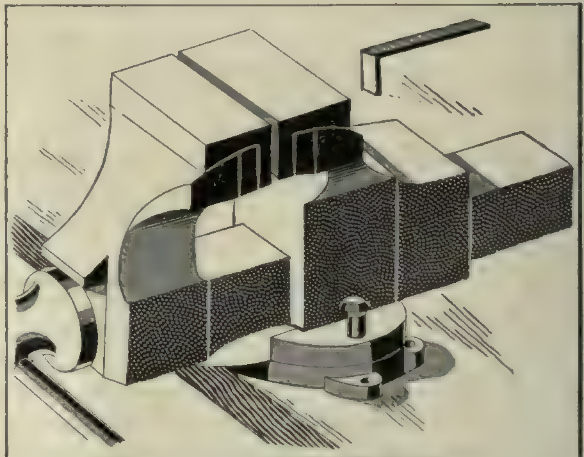
PIPE RIVETING HORN



LIGHT METAL PUNCHING FIXTURE

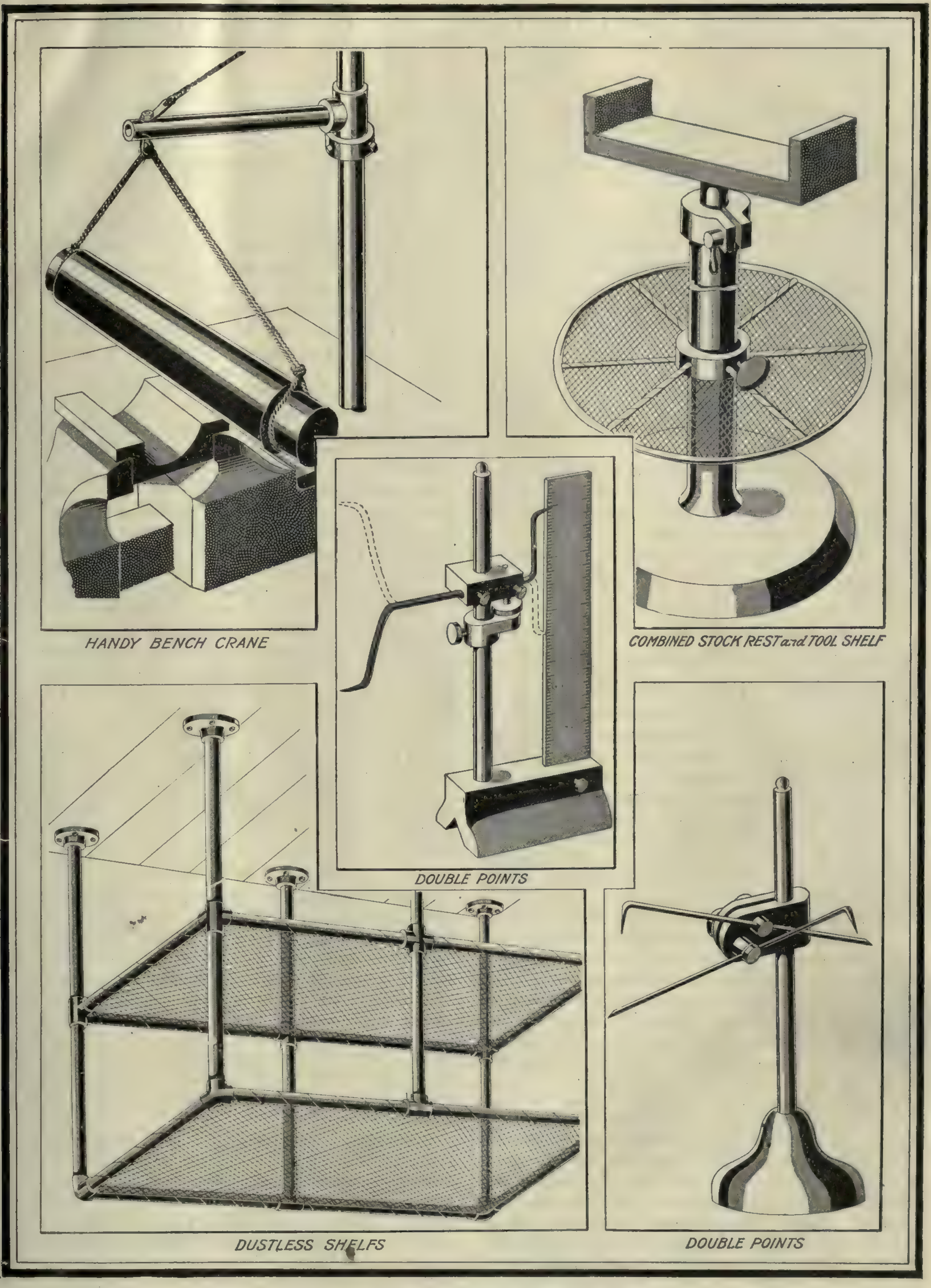


TEMPORARY SCREW REPAIR



FALSE JAWS FOR BENDING SHARP ANGLES

A NUMBER OF HANDY VISE KINKS



HANDY BENCH CRANE

COMBINED STOCK REST and TOOL SHELF

DOUBLE POINTS

DUSTLESS SHELFS

DOUBLE POINTS

SEVERAL USEFUL DEVICES FOR THE SHOP

Drafting Mechanics for War Purposes

By JOHN A. HONEGER
Service Engineering Co., 116 W. 39th St., N. Y.

IT SEEMS as though the members of our draft boards are obsessed with but one idea, and that is to get the required quotas for the New National Army, regardless as to what extent they disorganize the mechanical field.

This is a bold statement to make, nevertheless, it is true. The writer has been out "on a still hunt" as you might say, and had occasion to experience the workings of these boards in regard to the exemption of men in the mechanical field, 99 per cent. of which are engaged directly or indirectly on products required by our War Department.

From what the writer has experienced, industrial claims are not worth a "hill of beans," and it is a waste of time and money to file them, because conservatively speaking, about 20 per cent. of all claims filed are granted, and out of this number but few mechanical men are released.

With all due respect to the men deciding these claims, it must be admitted that regardless of a mechanic's ability or experience, he is denied exemption if not employed directly by the Government.

A little incident that happened not so long ago will better illustrate the facts the writer is trying to drive home.

One Incident

When the war broke out between our country and Germany, there was a tool designer working for an allied government, young in years but mature in experience, who thought he could help Uncle Sam a bit by offering his services to the Government. With this idea in mind he addressed a letter to the proper officials at Washington stating just what he could do. While awaiting a reply he continued working in his former position. In about a month's time he received a letter and application from the Public Service Reserve, the letter requesting him to fill out the application. Having filled out the application, he enclosed a second letter asking them to at least give him a chance to show what he could do. In the meanwhile registration day came and he registered as all good citizens should have done. Then came that great day of selection. About this time the young man became impatient, and taking matters into his own hands he wrote to the Chief of the Ordnance Department. A week later he received a letter from the Ordnance Department, and an application for the Ordnance Officer's Reserve Corps, the letter stating that they thought it would be best for him to come to Washington and talk the matter over before filing the application. Two days previous to this he received notice to appear at the local board for examination. He appeared, was examined and passed. He then filed claims for exemption on industrial grounds and following this, he took a train for Washington staying there three days at his own expense. He received an audience from an official in the Ordnance Department, and would have received a commission as a first lieutenant, but he was only 25 years of age. The official, however, informed him that a bill was pending in Congress for second lieutenant, and as soon as this bill passed he could apply for it, which would be in about three weeks. In the meanwhile, the official informed him that he could try the inspection department. Having a dogged determination to help out he tried the inspection department. The official here in charge, after hearing the young man's story, told him that the best thing for him to do was to apply at some of the arsenals. He wrote to several of them, and received answers to the effect that they could use skilled laborers in the shop. Before receiving the above answers he was informed that his claim on industrial grounds had been denied. Following the proper steps as required by law, he appealed his case to the President. The following week he received a letter from the Ordnance Department informing him of vacancies in the drafting-room at Washington which were open only to exempted men. To crown the whole affair the young man received his red ticket and was drafted into the army.

Some may get the impression that this young man was trying to "beat the game" as you might say. No, he was not trying to do that. This young man loved his profession, and sincerely believed that he could be many times more valuable to Uncle Sam at that profession than he could be at the front. If this young man had been allowed to continue in his profession, he would have without a doubt designed sufficient tools, or inspected that many more rifles or guns, or whatever it may have been, and Uncle Sam would have licked the Kaiser that much more. But, as matters now stand, Uncle Sam will have to wait so much longer for those products, and in addition he will have to train that young man all over again, taking about 4 to 6 months. Not only that, but all those days, weeks, months, yes, years, that young man spent in constant study and applied concentrated thought, will be of no available use to him now.

Many More Such Cases

Multiply this case by the many hundreds; yes, the many thousands of similar cases, and stretch your imagination into the future, and you will then picture for yourself the after-effects on the mechanical field, not only in private plants, but also in the Government plants. The effect may not be immediate, but it will be like an endless chain with a dozen or more links removed; a time will come when those dozen links will be of a deciding factor in the continuation of that chain, and if they cannot be found and neither replaced, you can draw your own conclusion as to what will happen to that chain.

There have been three or four links removed to date, and from present indications the draft boards will remove a great many more unless they are taught to see that these links are of a vital necessity in keeping up the production of the country, and thus supplying our soldiers with what they need most and plenty of it: namely, equipment.

To those who doubt the seriousness of this situation, the writer would suggest that they investigate a little on their own initiative, and he is quite sure that they will not be required to go very far before they realize that what he states here is not mere talk.

Of all the technical journals with which the writer has come in contact with, a great majority of them carry dozens of advertisements and notices for designers, toolmakers and gagemakers, inspectors, etc., not only from some of the largest concerns in the country, but from the Government also.

Does not this prove the scarcity of men? And if it does, why should the men in this field be compelled to leave it?

This war is a war of machinery and production, and unless this is realized and brought to the attention of the Government, this war is going to cost us dearly.

If the production of parts are under normal requirements now, what will the production be in six months from now if the same ruling is still in effect?

Proper Placing of Men

The writer does not wish to give the impression that men in the mechanical field should be exempted; this would not be fair to men outside of this field. However, he does advocate that the men in this field be mobilized into a large army, and sent throughout the country to speed up production and keep it there under the direction of the Government.

The seriousness of this situation can best be understood by reading about the trials that England and France had gone through before they woke up to the realization that, although they had more men in the army than Germany, they had less equipment, and where Germany had their mechanics behind the firing lines, England and France had them in the firing line, and they lost so many skilled men that in the early part of the war they had to fall back on us for their supplies. It was then that they realized their mistake, and with all haste started to recall their mechanics, but very few of them returned, and those who did return were of no use as their systems both physically and mentally, after going through those first weeks of war, were in such a state of wreckage, that it was impossible for them to ever attain the sensitive touch, and the quick deciding and concentrated mind that is so essential to every mechanic.

Lesson of England and France

This taught England and France the value of their mechanical men, but it was a costly lesson; costly, not only in the constructive lives lost, but in the retarding of all their supplies. In years to come they will see in a much clearer state the value of these men, whom they allowed to lay down their lives.

From the day of awakening on all men, who so much as understood only a lathe, were kept from either enlisting, or from being drafted into the army by the restricted trade-law, which was rushed through the proper tribunals and became an effective law immediately afterward.

Must this country also have as costly a lesson in order to realize the seriousness of this situation, or will we realize it beforehand, and make provisions for just such an emergency? For remember, we have no other country to fall back on as England and France had.

In closing, the writer wishes to take up one other point in regard to this situation, that of helping our allies to obtain their supplies. Time and again the writer has read editorial articles of how we are helping, or are going to help, our allies to obtain their supplies, yet in reality we are not helping but are hindering them a great deal in an indirect way. To prove this statement the writer will relate an incident in which he is involved, and thus knows from first-hand information that the statement is true.

The work the writer is engaged in plays a very important part in the campaign of an allied government, and therefore cannot be mentioned, but it is of great importance to that government.

Within the last month, four of the best men have been drafted into the army, and the writer himself expects to be drafted within the next few days, although, claim for exemption has been filed by representatives of the allied government. Does not this prove that the statement made by the writer is correct?

The old and often repeated maxim: "A stitch in time saves nine," is one which applies itself to this situation very satisfactorily. However, the nine stitches cannot be saved if little or no attention is given to the first stitch.

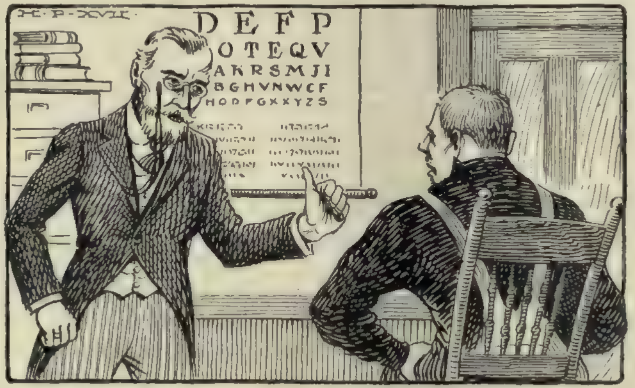
It is with the idea in mind of getting that first stitch started that the writer has given his last few days as one of the mechanical fraternity to the writing of this article, and thus drawing the attention of the whole mechanical fraternity of the country to a situation which, heretofore, has been given very little attention. If in doing so the writer has in anyway helped to start that stitch he will feel well repayed for the time spent.

Letters from Jack to Bill—Copper Pipes and Other Things

Deer Bill—This shure is a bully jobb, just laik I rote you, awl but wat I toald you abowt befoar, the kidin. I thingk wen a man asts a qweschun wantin to no sumthin we awl ort to bee wilin to lurn him doant you Bill. Now just today a man was wotchin em boarin out a silindr and he asts me wat the cowntrboar was for and I toald him gladly how it is to giv the oil a plaice to stay in so it wunt awl be blone upp the stak and he was man enuf to thangk me two. But verry ofn wen I asts a qweschun I gits a foole anser but not awlwis. I went in ware thay maik the lektristy to run the masheens and the lites and I sor a gaij laik a clok and ast the man and he toald me just laik a man ort to that it shode the presher of the lektristy and it sed 5 hunderd and fiffty pounds and I sed I would thingk it wood bust things and he was kined and eksplaned how they has saifty valvs so it can blo owt into the air wen it gits two hie. Now thats a good man I thingk but I ast anuther man wy the litl copr paips the lektristy cums in to the masheens and lites doant bust and he sais thay aint holler you goat. And I no betr for on a loakmotiv is a copr paip runin in undr the biler jakkit to a thing on the silindr that I spose is a sparrk plugg and Ive saw the hoal into it. How do thay maik sutch long hoals Bill? I aint nevr saw em dril nun so I doant no.

And I ast anuther man wat becaim of the drip wen the lektristy gits coald in the paips laik steem has pet koks too let it out but I aint sean nun on the lektristy paips and he sais thay doant nead nun for that stuf doant condents. I doant no wat condents meens do you Bill but I no the lektristy has too be kept worm or wy wood the paips for it awl be cuvverd with that cloth-lookin stuf. And anothur man toald me you carnt see lektristy and rite befoar his Is was the bolb oavr a masheen and he cood sea the lektristy shainin into it. He must thingk Ime a foole. And you can feal the stuf two Bill and Ile tel you how I no. I has to ware a pare of specs in the shopp and thats the oanly peece of tirany Ive saw hear. Wel, I had to taik the senter out of a laith and wen I was bangin it out with the poosh rod my specs fraim hit a swich thing on the hed end of the laith and I sor lektristy and fellt it two. It nokd me doun and the senter was in my rite hand and it flue and hit a man in his chesst, no not his toole chesst Bill, but the chesst of his boddy ware he keaps his lungs and livvers and sutch.

And Ile tel you abowt the specs tirany. Awl of we felers in the shopp had too git our Is testid and the testin gazabo sais three ¼s of awl we men neads specs and I no thair doant no three ¼s of me, no nur wun ¼ nead em but he setts me in a chare and sais how menny of them letrs on the charrt can you reed? and I sais I carnt reed nun and he sais dident you evr lurn to reed and hes a litl man and I sais mebbe betr than wat you can but no man carnt reed that stuf for its laik D E F P O T E Q and doant spel no Yunited staits wurds. And he sais wel, you shurely are just wat the bos toald me and I doubls up my fissts and sais feerce-like wat. And he sais o a skild mecannik and I sais thats so and he got me sum specs and the shopp dokd $4 out of my pay and if that isent plewtocratik tirany wat is? And too men wat had purfkly good specs bort offen a 5 and ten sent stoar the specs gink maid em by new wuns, moar tirany Bill but its a good shopp and Ime drorin down good munny moar than evr befoar.


H-P-XVII
D E F P
O T E Q V
A K R S M J I
B G H V N W C F
H O D P G X X Y Z S

NO MAN CARNT READ THAT STUFF FOR ITS LIKE D-E F-P-O-T-E-Q AND DONT SPEL NO YUNITED STAITS WURDS.

And a oald man wat noes a lot I ast him how thay maik the long hoals in the copr paips and he sais thay taik a hungk of copr as bigg as a flowr baril and dril a hoal then dror it owt long and the copr stretshes and the hoal two. Do you bleev it Bill? And I coodent reely trie it becaws I dident hav no copr with no hoal in it but I took a peece of copr wier the biggniss of a led pennsil and hichd one end to a laith dogg and wownd it sum arownd the jobb in the laith and the uther end I hichd to a step ladr and then started the laith. And the copr dident stretsh mutch but puld oavr the ladr and the gink wat was on top of it sed I maid him fawl and I sed he lide and the foarman sais no fitein hear but the ladr gazabo he isent a verry big man and me and too frends are goin to taik a wawk the furst plezent eavnin and trie to meat that gink and weel lik the tar owt of him.

Rite me abowt the long hoals Bill for I want to no awl I can. **JACK.**

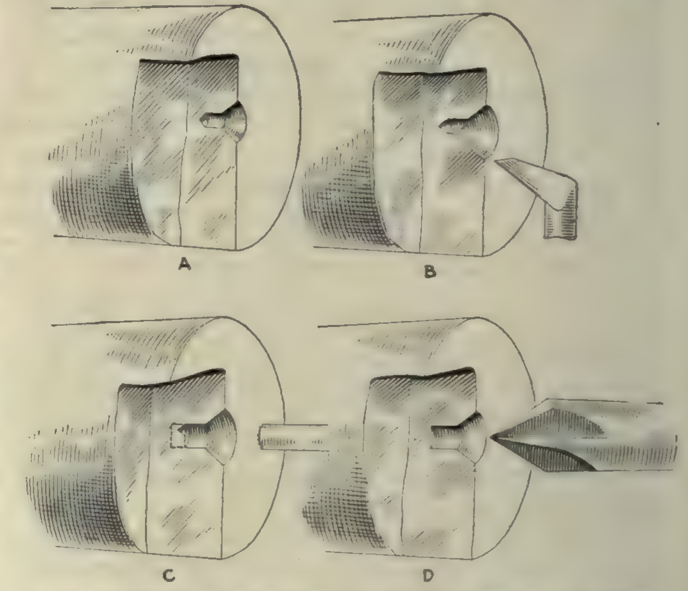
PS—Bill the specs gink wen I toald him my Is was O.K. he sais the mane trubl with you is serebral defishuncy. I wrote them wurds doun as soon as I got shut of him. Wat do thay meen Bill? Wil it perteck me from beein drafted?

Correcting Untrue Center Holes

BY GEORGE H. STAUFFER

I was given a job, one day, of turning down the end of a shaft to receive a gear. After swinging the shaft up on lathe centers, I found that the center holes had been drilled and reamed nearly $\frac{1}{32}$ in. off the geometrical center, as shown at *A*. There was but one remedy, and that was to correct the position of the center holes. The following method was successfully employed in doing this:

One end of the shaft was gripped in a chuck having four independent jaws; the other end was held in the steadyrest. The shaft was trued up nicely. A center-finding tool *B*, with one cutting edge, was placed in the toolpost, and with it a conical hole greater than 60 deg. was machined in the end of the shaft, as shown. Next, a half-round reamer *C*, having its cutting edge on the front end only and a diameter greater than the diameter of the conical hole at the point where the drilled hole breaks through, was made from drill rod. When ready, it was placed in a drill chuck and fed into the end of the shaft, by using the tailstock. Finally, the conical hole was brought to the proper angle by reaming with a standard center reamer *D*. The shaft was then removed, turned end for end, and the same operations performed.



METHOD OF CORRECTING UNTRUE CENTER HOLES

Fluework in a Railroad Shop

SPECIAL CORRESPONDENCE

In railroad repair shops, where locomotives are handled, flue work is one of the important operations. This article shows the practice of a Western shop for carrying on this work.

THE engravings herewith illustrate some of the methods and equipment used in connection with fluework at the Southern Pacific shops at Sparks, Nev. In Figs. 1 and 2 are views of the flue-tumbling apparatus located just outside the shop building. It consists of a perforated cylinder long enough to receive the tubes and provided at the end next the shop wall with power driving mechanism for rotating the cylinder upon its journals. At one side, as shown in Fig. 2, there is a longitudinal opening extending the full length of the cylinder to admit the tubes, which are hauled up on a car on the inclined track to a point directly in front of the cylinder. At the rear there is a series of inclined rails upon which the tubes fall when the cylinder is opened for their discharge. Down these rails the tubes roll onto a car placed on the track below, as shown by Fig. 1. This track leads directly into the building, so the tubes are readily handled between tumbler and shop.

In Fig. 3 are shown a lot of tubes in the shop, stacked up on a sloping rack immediately behind the swaging machines. Figs. 4 and 5 illustrate the roll swager and the pneumatically operated dies for the tube ends. The front view, Fig. 4, shows a tube just withdrawn from the oil-fired heating furnace at the left and placed in the roll swager at the center of the illustration. At the right is the air-operated swaging die. A better view of this is given in Fig. 5, with a tube in place for working under the dies.

The machine consists of a short-stroke cylinder and piston placed in inverted position in a framework built up of a top plate, pipe and through bolts on an old machine bed. The air pipes may be seen at the right-hand side of the structure. The machine is controlled by pressure of the foot upon a lever near the floor, so that the operator has both hands free to move the tube

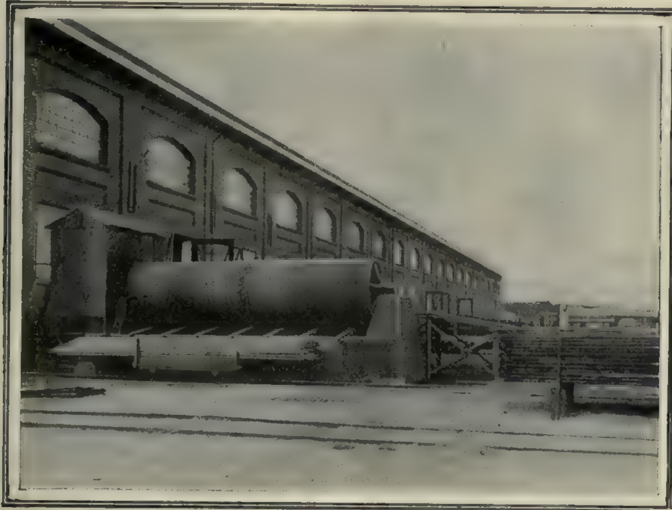


FIG. 1. TUMBLING APPARATUS FOR TUBES

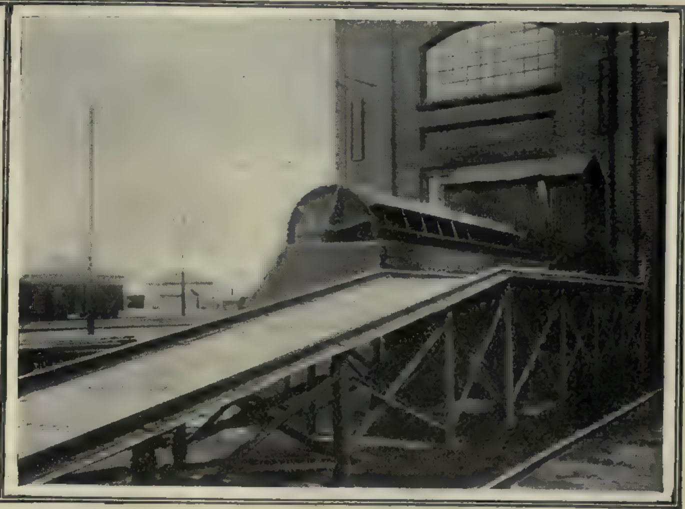


FIG. 2. LOADING SIDE OF TUMBLING APPARATUS

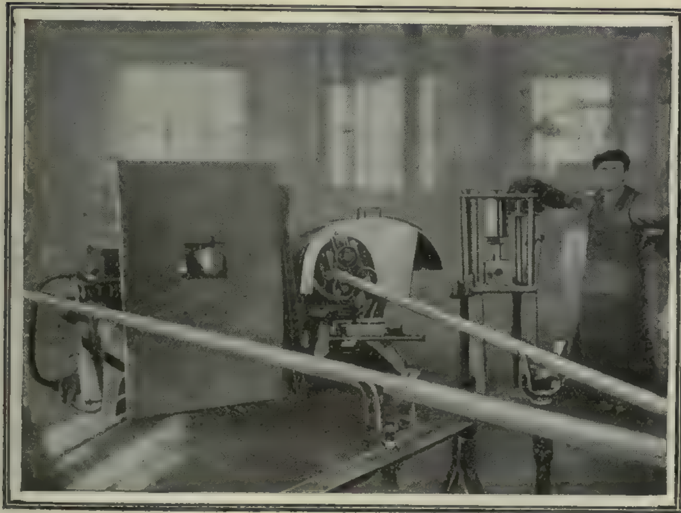


FIG. 4. HEATER AND SWAGERS

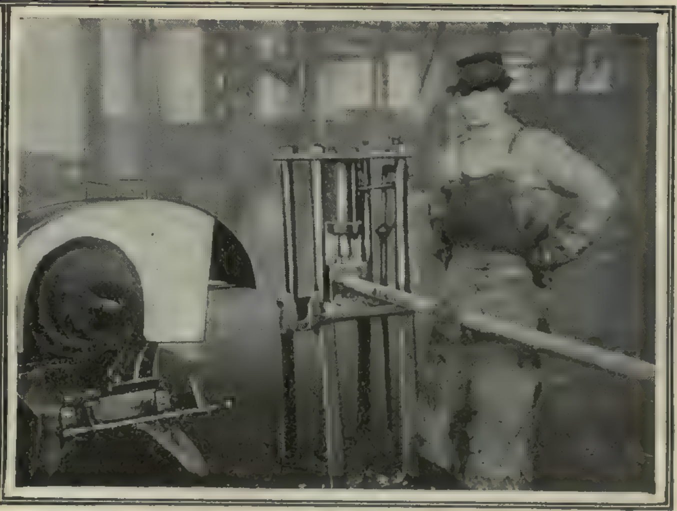


FIG. 5. A TUBE IN THE SWAGING DIES

about under the dies as is required for the operation. The machine in Fig. 6 is for trimming the tubes to length. It is another home-made device built up on a long bed with supporting rollers at each end to receive the tube and hold it in horizontal position for the application of the trimming knife, which is a revolving disk about 6 in. in diameter. This disk is mounted upon the end of a spindle that is gear driven from an electric motor at the rear end of the head, as indicated in the engraving. The lever for forcing the cutting or trimming disk into the tube is at the top of the machine with the handle bent forward to convenient position for the operator.

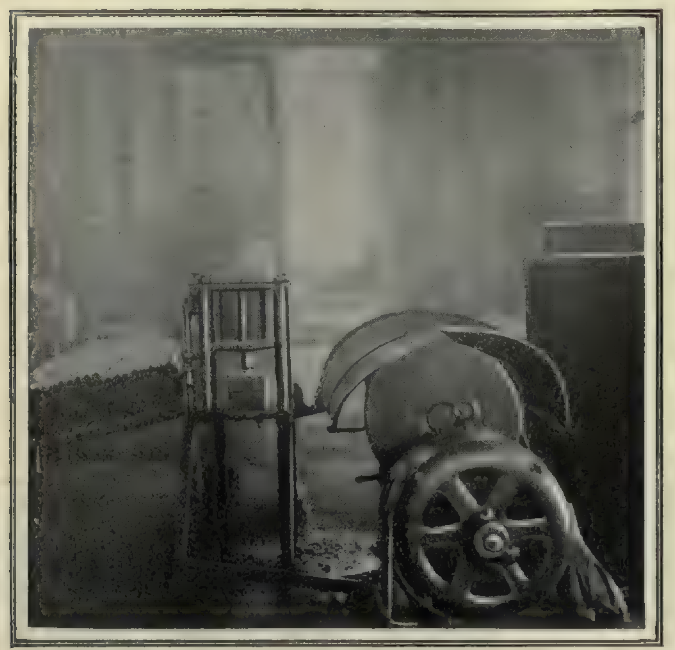


FIG. 3. FLUE-SWAGING EQUIPMENT

In Fig. 7 is shown the apparatus for testing the tubes under water pressure. The outer end of the tube rests against a closing gasket on a fixture adjustably mounted upon the long bed of the machine. The other end is closed by a packing ring in the cylinder head. Water is admitted by the valve near the operator's hand. The tubes as tested are placed upon the skeleton truck, which will be seen immediately behind the workman. This holds a large number of tubes and is of such form and weight as to be easily moved about with a full load of tubes. It is one of a number of very handy appliances for handling work of various kinds about different departments in this plant.

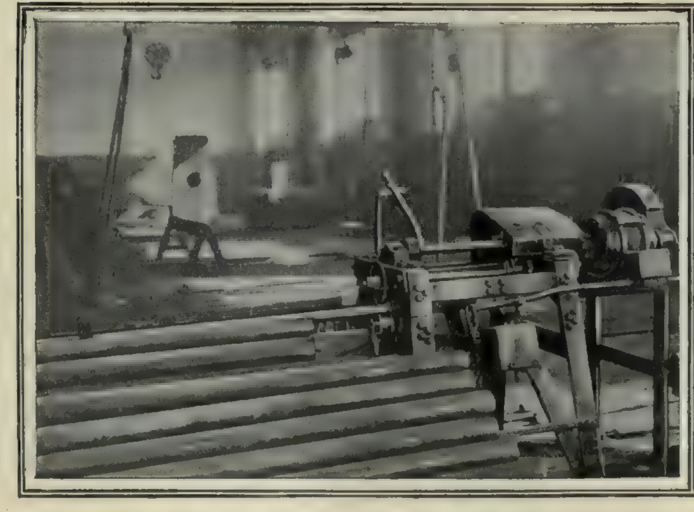


FIG. 6. TRIMMING MACHINE

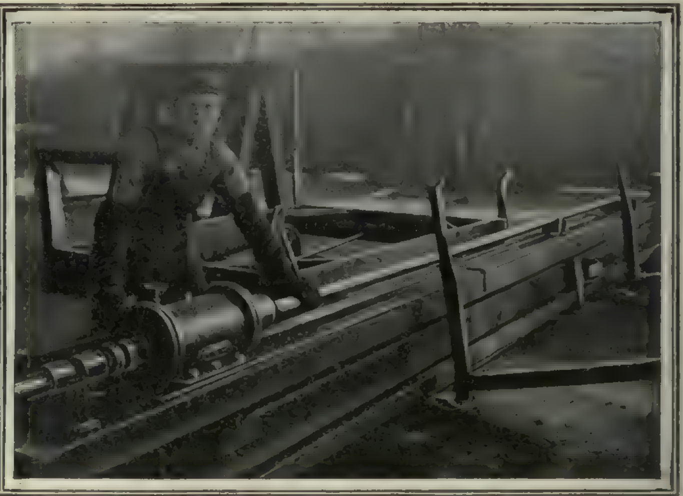


FIG. 7. TESTING APPARATUS

Civil Service Examinations

The United States Civil Service Commission announces open competitive examinations, as follows:

List No. 1. Examinations of the nonassembled type; that is, those in which competitors are not assembled for an examination, but are rated upon the subjects of education and training and experience and corroborative evidence. Applications for the following are received at any time: Inspector of artillery ammunition, clerk qualified in business administration, assistant inspector of cannon forgings, assistant inspector of finished machine parts, and gage designer, War Department, and finger-print classifier, War Department and Navy Department.

List No. 2. Examinations of the nonassembled type, for which applications must be filed by the dates specified: Specialist in agricultural education, Bureau of Education, Department of the Interior, Dec. 4; special agents for agricultural education, home economics education, trade or industrial education, Federal Board for Vocational Education, Dec. 4; inspector of stoves and ranges, Quartermaster Corps, Jeffersonville, Ind., Dec. 4; vehicle engineer, Signal Service, New York, N. Y., Dec. 4; pressman on offset presses, Bureau of Engraving and Printing, etc., Dec. 11.

List No. 3. Examinations in which competitors will be assembled for scholastic tests: Interpreter qualified in Spanish, Immigration Service (examination at El Paso, Tex., only), Nov. 21; bookbinder, Government Printing Office, Dec. 5; laboratory aid, Hygienic Laboratory, Dec. 5; lithographer. Hydrographic Office, Dec. 5. Full information and application blanks may be obtained by addressing the U. S. Civil Service Commission at Washington, D. C., or the civil service district secretary at Boston, New York, Philadelphia, Atlanta, Cincinnati, Chicago, St. Paul, St. Louis, New Orleans, Seattle, or San Francisco.

Economy of Tight Air Hose Connections

BY GLENN B. HARRIS

This article points out the frequent occurrence of costly leaks in air lines and hose, and recommends a number of remedies to prevent the costly waste of power.

IN THE use of compressed air it is essential that tight joints be maintained, not only throughout the pipe line, but at all hose connections on the latter, and the connections between the hose and the tools being operated. This is necessary not only that the tools receive air in proper volume and pressure for their efficient operation, especially where compressor capacity is deficient, but also as an economic proposition of no small magnitude.

When it is taken into consideration that 5 cu.ft. of compressed air at 80-lb. pressure will flow through a $\frac{1}{16}$-in. opening in one minute, and that it requires one horsepower for the production of the amount of air named at the pressure given, the expediency of conserving the air supply in all ways possible is self-apparent.

In some plants attention is given to this feature of economy, while in others it remains uncared for, and absolutely neglected.

Pneumatic tools, as a rule, are operated by unskilled labor who know nothing of compressed air, except that it makes their machine go. They know nothing of its cost of production, and care less. If there is a leak present at their machine, they make no effort to prevent it, nor trouble to report it.

In small shops where the number of tools in operation is comparatively few, the foreman should make it a part of his daily duties to inspect all hose and hose connections, and also the iron pipe line to ascertain as to their tightness. Frequently the globe valve on the iron pipe line is not tightly turned down to its seat, then too, grit or scale may be present to prevent the proper seating of the valve, or the valve itself may be leaky. Any of these causes contribute to unnecessary waste of air, and as shown this unnecessary waste is an expensive proposition, especially in large plants, where hundreds of pneumatic tools are in operation, and practically miles of piping employed in order that the tools may be utilized at convenient points.

In most plants, where a very large number of pneumatic tools are employed, it is usual to detail one man whose sole duty it is to inspect the pipe lines, valves, hose and hose connections and couplings to see that leaks are not present, and if so to immediately give them proper attention. This should be the practice in all plants of any considerable size. The expenditure for this inspection may seem an unnecessary one, but it will be found a paying proposition in the long run.

LOOKING FOR LEAKS

A leak at the joints can be readily ascertained by applying a torch, or by the application of a small quantity of water, which latter will of course bubble if there is an escapement of air.

In looking for leaks at the tool end, the tool should be stopped by closing its own throttle. The leak if present will be readily apparent by the sound of the escaping air, although probably the surest means which can be employed are the torch or water.

If leaks are located in the hose lines it will prove profitable to immediately cut out the leaky portion and couple up by means of pipe nipples. If the hose becomes worn or leaky to the extent that a number of connections are required, it will prove economical to dispose of the leaky section or sections.

A first-class quality of hose and rubber tubing should be employed, while it may be expensive in first cost, it will prove cheaper in the end than hose purchased at a low price. The latter as a rule will develop leaks in a brief period of time, and will quickly rot out under weather conditions. In addition to this it is so loosely put together, and the materials employed are of such poor quality, that it will not withstand the air pressure of from 80 to 100 lb. per sq.in., at which pressures pneumatic tools are most generally operated.

THE QUALITY TO USE

As before stated, the hose and tubing should be of first-class quality, and the long sections should be wound with galvanized wire, which will serve as an efficient protection against abrasion or cutting in dragging around the shop or yard. It should be at least six-ply, and the tubing which connects the tool with the long length of hose should be oilproof on its interior surface as the lubricant is usually introduced to the tool through this short section of tubing.

If a poor quality of hose or tubing is used it will hardly be possible to obtain the best results from the pneumatic tools. Delays will occur due to the periodic closing of the ports by the accumulation of rubber in the air passages.

It requires an expert to detect the difference between good and poor hose, and even the best of it undergoes a continuous deterioration in value.

The short section of rubber tubing is employed in order that flexibility of the tool may be obtained, and as much weight as possible removed from the operator. This short section of tubing remains, so to speak, a fixed part of the tool to which it is connected.

THE COUPLINGS

In order that the connection between the tubing and hose may be expeditiously and tightly made various types of quick-acting couplings have been placed on the market. Several of these possess merit in a considerable degree, and can be used to great advantage.

One of the most efficient couplings which ever came to the writer's notice was in use in a large shipyard located on one of the Great Lakes. This coupling was somewhat cumbersome and heavy, and these two drawbacks in connection with its expense, seriously militated against its more general introduction, notwithstanding its great merit.

The coupling referred to consisted of two sections, male and female, designed to be screwed together. These sections were placed on the hose and tubing, and expanding nipples were forced into the ends of the latter to a point where the rubber would project about ⅛ in. The distention of the hose and tubing, as a result of forcing the nipples to place, prevented the hose or tubing from drawing out of its respective section. When the coupling was connected up, the ends of the hose and tubing abutted, and when the coupling was tightened the rubber ends spread, and an absolutely perfect seal was effected. In making an examination not even the slightest leak in more than three hundred couplings could be discovered.

AUTOMATIC VALVES

To add to the efficiency of their air system, the branches of the main pipe line were equipped at suitable intervals with what might be termed automatic valves. These valves were so constructed that when the nipple on the end of a hose section was screwed to place the valve was opened, and air permitted a free and untrameled passage, and when the nipple was unscrewed a short distance or removed entirely the valve automatically closed. This permitted cutting off air to the hose line without detaching the latter, and also prevented leakage through inadvertence in not properly turning down the valve to its seat. The advantages gained by the use of the couplings and connections described amply repaid for any increased cost of installation.

There are a number of very efficient couplings to be had and at a small cost. Any of the well-known manufacturers of pneumatic tools is in position to furnish a coupling which will prove entirely satisfactory in use.

DIFFERENT TYPES OF COUPLINGS

It is not the intention of the writer to differentiate between these couplings so far as merit is concerned, but only to briefly refer to their construction, and operation and to present the advantages claimed for them.

One of the most efficient couplings has had a wide and extended sale, and seems to meet all requirements. These couplings are interchangeable one with the other in sizes from ¼ in. to ¾ in., inclusive, while sizes 1 in. and 1¼ in. interchange. These couplings are almost instantly connected and should be air-tight under all reasonable pressures.

Another coupling is extremely ingenious in its construction, and is universal in all respects, neither half is male or female, but a combination of both, which permits a ¼-in. hose to be coupled to a 1-in. pipe, and ½-in. hose to 1-in. hose. In other words any size will couple to any other size whether it be larger or smaller. The gaskets are so placed in the two halves of the coupling that it is impossible for them to drop or be blown out when disconnected.

There is also another coupling like the two couplings previously mentioned which is adapted for universal use, that is hose of ¾ in. diameter may be connected with hose up to 1 in. diameter, and this without any reducing. It only requires a third turn of the hose to effect a union. Like the other couplings, leaky joints are hardly possible.

The couplings referred to are all light in weight, and offer no detrimental obstructions, in fact this feature is one that has been worked out so far as could be with good results.

Another very essential point in the conservation of compressed air, is that where the nipple enters the hose or tubing, great care should be exercised to see that the nipple is tightly secured in place. It proves expensive, if a riveting gang of three men is stopped at their work while a nipple which has blown out is being replaced, and especially so if the blowing out occurs at the time a rivet is only partially driven. The nipple should have a grooved, or cut, face in order that the hose may sink into these grooves, or cuts, and thus be firmly held by the wire band or clamp, whichever may be employed.

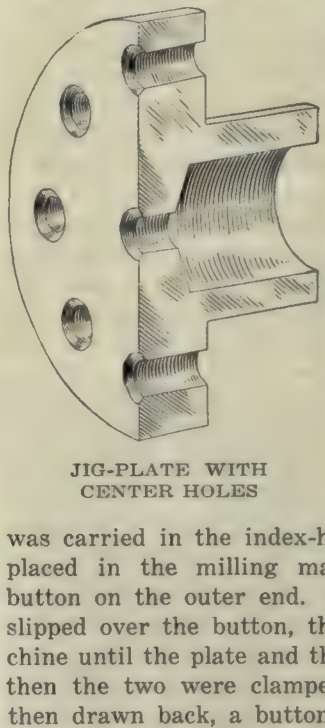
If attention is given to the saving of air through maintaining tight connections at all points, the compressor capacity is not only increased, but the coal bill is considerably diminished.

Using a Jig Plate To Locate Buttons

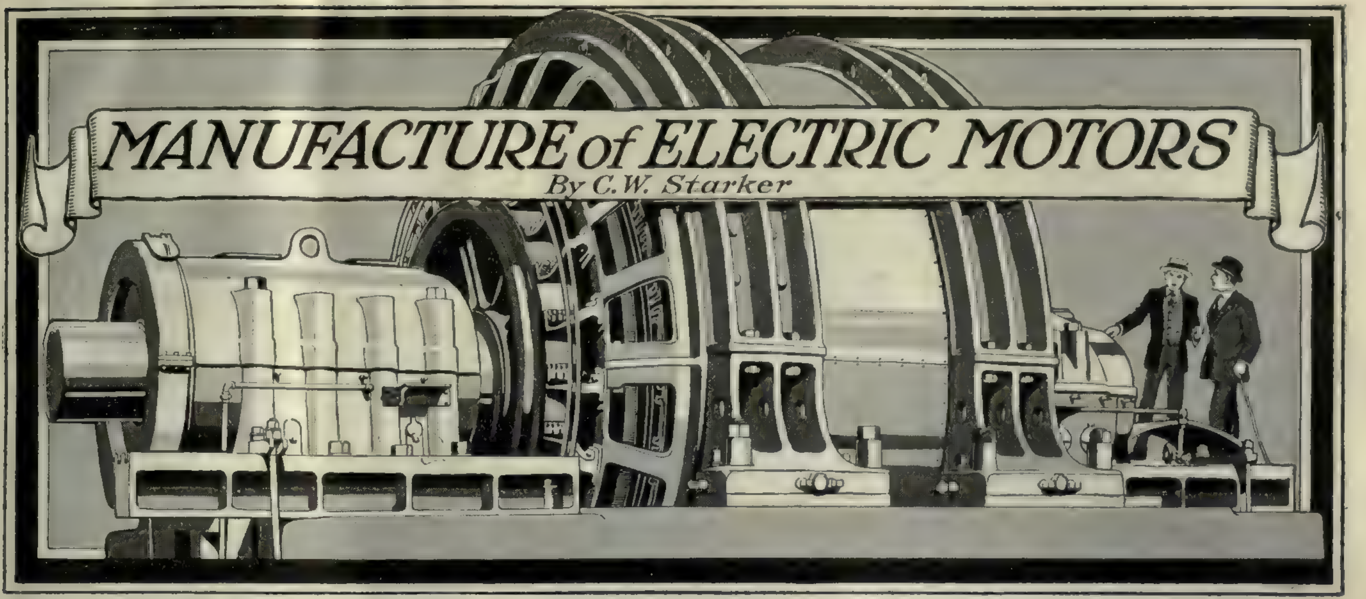
BY H. R. SELBY

The writer has seen a number of articles lately on jig plates and wishes to contribute his latest experience with them.

The job consisted of a plate, as shown, about 4 in. in diameter by 1 in. thick, in which it was required to locate nine ¼-in. holes, counterbored at an angle of 60 deg., to be used as centers in turning an eight-throw crank. One of the holes was located in the center, the others being equally spaced and equidistant from the center. The required holes were laid out, drilled and tapped to receive buttons. The jig plate was made from a piece of cold-rolled steel ½ x ⅝ x 3 in. The hole was bored square with the sides and 0.4002 in. in diameter. The index head was then mounted on the milling-machine table, and the spindle was made to run true with the milling machine. The work was carried in the index-head chuck. A test bar was placed in the milling machine with a true-running button on the outer end. The jig plate was carefully slipped over the button, the table run toward the machine until the plate and the work came in contact, and then the two were clamped together. The table was then drawn back, a button was placed in the hole and screwed down, and the jig plate was removed from the work.


JIG-PLATE WITH CENTER HOLES

The table was next moved endwise the amount of the radius of the circle on which the holes were located, after which the jig plate and the master button were again brought into use in locating the first hole in the circle. The rest of the holes were located in the same way, only the index head was rotated each time the required number of turns to give the correct spacing. The job was then transferred to the lathe, where it was finished. The greatest error found in the spacing was 0.001 in.



MANUFACTURE of ELECTRIC MOTORS

By C.W. Starker

VI. Operations on Bearings

Interesting and novel processes involved in the manufacture of motor bearings, together with some specially designed machines and instruments are described in this article.

THE construction of the motor bearings, themselves, has been touched upon in connection with the motor brackets of the split and solid types. In the type of bearing shown in Fig. 51, the bearing and housing are cast in one piece, and the bearing surfaces and end flanges are lined with babbitt.

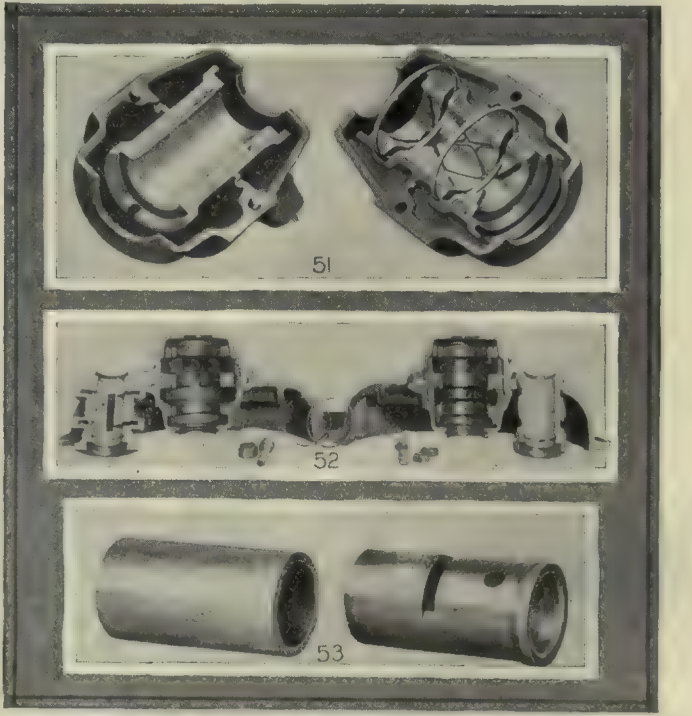
In a later type of construction the bearing shells are separate from the housing, which is cast in one piece with the bracket, Fig. 52. The simplicity of the solid steel shell with babbitt-lined bearing shown in Fig. 53, as compared with those shown in Figs. 51 and 52, is very apparent. The replacement of the first two involves considerable trouble and expense, and the use of more or less complicated babbitting mandrels; while with the bearing shown in Fig. 53, the cost is so slight that it is much cheaper and easier to replace the entire bearing than to rebabbitt it.

In the manufacture of these bearings the shell in Fig. 53, is cut from mill lengths. As it is not always possible to obtain commercial tubing with the desired inside and outside diameters it is sometimes necessary to either expand or contract these shells. It is also desirable to have one end expanded in order to secure a good shoulder for taking up end thrust.

The change in tube diameters is made either on a drawbench, for reducing long lengths, or on a hydraulic press for short lengths, and for expanding and shaping the shoulder. After these operations the shells are carefully annealed and pickled to remove scale and oil, after which they are tinned inside and babbitted on collapsible mandrels, Fig. 54. It will be noted that these mandrels also form the oil grooves. Adhesion between the shell and babbitt lining is very important, and by this process the desired result is obtained without the use of anchor holes, etc.

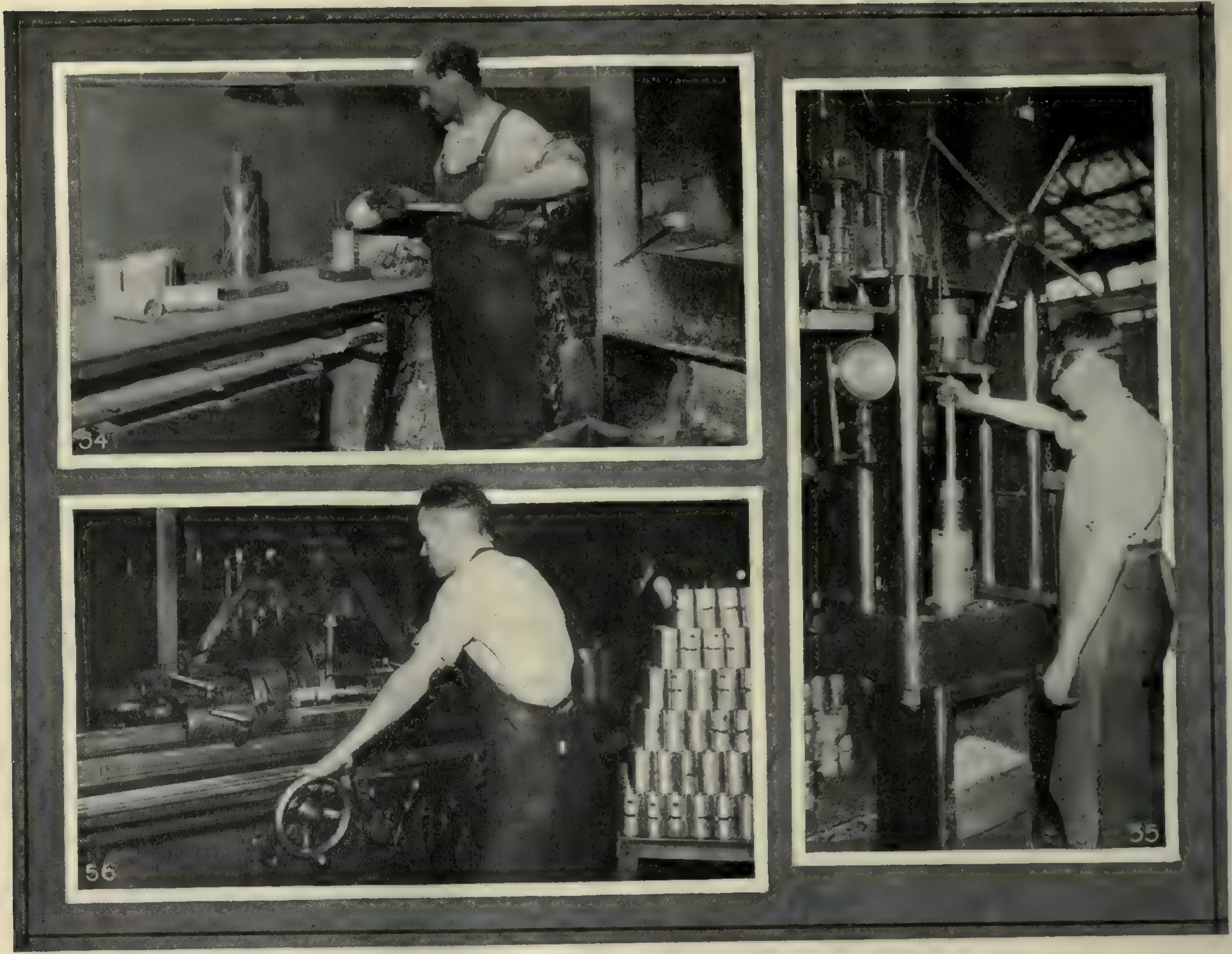
After babbitting, the bearings are broached on a hydraulic press, Fig. 55, which gives them a smooth and dense bearing surface. The succeeding operations are facing the ends, milling the oil ring slot, drilling holes, a second broaching operation, turning the outside diameter and finally wet grinding the outside diameter to finish size, Fig. 56. A tolerance of —0 to +0.005 in. is permitted on this dimension in order to secure a tight fit in the housing.

The bore of the bearing requires a certain clearance for lubrication and alignment. In solid horizontal bearings with ring lubrication this clearance for a 2-in. shaft is +0.002 to +0.006, so there is always a clearance between shaft and bearing of from 0.004 to 0.008 in. For vertical bearings and those using grease lubrication different allowances are required.



FIGS. 51 TO 53. BEARING DETAILS

Fig. 51—Bearings and housings cast integral. Fig. 52—Bearing and housings cast separately. Fig. 53—Sleeve type of bearing



FIGS. 54 TO 56. BABBITTING BROACHING AND GRINDING OPERATIONS

Fig. 54—Babbitting sleeve type bearings. Fig. 55—Broaching sleeve type bearings. Fig. 56—Grinding outside diameter of sleeve

The grade and composition of bearing babbitts is very important, but many wrong impressions exist regarding these points. Tin-base babbitts contain from 80 to 90 per cent. of tin with an addition of antimony and copper. Lead-base babbitts contain from 80 to 85 per cent. lead with a relatively small amount of tin and antimony. Composition alone is not the only controlling factor for it has been shown that the temperature of the housing when casting also influences the hardness of the material and its resultant quality to some degree.

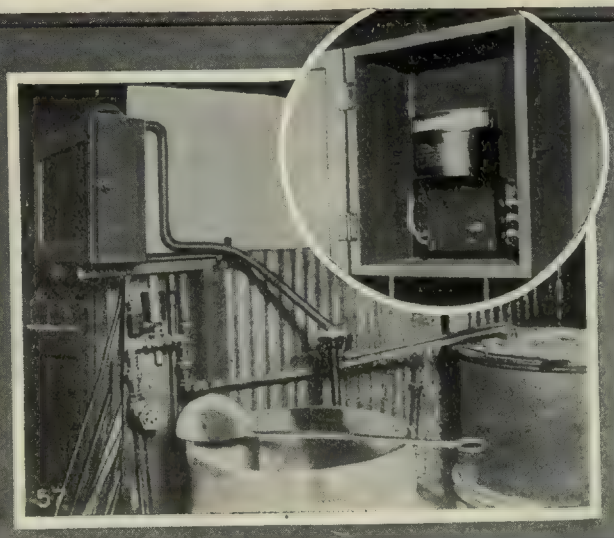


FIG. 57. THERMO CONTROL FOR BABBITTING POTS

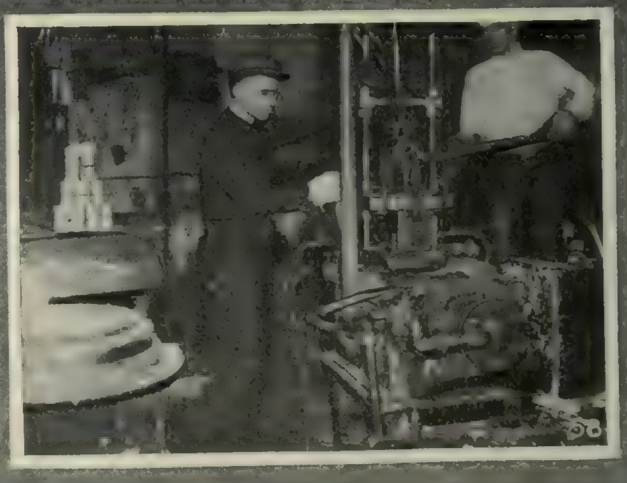


FIG. 58. DIE-CASTING SMALL BEARINGS

On account of the conditions mentioned, heat control apparatus is used on the babbitt heating pots, and a surface hardness is obtained with lead-base babbitts that is equal in serviceability to the much higher priced tin-base alloys.

Lead-base babbitts, with automatically controlled housing temperatures, are now used on the work under description, and excellent results are obtained in severe geared service, such as steel mills and street cars. The apparatus used for controlling temperatures is shown in Fig. 57. This apparatus is self-contained, and consists of a pyrometer and electro-magnet for automatic control of gas and air supply.

Bronze bearings are no longer used on these smaller commercial motors, because babbitt is considered better and more economical for this class of work. A material similar to Lumen-bronze, containing 85 per cent. zinc, 10 per cent. copper and 5 per cent. aluminum, is quite extensively used for die-cast bearings; but being rather brittle its use is limited to motor bearings of small size not to exceed 1½-in. bore. These bearings are made with the die-casting machine shown in Fig. 58.

Ball bearings have been used quite extensively for certain specific applications as on vehicles, auto lighting and starting apparatus and on certain applications in the textile industry; but they have not yet found very wide application in general-purpose motors. If properly selected as to size and quality and properly mounted and maintained, ball bearings will give excellent service, but failure to comply with any of these requirements means failure. Many persons imagine that ball bearings do not require as much attention as bearings of other types, but the writer's definite experience has been that frequent attention and lubrication is just as desirable and necessary with ball bearings as with high-class sleeve bearings. Furthermore, oil leakage, which is largely overcome on well-designed sleeve bearings, is not unknown with ball bearings. Their initial cost is considerably more and, on account of the close machining required in mounting them, they cost the manufacturer, and consequently the user, more.

Special Motor-Shop Equipment

Special Correspondence

In handling large motors such as are used in airplanes, it is quite important that the assemblers have easy access to all parts. The assembly cradle shown in Fig. 1, which was designed by the Wisconsin Motor Manufacturing Co., Milwaukee, Wis., to facilitate its work, has proved very convenient, as it can be turned and clamped in any position.

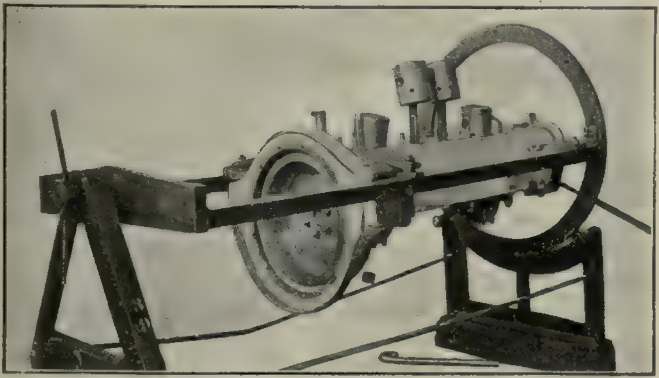


FIG. 1. CONVENIENT ASSEMBLING CRADLE

This company has also designed and built several special machines for boring the crankshaft bearing liners in position, as shown in Fig. 2. The boring bar is driven by an electric motor belted to the pulley *A*. The feed is actuated by hand. This combination insures a very smooth and accurate finish of the babbitt liners or boxes.

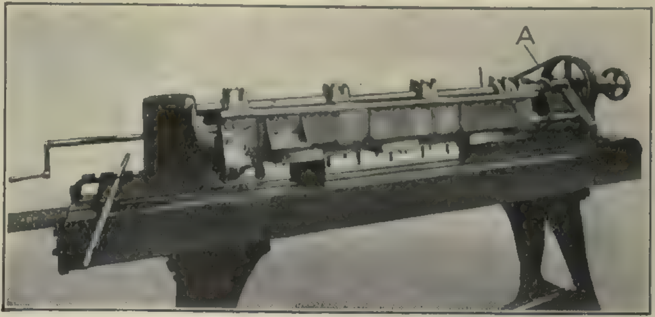


FIG. 2. SPECIAL BORING FIXTURE

Recognizing the fact that in testing out these large motors a great deal of power was going to waste and also that they should be run under load, convertible dynamo motors were installed, as shown in Fig. 3. These motors are connected to the motor shafts by flexible joints, shown at *A*, and the motor is used to start the engine being tested. As soon as the engine is running under its own power, the switch is thrown over and the motor acts as a dynamo and generates current, which is used to start some of the other motors as well as to supply power for the shops. In this way about 200 kw. are generated that would otherwise be a dead loss.

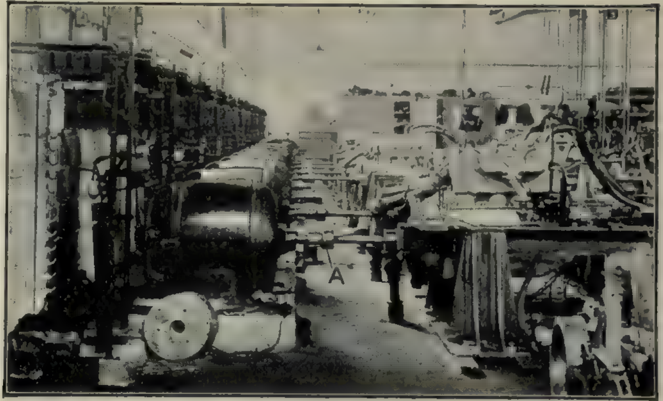


FIG. 3. MOTOR-TESTING DEPARTMENT

Advantages of Plate Patterns

By M. E. Duggan

On page 166, E. J. Leach describes in a very interesting way his experiences with plate patterns made of metal and wood. I noticed in particular what he says for and against plate patterns made of wood. I appreciate Mr. Leach's article very much.

My experience with metal plate patterns is somewhat limited. I have had considerable to do with the making and the molding of plate, or match-board, patterns made of wood. All, or nearly all, of these were intended for what were termed season, or model requirements and extras for stock and repairs. For the production of these castings wood plate patterns served the purpose.

Many of the troubles with plate patterns made of wood can be attributed to the patternmaker's limited knowledge of what is required and what constitutes a practical and well-made pattern. For example, I have seen plates made $\frac{5}{8}$ in. in thickness with plain flat battens at the ends, fastened with wire nails only, the pattern varnish-finished in a slipshod manner. The reason given by the patternmaker was that a thin plate is light for the molder to handle and if made thicker the flask pins would not reach through, which is a rather lame excuse for spoiling an important and expensive piece of work.

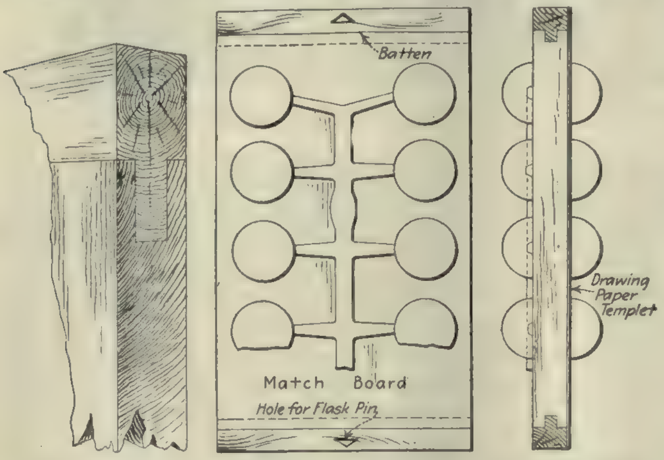


FIG. 1 FIG. 2

FIGS. 1 AND 2. METHOD OF SETTING THE BATTENS AND A SAMPLE MATCH-BOARD PATTERN

Mr. Leach clearly describes his method of making the patterns. It applies to the making of wood patterns and requires no further description, except that I apply at least three coats of varnish to each half-pattern, also the board, before assembling the parts on the board. The width and length dimensions of the board are determined by the size of the flask that is to be used. The thickness I make 1 in., never less. I use cherry wood in the construction of both patterns and match board. The shape, dimensions and assembled batten, fastened with glue and screws, are shown in Fig. 1.

Assembling and Matching

My method of assembling and matching the half-patterns on the plate, as shown in Fig. 2, is not common in pattern shops, but it is a simple way and practical. A sheet of drawing paper a little larger than the board is fastened with thumb-tacks to one side of the board. The paper is carefully trimmed flush with the edges of the board. The half-patterns are placed on the paper in their correct positions and temporarily fastened with fine wire nails driven through the pattern, the paper and into the board about $\frac{1}{4}$ in. In other words, these nails are nothing more than dowel pins.

With a knife made pointed and sharp, the paper is cut through along the edges of the patterns. If this job is carefully done, the sheet of paper can be lifted away from the patterns and the plate, leaving the patterns and the paper under the patterns fastened to the board. Each half-pattern, the plate and the paper should be carefully marked in a way that will insure the return of the patterns and paper to their correct and relative positions on the board. The paper is transferred to the opposite face of the board, flush with the edges; the match halves of the patterns are placed in the holes in the paper and fastened in the way described above.

The job is now ready for the final fastening of the patterns to the board. The patterns are removed from the board, a coat of thick shellac is applied to the joint face of the patterns, and while the shellac is fresh, the pattern is securely clamped to the board and fastened with fine wire brads. When the pattern is finished, it is given a last coat of shellac.

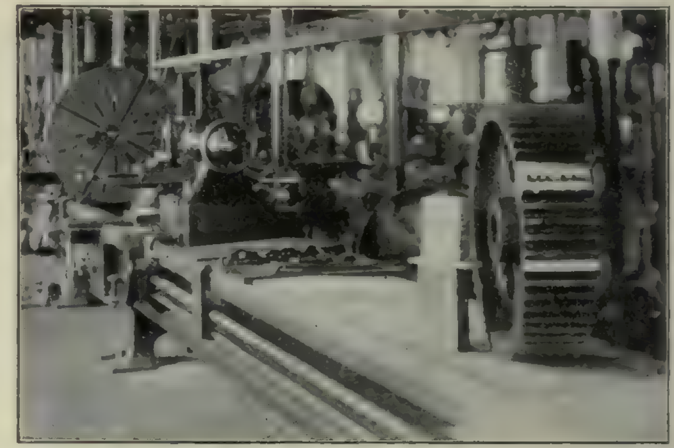
The holes are cut and fitted to suit the pins on the flask that is to be used on that special job. Do not be guided by templets or measurements. See the flask; notice its condition. A good plate pattern and a rattle-trap flask do not work well together. Store your plate pattern on end in a special box made for the purpose. Wherever the pattern goes this box goes with it and saves much trouble.

Gear Dentistry

By J. A. Lucas

The discussion, by Robert E. Newcomb, of "Gear Dentistry," page 472, is fine regarding general repairing on gear teeth as only a temporary doctoring up, to keep the wounded going until the new gear arrives. But referring to the beginning of the article, where he disapproves of the method, I think he is not quite correct.

I admit that there are many ways by means of which gear teeth can be repaired with more or less satisfactory results. The dovetailed teeth will get loose and rattle; taper pins not screwed in will get loose and fall out, doing more damage. The babbitt tooth may peen and may become distorted in time, but on account of the downward taper of the pins will stick to them and drive around them.



REPAIR WORK ON THE GEAR

Here is proof, as shown in the illustration: Two teeth of this large gear were pinned and babbitted with the plaster mold, as previously described. They made thousands of revolutions during the time taken for a new gear to come and, somewhat distorted, still clung to their supporting pins after six months of duty.

Drilling 300 Miles of Holes Per Day

BY E. C. PECK
General Superintendent, Cleveland Twist Drill Co.

We are apt to overlook the importance of small tools in the machine business, and seldom realize the large percentage of the total machine work done by them. One of the too often neglected tools is the twist drill. This article gives some of the interesting facts connected with the growth of its usefulness, and the work it is doing today.

AUTHENTIC records have been found which show that metal drilling was known in prehistoric times, and there is good evidence that the Roman Empire, in its time, used a square shank drill with a forged twist, but from that time until 1860 there seems to have been little improvement in the general construction of the twist drill. The birth of the *American Machinist* came at a time when the twist drill might have been said to be struggling for existence, although the modern drill seems to have come into existence about 1860. This struggle for existence was due mainly to lack of proper facilities to hold the drills so that they would run true. Universal drill chucks had not been sufficiently developed to be depended upon to hold a drill from slipping and insure running true. Drilling machines were fitted with a straight hole socket and setscrew. This hole being ½ in. in diameter required all drills to have this size shank, which made some of the sizes unduly expensive.

The reconstruction period, after the Civil War, seems to have created a demand for more accurate drilling than was known before, and the modern drill filled this requirement so well that all shops, doing fine and interchangeable work, adopted it; and soon thereafter twist drills were found in all good shops in a large variety of sizes, but through the Middle West they were rarely found larger than ¾ in. in diameter. In fact, flat drills above 1 in. in diameter were very common in shops through the Middle West, as late as 1890. In the early days of the *American Machinist* many drilling machines were not accurate enough to use twist drills and get results. When drilling machines were made better, so that the axis of the drill and the axis of the spindle could be maintained in alignment, the common twist drill rapidly crowded out the older type.

TAPER SHANK MORE SATISFACTORY

The introduction of the taper shank was an important factor in the adoption of twist drills, as it entirely eliminated the chuck trouble. While the taper shank drills cost about the same as those with ½-in. shank, they were much more satisfactory, and saved time where accurate work was done.

In the olden days the problem seemed to be to get a hole through a piece of metal somewhere near the right dimension, and fairly straight. The drilling of holes has, however, advanced to such a point that now the problem is this: How many inches of accurate holes can be produced for a given sum of money? The mere question of drilling has long ago been forgotten, and the modern world is now interested in nothing but the following question: How fast and how accurately can you drill?

The twist drill has been greatly improved since 1860 until, at the present time, it is perhaps the most efficient tool used by mechanics. Considering its size and strength, it will remove more metal in a given time than any other tool. A 1½-in. drill has repeatedly, on bona fide tests, removed 113 cu.in. of iron in one minute. To demonstrate what both a modern drilling machine and drill could do under the most favorable conditions, a 1½-in. drill, running at 650 r.p.m., with $\frac{1}{10}$-in. feed was put to a 4-in. iron billet. This is equivalent to drilling at the rate of 65 in. per min. The efficiency of the twist drill, as a metal remover, is so well-known that it is regularly used in making the initial openings through various kinds of forgings, preparatory to finishing with slotting and milling machines.

All this was made possible largely by the improvement in steel, the greatest single step in advance being the introduction of chromium and tungsten into tool steel. This is the now well-known high-speed steel so necessary to rapid production. For a rough calculation, a high-speed drill, under proper conditions, will produce six times as many holes in a given time as a carbon drill, and in many cases the high-speed drill will readily drill material that can scarcely be drilled at all with a carbon drill.

ATTENTION GIVEN TO TWIST DRILLS

Twist drills rarely get the same careful attention in their sharpening that are given other machine shop tools, but even under such adverse circumstances they give a good account of themselves. They stand more abuse and are forced to operate under more adverse circumstances than any other tool a mechanic uses. An instance of this, which happened in New York City about the time of the Spanish War, brings this out rather forceably. A workman was drilling some street railway track with a hand drilling machine, using $\frac{5}{16}$-in. drills. It was noticed that he was turning it backwards, or left-handed, and when asked why he turned it backwards, he said: "It cuts better that way." An examination of the drill showed that it had been ground so poorly that the only way it would cut was by turning it backwards.

The part played by twist drills in modern industry is so great that statements regarding its importance often appear exaggerated. Those who have had an opportunity to become acquainted with the work connected with military maintenance, however, have come to the conclusion that the twist drill performs the most important single operation in modern machine shop work. The tool is so common, and its performance so uniformly successful, that its great importance is only felt when there are no drills to be had.

It has been computed that when we take modern first-class machinery, automobiles and war munitions into account, the ordinary twist drill performs about

30 per cent. of the total number of mechanical operations. By actual count, in the building of a well-known 3- to 4-ton truck, 40 per cent. of the mechanical operations consist of drilling. This does not include the drilling done on pieces being made in the automatic screw machines. Of these holes, 2173 are under ¼ in. and 2046 are between ¼ in. and ½ in. It is estimated that there are now being made in the United States 750,000 drills per day. Considering these drills only capable of drilling the equivalent of a hole 2 ft. in length during their life, and doing it in one day, we would be producing nearly 300 miles of holes daily in the United States. The writer is of the opinion, however, that there are more than 750,000 drills being made per day. Also, that each drill, on an average, will do very much more than 24 in. of hole during its life. It is also to be understood that all of these 750,000 drills are not used to destruction in one day. Well-known authorities have said that the Allies, in a concerted action, will fire one million shells in a day, and, considering these to be of the 3-in. size, they contain 19¼ in. of drilled holes each, or 300 miles as the grand total, which is being shot away. Each Springfield rifle contains 94 drilled holes and, if we only provide one rifle for each of our proposed 500,000 army, it will require the drilling of 47 million holes to get the army started. After they are in action four rifles will be required per man.

Technical Education and Technical Journals

By DEXTER S. KIMBALL
Sibley College, Cornell University, Ithaca, N. Y.

NOT a great while ago all workers in the industrial arts were trained in their callings by methods more or less akin to the old apprenticeship method. The theory and practice of the calling were handed down by verbal communication by those qualified to instruct the beginner and such instruction, being of the hit-or-miss type, usually required a long time, comparatively, to achieve results. Recorded information was rare, and was to be found, for the most part, in handbook form. It cannot be denied that some great results were obtained by these methods, and the work of some of the engineers and builders who were trained in the old way still remain as monuments to their skill and knowledge.

Changed industrial conditions, however, have made necessary new and different methods of training men for industry, and in these new methods books and other forms of literature have taken an important place. There are several reasons for this innovation. First, every industrial calling tends to become increasingly complex and to require an increasing amount of knowledge for its successful prosecution. It became evident long ago that no single mind could contain all the facts and principles involved in many callings, and men began to collect these matters into handbooks, which were the first forms of technical literature.

GROWTH OF FIELD OF KNOWLEDGE

In a calling or profession where no progress is taking place, and which is concerned only with things that have been, books and printed records are often sufficient for an educational basis. We still have a few such callings and professions, but in almost all human activities the field of knowledge grows apace, and any books dealing with these pursuits are necessarily behind the times, somewhat, even before they are printed. It must not be inferred from this that books are not necessary; for such is far from the truth. Books always have, and always will, contain the records of basic facts and principles. They serve as a repository, as it were, for the foundation stones of all collected knowledge.

But in a progressive calling one must know what is going on at the present moment if he is to keep abreast of the march of progress. He must be keenly alive to daily events if he is to lead in the field, and this can be accomplished only by constant reading of current literature. In fact the revision of all textbooks has come to depend in no small degree upon the material contained in current literature. Not the least important value of current literature is the stimulation that comes from knowing what some other worker in the field is doing; and the interchange of ideas between men who are interested in kindred problems, but who may be separated widely in a geographic sense, can be accomplished only by the current magazine or paper. This principle is beginning to be appreciated even in our public schools, in many of which small weekly or monthly periodicals under such names as "Current Events" or "Timely Topics" are becoming quite common.

IMPORTANCE OF THE MATTER

This matter is of great importance to all workers in the industrial field. No shop man can keep abreast of his work without reading some good paper. No manager can hope to keep up with his competitors unless he reads some current literature on shop organization and management. No engineer can possibly keep in the front of his profession unless he is a constant reader of several periodicals.

These principles have also found a place in modern educational methods as applied to the training of young engineers. A few years ago the methods in common use were those of the older educational curricula which rested almost entirely upon books. To a large extent this will always remain so since the teacher is, to a large degree, concerned with basic principles. Yet the modern teacher will fail utterly in his duty unless these basic facts are illustrated by applications to the latest phases of the industrial field, and unless he makes a strong effort to impress upon his students that they are living in the present and not in the past.

Every student in a professional college should be strongly urged, if not required, to read at least one good periodical devoted to the interests of his future calling. Aside from the actual information so obtained the habit of reading such literature is one that must be formed when young. It is always easy to read entertaining literature, but it requires the force of habit to make solid reading interesting and attractive. In Sibley College of Mechanical Engineering, Cornell University, there is a well-equipped branch library open to all engineering students at will. This library contains a small but carefully selected collection of the best books on engineering subjects. In addition, however, there is a large and well appointed reading room which contains practically all the engineering periodicals issued in this country and many from abroad. Students are encouraged to haunt this room and it is well filled all of the time during study hours. It is considered part of the educational equipment of the college.

The writer has always felt that the *American Machinist* occupies a very important place in this line of work so far as mechanical engineering is concerned. A considerable amount of its contents are eminently practical and is, therefore, of interest to the budding engineer; while at the same time there is always something of scientific interest to tempt his curiosity to an effort to read it understandingly; and the college professor will always find in its pages that which will keep him alive and in touch with the manufacturing field and that which will interest him from the scientific side of his calling. To the writer the *American Machinist* is an old friend for I have read it as journeyman, designer, works manager and teacher. May its field of usefulness be widened and its subscription list be lengthened.

Figuring the Cost of Work

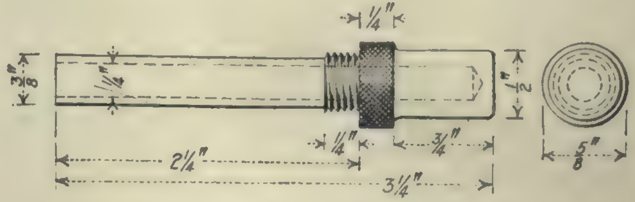
By W. D. Forbes

In a certain downtown club where machinery men foregather for lunch, and to smoke a quiet cigar afterward, a man came in and joined a group of three. He took out of his pocket the piece shown in detail, and seemed to be in the condition that in some parts of the country would be called "all het up." "Now gentlemen," he said, "here is a piece which is tool steel. I have just had it made in a jobbing shop, and I paid for it. You are all practical men, how much do you think they charged me? I gave them a nut to fit the screw to and told them that the tube part must be hardened and drawn to deep yellow, and that the other end should be nicely polished up; that all the dimensions were scale measurement and the hole was to be reamed."

The first man of the group took the piece and, looking it over, said, "If any of my toolmakers took more than 1½ hours on the job I would fire him." The second man, after inspection, agreed that the "time was about right." The third man considered the piece for a few moments, and then said: "Now, look here; let's see just how this piece was made and add up the amount of time taken. I think you two gentlemen will be surprised at the result.

"What happened was about this: Our friend goes to the jobbing shop and sees the proprietor, who calls the foreman and describes the work to him. The foreman goes out into the shop, and sees that one of the toolmakers has some work on the centers which can be dropped for the moment. He goes over to him and says, 'Here, George, stop that job and do this.' George stops his lathe, listens to the explanation, and says, 'I don't think our knurl is quite as coarse as that; does that make any difference?' Back goes the foreman and just catches our friend going out, who says that the checkers of the knurl are unimportant. Back comes the foreman and tells George to use any knurl he can get.

"The foreman gives the toolmaker a job slip, and George proceeds as follows: He calipers up the knurled size, measures the length over all, goes to the stockroom, gets a piece of tool-steel material, makes up his mind that he will cut it off 1½ in. longer than the piece wanted so that he can hold it in the chuck, takes it to the cutting-off machine, cuts it off, takes the rest of the bar back to the stockroom and gets his piece weighed up.



DETAILS OF WORK TO BE DONE

"In cutting off the piece he finds that the bar was not annealed, so he takes it to the blacksmith shop, tells the blacksmith to give it a quick anneal and waits to see it heated up and buried in the ashes. Then he goes back to the lathe.

"Now, gentlemen, by this time a half hour has surely been used up, so we will put that down. Then the toolmaker takes the faceplate off his lathe, puts on a universal chuck, goes to the toolroom, gets his knurl, drill and reamer, and comes back to his lathe. He gets a dog out of his tool chest, clamps his drill in it, takes up his oil can, gives it a shake to see if there is any oil in it, gets it filled up, comes back to his lathe, and wonders 'if that piece of steel is cool yet.' He goes into the blacksmith shop, uncovers the steel and finds the piece is still pretty warm. But, taking a piece of waste, he carries it back to his lathe, puts it into the chuck, measures to see if he has got enough length sticking out to allow him to make the piece and cut it off, tightens the chuck on all three jaws, selects a side tool, puts it in the toolpost and is ready to square up the end, which would be his first operation. Here, gentlemen, is another half hour and no work done, except cutting off the stock.

The Lathe Work

"The toolmaker throws out his back gear, shifts his belt to give the proper speed, starts up his lathe and proceeds to square up the end of the piece with his side tool, takes out the side tool, backs his tailstock out of the way, digs into his tool chest to find his little drill and countersink, puts it in a V-block in the toolpost, brings it up to the center of the stock, drills and countersinks the end, stops his lathe, takes out his countersink and V-block and puts them back in his tool chest, wipes out the countersink with a piece of waste, backs his toolpost out of the way and brings up his tail center, clamps it, brings the center up, putting a drop of oil on it, puts a half diamond tool in the toolpost, calipers again the diameter of the knurl, starts his cut for about a half inch, calipers it, comes back, takes another little cut, calipers it again and finds he is pretty near right, throws in his feed, runs the cut up close to the chuck jaws, comes back with his tool, sets his caliper to the diameter of the top of the threads, starts another cut, tries the diameter with his caliper a couple of times, scales the length to the shoulder of the knurl, throws in his feed, comes up pretty nearly to his mark, takes out the diamond point, puts in an offset parting tool, sets his caliper to the bottom of the threads by taking the measure from the sample tube, brings the tool into position to get the proper length, feeds the parting tool in until the calipers slip over the piece, measures the length again and finds he is all right, takes out his parting tool, puts in his one-half diamond tool again, sets his calipers once more to the outside diameter of the thread and runs this cut over the entire length of the tube and threaded part, comes back, sets his caliper to the diameter of the tube, feeds in his tool until he gets the right diameter, measures the distance from the end of the tube to the beginning of the thread, marks it and runs the cut up to it. After this he takes out his half diamond tool, reverses it in the toolpost, takes his drill and dog, backs out his tail center, puts his drill on the countersink, sets the heel of his tool against the drill and starts to drill, taking care to have the drill run true. He takes out his tool in the toolpost, goes and gets a little drip pan to catch the oil, shifts his belt to give greater speed and proceeds to drill the hole. Then he dogs the reamer and reams the hole. By this time one solid hour has passed surely.

KNURLING AND THREADING

"Now the toolmaker takes his thread gage and finds the pitch of his thread, selects the proper gears for cutting it, puts them on, shifts the belt to a lower speed, and then makes up his mind that he ought to do the knurling next. This he should have done before. He therefore shifts his belt again to give a slower speed, takes his offset parting tool, sets his calipers for the diameter of head and roughs it down pretty nearly to the diameter, leaving enough for a fillet. He then takes a larger offset parting tool than he has been using and grinds off one corner round so he can finish the fillet, finishes up the fillet and head, takes out the tool, sets his knurl, brings up the tailstock so the center will steady the job, and feeds in his knurl. It looks nice. Next he takes a side tool and just touches off the shoulder where the knurl has worked the stock over. Then he finds that his patent threading tool will not let him run up close to the shoulder, so he proceeds to grind up the offset parting tool. After this he starts cutting his thread. When he has made four cuts, he takes the nut to try the thread. He knows it will not go on, but he is going to try it all the same. Then he thinks he had better use the thread stop, and proceeds to put it in place. He takes a few more cuts and tries the nut again; a couple of cuts more, and the thread fits. He takes out his threading tool, speeds up his lathe, uses some emery cloth on the tube part, fillet and head, then measures the job up again.

"Then he grinds off his threading tool, making it a parting tool again, and proceeds to measure the overall length—and cuts off the piece. He opens the chuck jaws, takes out the waste stock, reverses the piece he has almost finished, and finishes the end with a side tool and file. He then polishes it up with emery cloth, takes the piece out of the chuck and starts for the blacksmith shop. He has to wait a little while before the blacksmith can tackle the hardening job; but finally the hardening is done and he takes the piece back to the lathe, polishes up the tube end with emery cloth, takes it back to the blacksmith shop, and the blacksmith draws it down to a dark straw. Back goes the toolmaker to his lathe, chucks the piece with the head out and polishes up the same. Once more he measures the piece all over and calipers it, after taking it out of the chuck. By this time two good, solid hours must be added to the time already noted, but this is not the end of the job.

"The toolmaker had been on a piece of work which had been interrupted, and in order to charge the work fairly, the toolmaker had to take off his chuck, replace the faceplate and add this time to the work, as well as the time required to place the interrupted job in position. But we will throw that matter out this time. All together this makes, we will say, four hours. Now, besides the time used by the toolmaker in machine work, there must be a half hour charged by the blacksmith, as most shops do not charge less than half an hour for any work. Four and a half hours will be the total time on the job for machine work, and this added to the blacksmith's time would make the total work on the job five hours. Taking the present rate of say 80c. an hour, which is usual in New York, there is a charge of $4 plus a half pound of steel, say 10c., or a total of $4.10.

"To my mind, gentlement, that is the time it took to do this job. And it was done about as I have described. Now, let us see how near I come to the price which our friend here paid for the job."

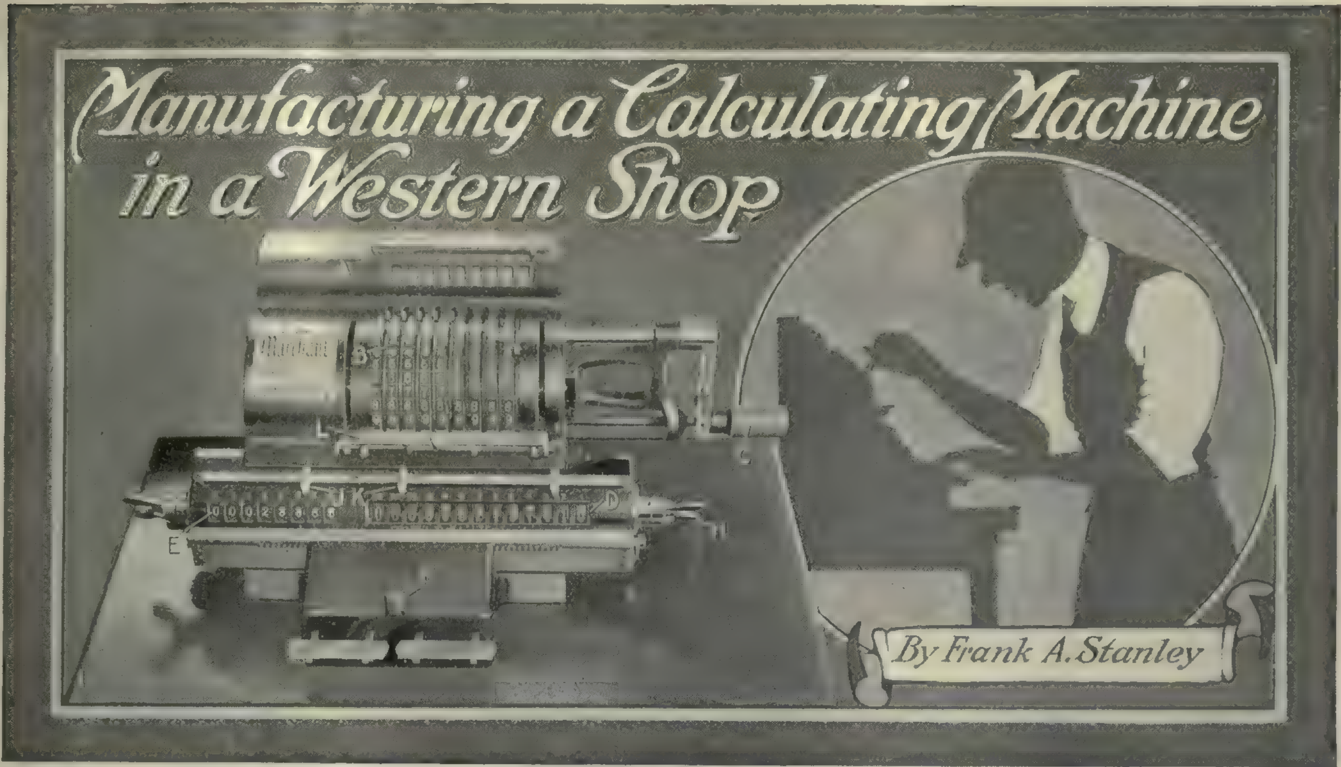
The latter put his hand into his pocket and drew out a bill which showed a charge of $5.50 and, after a moment, he remarked: "I think I was a little hasty in what I said to the machine-shop people, and the difference between your figures and theirs is somewhat accounted for by their making me a charge of 85c. instead of 80c. an hour.

Lathe Tools from Broken High-Speed Drills

By ALBERT W. KOCHER

In view of the cost of high-speed steel, and the depletion of stock especially in the smaller sizes, I have successfully used the shanks of broken straight-shank drills for threading tools. I instructed the toolroom boy to save all broken high-speed drills, and in a short time had quite a collection of various sizes on hand. In sorting these I found some shanks $\frac{15}{64}$ in. in diameter. In using the longest piece I drilled a hole $\frac{1}{2}$ in. in diameter and of suitable depth in a piece of cold-rolled steel. About $\frac{5}{8}$ in. from the end I drilled and tapped a hole for a $\frac{10}{32}$-in. screw and thus made a toolholder, which I put in the Armstrong boring toolholder, and had an efficient threading tool. It is only necessary to grind the tool for the desired width or angle.

Manufacturing a Calculating Machine in a Western Shop



By Frank A. Stanley

This machine uses a carriage which is finished in a variety of operations, including milling, shaping, slotting and drilling in special fixtures, which assure accurate results. Details of numerous tools and processes are covered in the article.

THE accompanying illustrations show some of the methods used in the new plant of the Marchant Calculating Machine Co., Oakland, Calif. The machine manufactured by this concern is of interest to engineers and others, not only because of the readiness with which it may be used in making all classes of calculations, but also because of its compactness of design.

It is not the intention of this article to give a detailed description of this machine, although brief reference will be made at various points to some of the functions of certain members in order to describe more clearly the machining operations required in preparing them for assembling in place. It may be stated that there are comparatively few members in the mechanism which is of simple character throughout, as will be evident upon examination of the headpiece and Figs. 1, 2 and 3, which show respectively the complete machine ready for operation; the machine with the top cover removed and finally the principal members of the mechanism taken apart and separately illustrated.

Referring to the headpiece, *A* is the body of the machine; *B* the setting dials 1 to 9; *C* is the operating crank; *D* the product or dividend dial; *E* the quotient or proof dial; *F* the carriage shift key; *H* the dial clearing key; *J* and *K* the decimal indicators; *L* the general dial clearing comb.

The calculating machine illustrated is the "Pony" model and measures over-all only about 8 in. in length, its weight being but 12 lb. The larger, or standard model, is likewise very compact, although somewhat longer than the one presented herewith. The two models are similar in construction and the methods of manufacture and assembling are alike.

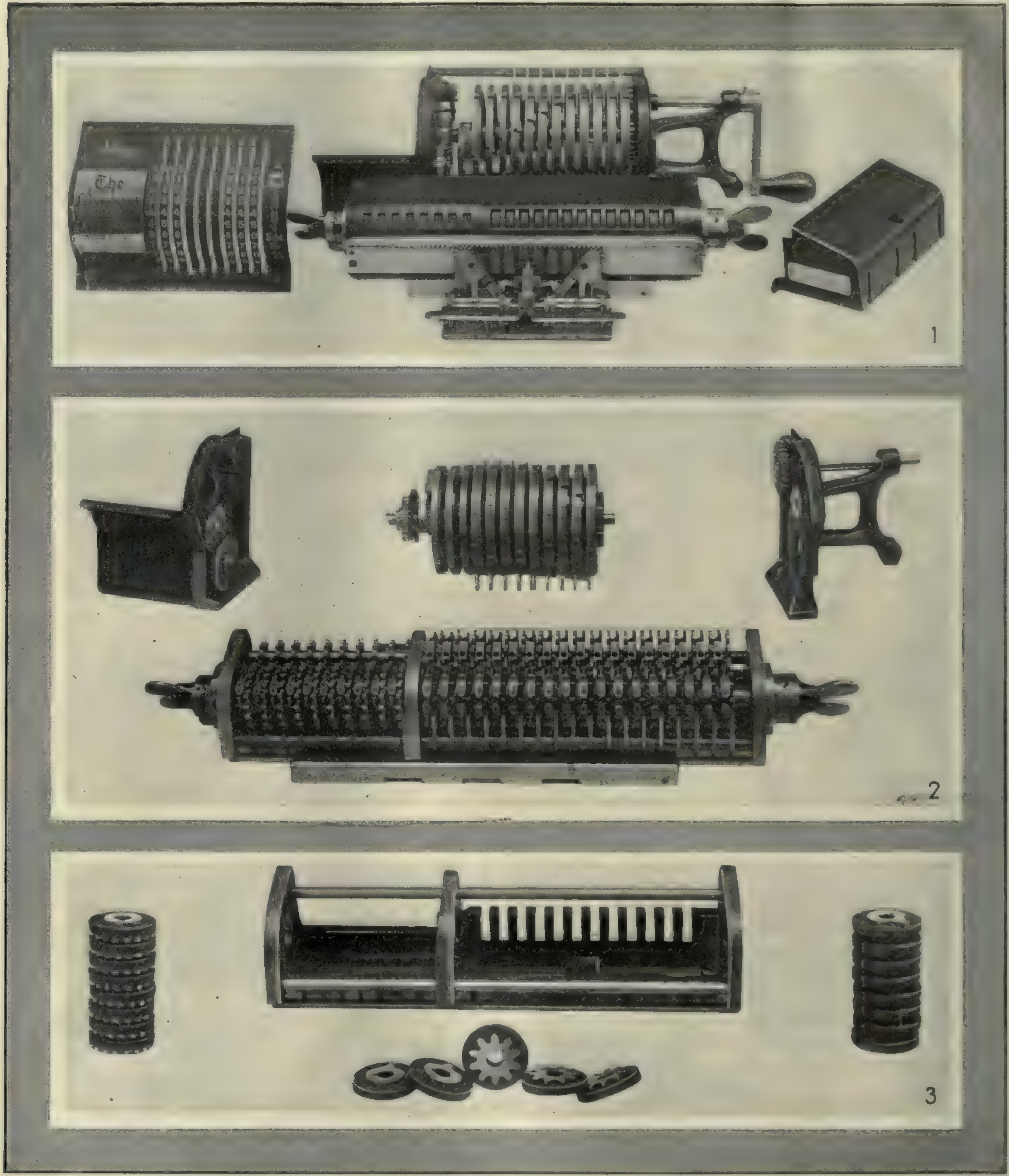
One of the most important parts of the machine is the carriage in which are placed the product or dividend dials and quotient or proof dials, as already referred to at *D* and *E*, and in Fig. 2, shown removed from the machine, but with the dials in position. This carriage in skeleton form, before assembling the dials, is shown in Fig. 3, and in Fig. 5 a detailed drawing is reproduced, giving all of the important dimensions and showing the various surfaces which require machining.

CARRIAGE OPERATIONS

The carriage is a brass casting a little over 7 in. in length by 1½-in. width, with several uprights and ribs in which numerous holes and slots are accurately machined to receive the dials and other parts. The body of the carriage is surfaced along the bottom, edges and ends and considerable care must be taken in the process to produce perfectly flat, true bearing surfaces throughout in order to provide for correct assembling and operation of the entire mechanism.

The lower surface and edges constituting the bearing surface proper are first roughed by milling, following this in order that the surface may be as true as possible, the carriage is placed on a special fixture on the shaping machine, as in Fig. 6, where with a single-point tool, a light cut is taken across the work. In Fig. 6 a carriage is shown secured in the fixture, while to the left, to the back of the shaping-machine table, will be noticed another carriage ready for dropping into the fixture, upon the completion of the one shown under the cut.

The shaping-machine fixture is in the form of an angle plate, where the vertical surface provides a seat against which the carriage casting is drawn lightly but securely when the two handles in front are operated. These act upon clamping members which secure the work from the ends and hold it against the fixture face without danger of distortion.


1
2
3

FIGS. 1 TO 3. SOME OF THE PARTS DISASSEMBLED
Fig. 1—Machine with cover removed. Fig. 2—The carriage drum and brackets. Fig. 3—The carriage before dials are placed

The machining of the ends of the carriage, Fig. 5, is accomplished with the straddle-milling cutters shown in Fig. 7. Here the casting is secured squarely against the bottom and vertical surfaces of another fixture by means of simple clamps, which keep it in position during the passage between the mills. The cutters are of the inserted-tooth type, about 5 in. in diameter. The cutter blades are held in position by taper pins in slots cut between the openings for the teeth. This pair of straddle cutters is kept sharpened on their arbor and held to an exact distance apart to preserve an accurate over-all length across the work.

This milling operation, like various others required, is taken care of in a well-organized department, a general view of which is presented in Fig. 8, which shows numerous jobs under way in the different machines, some of which will be referred to later.

After the flat surfaces have been machined on the carriage, the series of slots shown in Fig. 5 are cut with the aid of the fixture illustrated in Fig. 9. It was originally undertaken to mill these slots with gang cutters, but it was found that the removal of so much metal at one pass of the work tended to produce a certain degree of distortion, likely to lead to difficulties in subsequent assembling processes. So a fixture was devised for indexing the carriage crosswise of the milling-machine table to allow the slots to be formed one after another with a single cutter.

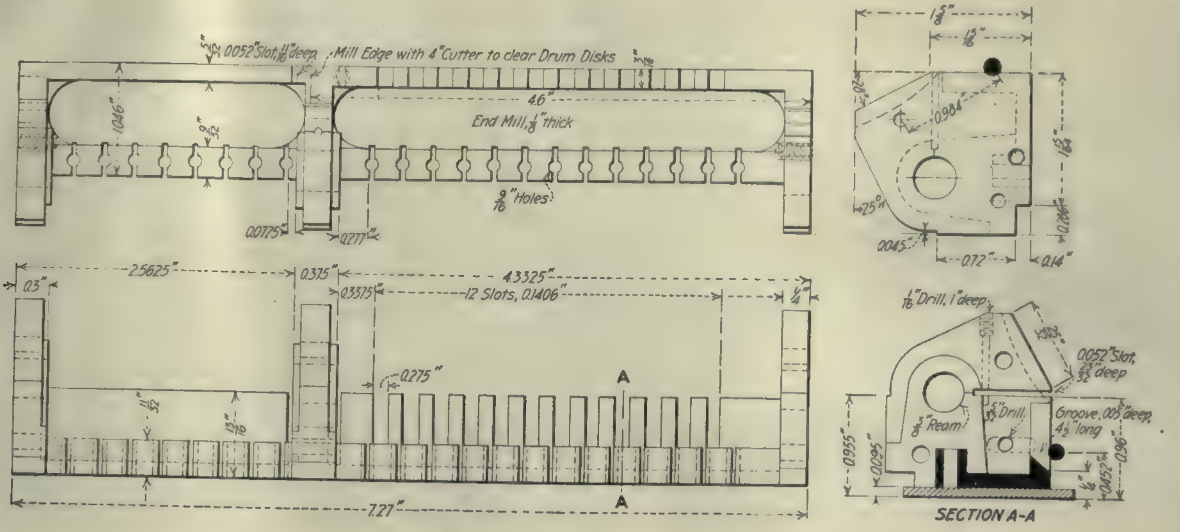


FIG. 5. DETAILS OF CARRIAGE

The essential features of this fixture are well brought out by Fig. 9. The fixture is designed for the slotting of both the "Standard" and "Pony" carriages and for this reason a double series of indexing notches are provided for the slide upon which the work is mounted. This slide has a conventional dovetail bearing in the fixture base, and is kept in proper adjustment in its guide by the flat gib in front. The index notches, it will be noticed, are cut in a steel plate attached to the fixture base, and the index pin operates in a bracket secured firmly to the edge of the work slide. The pin is withdrawn against the pressure of its spring by means of a small lever controlled by the fingers of the workmen.

Slotting Operations

The seat on the upper face of the slide which receives the carriage to be slotted is only $\frac{1}{8}$ in. in depth, leaving a narrow ledge at each side against which the straight surface of the carriage is located positively, when clamping in position for the slotting operation. This means that the locating is done by one edge of the work only, so that this same locating surface may be used in various operations to assure the most accurate results. Positive means are also provided for location of the work endwise to insure an exact position for the starting of the series of slots.

There is a great deal of drilling to be done on the carriages and other parts, and Fig. 10 is shown at this point to illustrate the arrangement of a number of drilling machines in the department devoted to this work. Fig. 11 illustrates a great number of carriages piled up on the workbench with the drilling jig in front ready to be placed under the spindle of the drilling machine, and Fig. 12 represents the operation of drilling the hole through the three carriage uprights for receiving the spindle for the dials. This illustration, with Fig. 13, gives an excellent idea of the character of the jigs used for carriage work. In the former illustration the work is shown secured in the jig, while the latter illustration shows a carriage outside of a jig which, in this instance, is utilized for drilling a smaller hole in each casting.

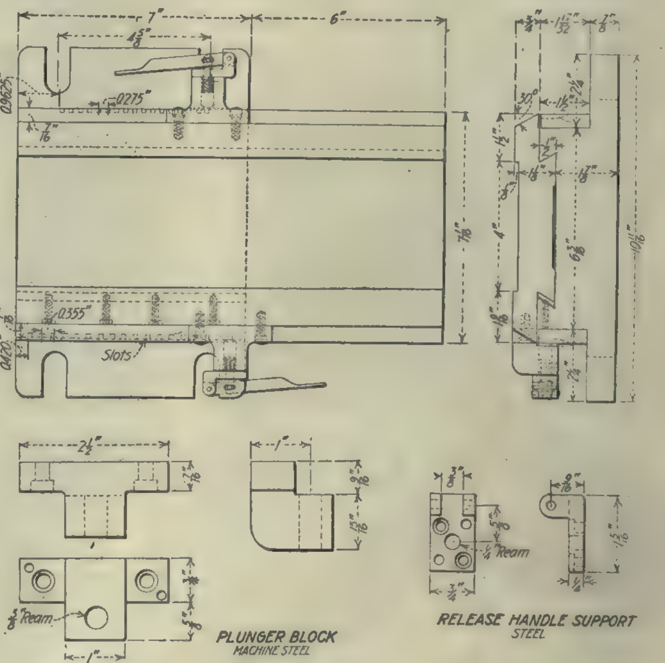
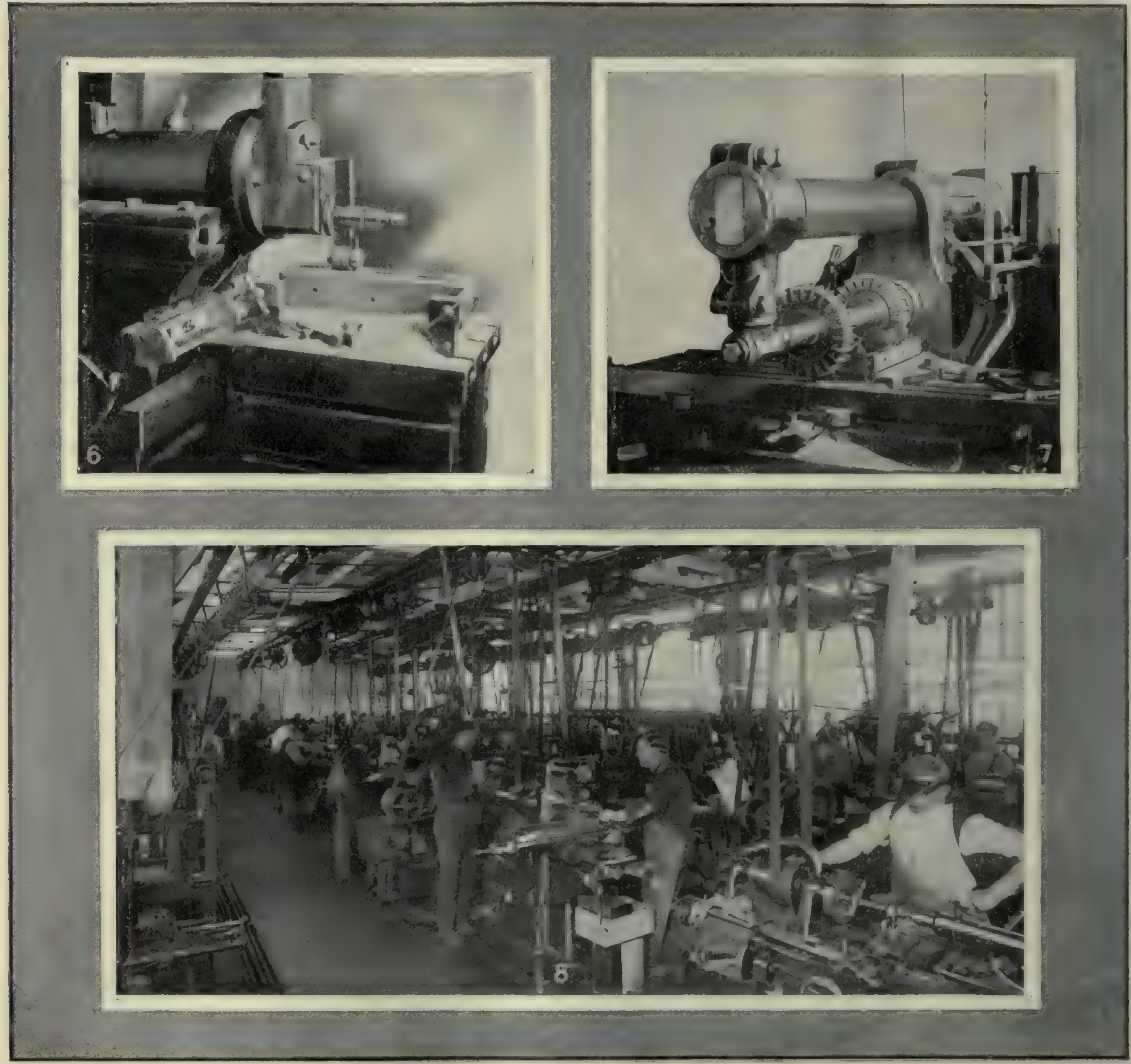


FIG. 9. FIXTURE FOR SLOTTING CARRIAGES

These drilling jigs are of open construction with a tie-plate at the front, and with four hardened feet on each end, so that the jig may be turned over and used on both ends. Here the carriage is located against a straight-edged plate, which is accurately secured by screws and dowels, and small thumb-screws are provided at the opposite side for pressing the carriage lightly against the locating strip. The main hole through the carriage is put through with a long drill, and afterward reamed dead to size. As shown by Fig. 12, the intermediate bracket or upright on the carriage is drilled in line by the aid of a special guide immediately above the work.



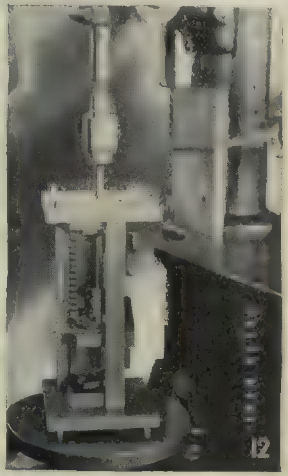
FIGS. 6 TO 8. A NUMBER OF MACHINE OPERATIONS

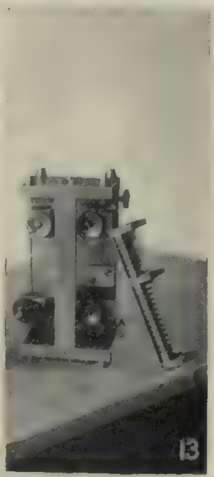
Fig. 6—Finishing carriage bearing. Fig. 7—How the ends are finished with straddle mills. Fig. 8—Various jobs in the milling department

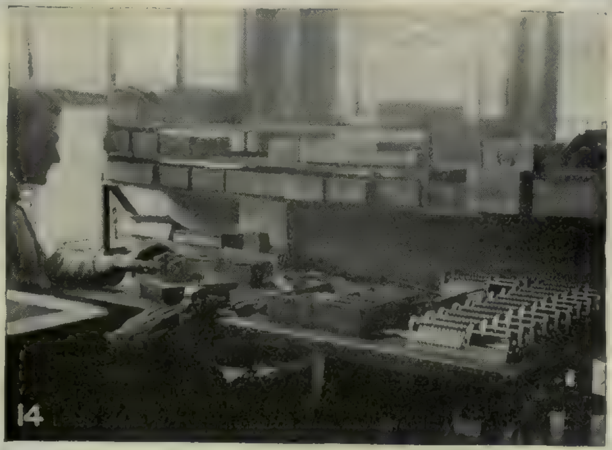
Referring again to the jig in Fig. 13 for drilling other holes in the carriage ends, it may be pointed out that the work is here located against suitable back stops, and secured by short clamps, which are operated by light thumb-screws to obviate the possibility of springing the casting while clamping it in place.

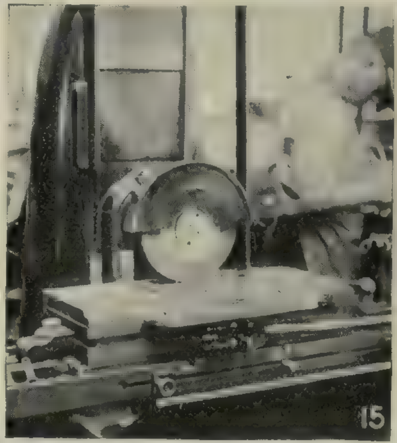
Fig. 14 illustrates a workbench with a number of carriages in the assembling process, showing an empty carriage on the surface plate ready for the insertion of the spindle and other parts, while at the outer end of the bench will be seen a group of carriages with various small members in position. The thin, steel arms shown on the rods in the carriages are finished like certain other similar parts by grinding on the sides to an exact thickness, an operation which is performed with the surface-grinding machine. Fig. 15 represents one of these grinding machines with a magnetic chuck on the table, on which some two or three dozen pieces are held simultaneously while undergoing the finishing process.

It will be readily understood that the large majority of the necessary parts are what would be classed as small, but in order to make them interchangeable it is necessary to hold the finished dimensions to close limits. This is accomplished by utilizing a very complete system of jigs and fixtures for all operations, and by following this up with careful inspection at various steps in the manufacturing process. The results accomplished are well worth the trouble and expense involved.









FIGS. 10 TO 15. VARIOUS PARTS, JIGS AND PROCESSES

Fig. 10—Drilling and other work. Fig. 11—Carriage put through in large numbers. Fig. 12—Carriage jig under the drill spindle. Fig. 13—Another drill jig. Fig. 14—Carriage inspection and assembling. Fig. 15—Surface grinding small parts on the magnetic chuck

Machine Tools in Spain

By HENRY S. MOOS, M.E.
Member American Machinery Syndicate, New York and Spain

ALTHOUGH at the present moment our exports of machine tools are under a partial embargo, and without doubt the embargo regulations existing at present may influence our future prospects, I feel that it is quite opportune to discuss the subject of trade expansion with Spain. Export trade is not created in a day. It takes some efforts to make the proper connections, and once started, it takes and requires continuous nursing and undivided efforts to hold that trade. Export trade insures the manufacturer added strength and a broader independence in his domestic business, while at the same time it is to him a new and unlimited source of profit. It also enables him, once he has familiarized himself with the foreign market requirements, to keep all hands busy at the factory instead of having to lay off part of his help during slack season with the disastrous effect of having to break in new men when the rush sets in.

I have been living in Spain for twelve consecutive years, devoting my time to the introduction of American machinery; machine tools almost exclusively, carrying on a continuous fight with the rest of your European competitors combined. It has been my experience while in Spain to find out that customers, when their orders are shipped promptly, their specifications carefully observed, and their machines are above criticism, will pledge their loyalty and their trust with the men or the manufacturing concern they deal with to such an extent as to make it extremely hard to win them over to a competing concern.

The Spain of today is beginning to take a more prominent position in the world's markets of machine tools than heretofore. Spanish capital and industries are realizing to what extent they had been depending on the foreign markets and immediately steps were taken to readjust local conditions. Thanks to individual efforts combined with the Government's encouragement, industrial life in Spain has now reached a degree of activity never known before in peace times.

The railroads have recovered from a period of depression, while the merchant marine is so prosperous that the government has discontinued the subsidies granted them in the past.

Although in many instances factories and mills have suffered for lack of raw materials and necessary machinery, yet the higher prices obtained for the finished product resulted in larger profits. The Spanish industries gradually realized the necessity of freeing themselves of foreign market dependency and at present Spain is manufacturing a score of products to which no thought had been given until the country entered this era of prosperity.

The Spanish government has under consideration the establishment of a National Bank of Foreign Commerce, with a view to promoting the establishment of new industries and proposes to grant special protection and privileges to industries by advancing them funds up to 50 per cent. of their capital invested; guaranteeing minimum dividends on the invested money, tax exemptions for a number of years favoring import duties on raw material not produced in the country, imposition of low transportation charges, etc.

Spain's wealth in minerals is an established fact. The Rio Tinto Copper Mines and the iron mines in the Bilbao and Almeria districts are known the world over. Four million tons of iron ore alone are produced yearly in the Bilbao district. The metallurgical plants at Sestao and Baracaldo, near Bilbao, the steel mills of La Felguera, Moreda and Mieres, in Asturies, Nueva Montana en Santander, all have modern coke furnaces and rolling mills for making steel rails, bars, sheets and products of all kinds of iron and steel, machinery and hardware. The government maintains a steel foundry at Trubia for the production of steel for cannons and projectiles. All of these establishments are fitted out with thoroughly modern machinery and appliances, and these several industries are constantly assuming greater importance.

The steel mills of Altos Hornos, of Bilbao, can be favorably compared with the largest plants on the Continent, handling alone in the neighborhood of 3,000,000 tons of iron ore per year.

SHIPBUILDING

The shipbuilding yards of Spain on both sides of the Peninsula are actively at work since the outbreak of the war, and they are continually enlarging their facilities and putting in new and additional equipment. The merchant ships now on the ways represent an estimated total displacement of 180,000 tons. Among the very important shipyards, three are located in Bilbao, two in Santander, two in Barcelona, one in Vigo, two in Cadiz, one at Gijon, one in Ferrol, two in Cartegena. A number of vessels have been recently completed and aggregate about 90,000 tons. One of the shipyards near Bilbao, recently enlarged, occupies an area of 120,000 sq.ft. and employs about 2000 workmen. Two new shipyards are under construction, owned by recently incorporated concerns. The Spanish government has under construction in its own and in some of the larger shipyards a number of war vessels.

Several concerns in Spain are beginning on a large scale the building of ship's engines, Diesel and internal combustion, and inquiries for a large number of machine tools for such shops have recently come in. A new concern in the northern part of Spain specializes in the construction of steam- and oil-driven fishing vessels, and has already placed substantial orders for machinery.

RAILROADS

Spain started to build her railroads in 1840, and at the beginning of 1916 possessed 8700 miles of track. Up to 1915 the Spanish government has contributed $139,000,000 toward railroad construction. The street railways represent some 600 miles of track. About 86 miles of new track was finished in 1916, the extension of the secondary and strategic railways of Spain having been made the subject of a bill by the Government last year, and provide that the concessionaire of any such lines now under construction may obtain a guarantee of interest of the government, the amount to be based upon the initial cost of the undertaking. Instead of this guarantee in the future a fixed subsidy per kilometer will be allowed by the state, the total subvention for any line not to exceed 60 per cent. of the estimated cost.

Heavier locomotives have now been acquired, and many bridges are being strengthened to support them. Some rolling stock has been imported, and Spanish car builders have been active in producing material both for domestic use and for export.

A prominent industry in Spain is the railway- and tramway-car building industry. There are five factories in Spain, two of which are very important. The largest plant is located near the French frontier, and is manufacturing its own axles, tires and wheels, and is turning out thousands of railroad cars per year. A new corporation has just been formed for the manufacture of railroad equipment, cars, tires, locomotives, forgings, etc., and one of the engineers of this concern is at present in the United States studying conditions, with a view of purchasing several hundred thousand dollars' worth of machinery.

The automobile industry in Spain is making notable progress. The largest factory in this line bought about $300,000 worth of American machinery in 1915, and recently there has been established in the central part of Spain a new company for the manufacture of motor trucks, which in the last few months has placed orders for American machine tools, amounting close to $250,000, and is constantly purchasing new and additional equipment. Five airplane factories are working under contract for the Spanish and Allied governments.

MACHINE TOOLS

As a consequence of the difficulties which a number of Spanish manufacturers have experienced in securing machine tools from the United States since 1914, an entirely new industry has been created in Spain. Before the war practically no machine tools were produced there, and at that time only one concern had started to build a facsimile of a German lathe, while some other concerns were making wood-working machinery, two or three types of drilling machines, a slow-speed hacksaw, bench grinding machine, and some power presses; also some tinsmith machinery, which to my knowledge, covered the Spanish machine-tool industry.

There are now at least 20 firms, some of them employing more than 500 men, engaged in the manufacture of a wide range of machine tools, principally upright and sensitive drilling machines, screw-cutting engine lathes, planing and shaping machines, etc., and at the present time all of these concerns are selling all they can produce.

ELECTRICAL INDUSTRY

The electrical industry in Spain has taken extraordinary impetus. The rivers flowing from the Pyrenees and vicinity alone are estimated capable of generating 1,350,000 hp. American engineering skill has been practically demonstrated in the Catalonian district in connection with hydro-electric development and irrigation work. A number of concerns are building high-grade electric motors, generators and other kindred material, and new factories for the manufacturing of electrical and hydraulic machinery are now in course of construction.

The opportunity for American manufacturers to obtain a lasting foothold in Spain is greater now than it has ever been. The number of machine tools shipped in the last three years from this country to Spain is probably larger than the total of such shipments during the 20 preceding years. With few exceptions, these machines have established for themselves and their producers a wonderful reputation, which will serve as a stepping-stone for future business.

This is the time to readjust the national policy, to cater to the golden opportunity of export trade. Reorganization and readjustments for peaceable pursuits will require some time, and it will take time to replace ten million first-class mechanics, experts and trained workmen fallen on the battlefield. The advanced cost of living, increased wages and other causes incident to the war will raise the cost of production abroad.

DUTY OF THE AMERICAN MANUFACTURER

The time is ripe, and it is the duty of American manufacturers to broaden their scope and welcome export trade as the constituted program of their enterprises. Let us realize what will happen to our factories and to our laborers when this disastrous war is over, unless we carefully lay our plans for such markets as Spain to make up for the decline in domestic demand, which will necessarily take place just as soon as the normal condition has once again found its level. All those expenses which have been forced upon us for the last three years to enable us to cope with the unnatural demand for overproduction may prove a severe drain upon the accumulated resources of those who are unwilling to look the unavoidable future in the face.

Grinding Thin Pieces

BY W. NEAL KRAFFT

Perhaps some of my fellow readers have experienced the same difficulties I encountered in grinding accurately and keeping parallel thin steel, soft and tempered.

I was given a bunch of old hacksaw blades that had been worn out or broken in the power saw. From them I was to obtain stock to make size pieces for inspection purposes. These pieces were to start at 0.030 in. thick and run up to 0.050 in. thick, leaving stock to lap, each piece to be 0.001 in. thicker than the other. After grinding the teeth flush with the back of the blades, I clamped 10 of them together, side by side, and placed two flat vises parallel to one another and parallel to the wheel on the magnetic chuck. I put the saw blades in the vise, leaving them sticking up above the jaws about ⅜ in.

The portion protruding above the jaws I clamped together with "Brownie clamps," one clamp to each vise and one in the space between the vises. These clamps were to hold the blades rigid. They also prevented chatter, which is likely to occur where uneven surfaces, due to hardening, are placed together. Moreover, when the jaws of the vise were opened to move the blades forward the proper length, the pieces were held together tightly enough so as to prevent movement of the blades, which would cause the ends of the blades to be uneven and make the pieces of unequal length. I then moved the table of the grinding machine in, cutting through the soft ends—with holes—and cut off about

2 in. This also served to square up the ends. The blades were then cut to ¾-in. lengths until the stock was used up. Before starting to rough the stock down, I dressed the surface of the magnetic chuck perfectly parallel with a 30-Q wheel, which is a very good wheel for cast iron.

Now my troubles started. I laid the stock flat on the chuck after dressing the wheel perfectly true with the diamond. I proceeded to rough all the pieces to the same size, using a cut of 0.001 in. per each feed across. For this operation I used a new 46-G wheel, which was the best I had at hand. It was 7¼ x ½ x 1¼ in. I demagnetized the chuck, then placed the pieces on a true surface plate (the inspector's) and indicated them with a "last-word indicator." I found that they had bowed in the middle about 0.003 in. I placed the pieces back on the chuck without magnetizing them, so as to grind the bow out. I would say that this was caused by two reasons—by friction of the wheel on the stock, causing heat, and by magnetism drawing the stock down flat on the chuck, whereas by throwing the switch out, it relieved the stock and allowed it to return to its original shape.

THE SECOND METHOD

This time I ground the bowed side parallel, then turned it down to the surface of the chuck, magnetizing it. I used a cut of 0.0002 in. on each cross-feed. I found that the stock bowed some, although not as much as before. This I believed was due to too much wheel surface causing an overabundance of heat. This would not do, so I thought of eliminating some of the cutting surface of the wheel by dressing the wheel to a little under ⅛ in. wide. This plan also worked about the same as my second attempt, still causing too much heat, although hardly noticeable to my hand, yet enough to make a little bow in the stock.

By this time I was beginning to wonder if the foreman did not think I was spending too much time on the job, so I began to do some "tall thinking." If the heat from the wheel could be cut down or eliminated, the job would be "easy sailing." I used a pair of pliers and broke a piece from the wheel, perhaps ½ in. deep and 2 in. long. On the other side of the wheel, just opposite to this, I broke out a piece of about the same size. I then dressed the face of the wheel with a diamond and went ahead with the job. Thus, I want to impress on my fellow readers, by hacking the face of the wheel the continuous friction of the wheel on the stock was broken, and there was not enough heat generated to spring the steel.

THE QUESTION OF SAFETY

Perhaps some machinists would hesitate to use a wheel broken out like this, but by pinching off the pieces with pliers I believe the wheel is not strained as it would be by a blow from a hammer. Also, there is quite a difference in the centrifugal force in a wheel ½ in. thick and of one ⅛ in. thick.

I have since talked with gagemakers who have followed surface grinding for years, also with several toolmakers, and they had never heard of this little trick. I offer it to those who have work of this character to do and who have experienced the same trouble that I had.

Women In Industry

By Entropy

As usual, we are groping with a new problem by doing what has been done before instead of analyzing it and going after it with long strides.

Women in industry can, of course, do what they have already done, in greater numbers, and they will, once the chance is offered. They will tackle any kind of a job that is offered them. They recognize no limitations, and for that very reason need more careful supervision than men.

THE FIRST STAGE OF EMPLOYMENT

The first stage of employment for women brings out those who prefer jobs where they can wear their last year's ball dresses to save buying overalls. These girls want rest rooms, short hours, light and clean work. After this class is taken out of the idle community, however, there comes the serious minded woman who works of necessity, born of the departure of the bread winner, or out of sheer feeling of duty and the necessity of doing her bit, who cares little for the risk of overexertion, does not know what she can do, but is willing to do anything which is within reason.

There must be some pretty definite limitations, which should have been discovered long ago. How heavy a weight should a woman lift? Here, for example, is an instance where individual parcels weigh about ten pounds each, rated as a perfectly safe weight for women to lift from floor to bench, yet they prefer to pile up five or six parcels and make one lift of it. Is it safe to let them do it? Who can tell us?

Some say that a woman cannot drive a nail, but here is a shop where they have driven some tons of nails with fewer pounded thumbs reaching the hospital than in a similar number of men. To be sure it gives a man a shiver to see them do it, but the results are all right if the methods are crude. What weight hammer is adapted to the feminine hand, and what is the proper shape? Almost every industry has ideas of its own as to the desirable hammer to use. A shoemaker's hammer is a poor instrument for a stone mason to use, but no one has worked out a feminine implement of this kind.

WORKING CONDITIONS

Do women stand heat, dampness, cold, or must they be protected? To see the cruelty with which they costume themselves it seems as though men needed more protection from the elements than these girls, but in the shop they ask for comfortable working conditions. But do they ask for any better conditions than men ought to insist upon?

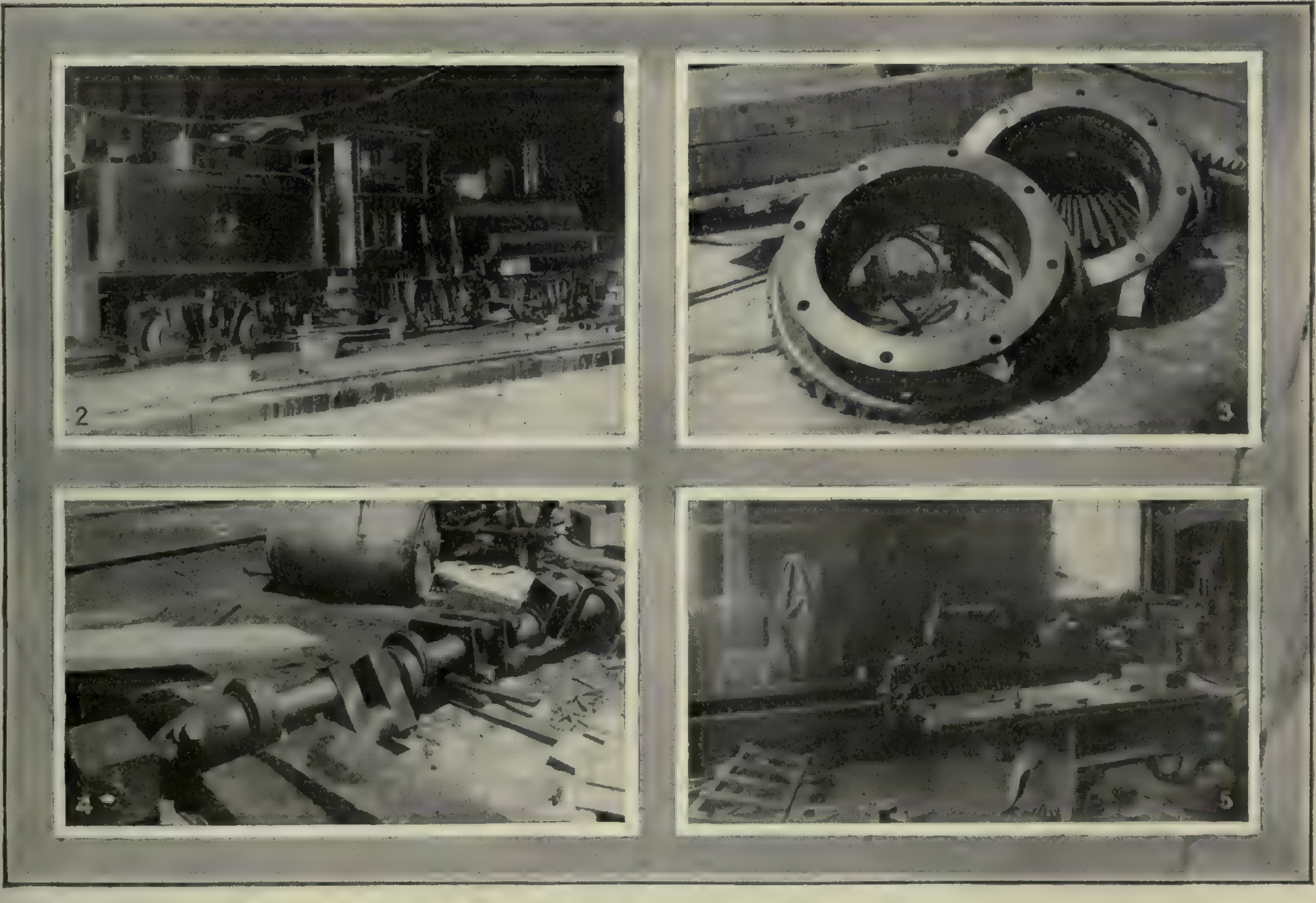
These and many more conditions should be the object of inquiry. These and similar matters, were presented to a committee of one of our prominent women's organizations as affording an outlet for their energies, which would prove of real value to the country, but they did not prove spectacular enough, so they are spending money and effort counting those that are already in the industry, while the rest of us are groping in the dark and trying, little by little, to increase their working field. Will some mere man study this out for us, or shall we have to wait until the ladies have performed all the grandstand tricks that they can before they will give us help?

REPAIR WORK in a STEAM SAWMILL

SPECIAL CORRESPONDENCE

THE machine shop of a big sawmill has a variety of equipment to take care of, which in general differs materially from the class of machinery usually overhauled in the common run of repair shops. In addition to the regular sawmill machinery there is the woodworking apparatus in its numerous forms, the logging outfit with various types of locomotives and cars, hoisting winches, yarding engines, loading cranes and so on to take care of. A typical repair shop for a plant of this kind is shown in the headpiece, this view representing the exterior of the shop at the mills of the Verdi Lumber Co., Verdi, Nev. A casual glance at the illustration will reveal the fact that some of the work here is akin to that in railroad shops. The front portion of the structure is arranged with stalls for logging engines, there being three tracks leading into the building. Two of these have drop pits, as shown clearly in Fig. 2, which is an interior view.

On the far track will be seen a Shay locomotive undergoing the process of overhauling. This is a 50-ton

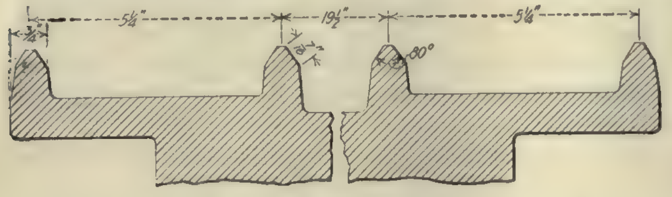


FIGS. 2 TO 5. VARIOUS TYPES OF REPAIR WORK

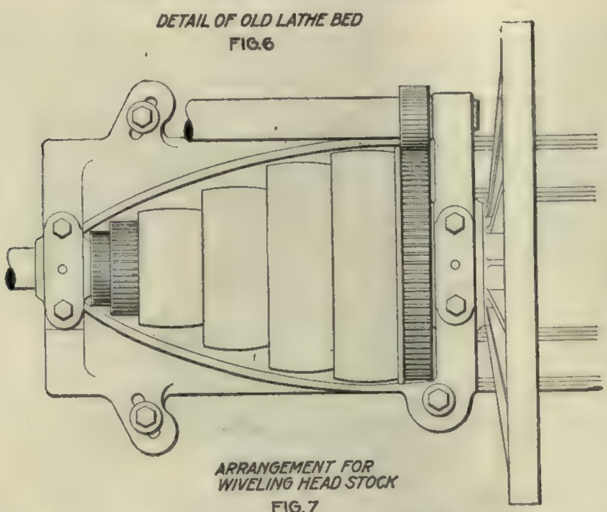
Fig. 2—Logging locomotive over the pit. Fig. 3—Bevel driving gears for logging locomotive. Fig. 4—Repair to a crankshaft. Fig. 5—Two old tools in the repair shop

engine and one of several used for hauling log trains from the camps across the Sierras to the mill pond in Verdi. This engine, as indicated is driven by three vertical cylinders at the right-hand side, the connecting-rods operating a three-throw crankshaft placed longitudinally below the side of the firebox and connected by means of knuckle joints and shaft with a pinion shaft that actuates the bevel gears and wheels under the tender. The drive is thus transmitted to the tender wheels only. On this locomotive the driving mechanism is on one side only, as explained above; but on the larger, or 70-ton, engines of the company the drive is duplicated on the left side.

The gears attached to the wheels of the tender are of cast steel in the form of heavy rings, several of which are shown in Fig. 3. The cast teeth are sufficiently accurate to require no finishing further than touching up here and there with a file. They are provided with eight holes for through bolts by which they are secured to the sides of the wheels, the bolt holes being drilled in the flanged faces of the gear rings, which fit closely in recesses in the wheel faces. These bolt holes in gears and wheels are reamed in line, and body-fit bolts are used. The actual drive is taken by rectangular keys fitted in crosswise seats in the flanges, so that the bolts are not subjected to shearing stresses and the crosskeys carry the stress at a radius practically as great as that of the bevel driving gears. The latter are themselves almost as large in diameter as the wheels to which they transmit motion.



DETAIL OF OLD LATHE BED
FIG.6



ARRANGEMENT FOR
WIVELING HEAD STOCK
FIG.7

FIGS. 6 AND 7. DETAIL OF OLD LATHE BED AND ARRANGEMENT FOR SWIVELING HEADSTOCK

The form of the crankshaft is shown in Fig. 4 which represents a discarded shaft lying in the shop yard. It is still of interest at this point as illustrating a neat repair to a pair of webs, which enabled the locomotive to be operated with the old shaft until a new one could be secured and put in place. The broken webs were on the central throw. The repair consisted in forging up two heavy U-shaped straps, which were turned down at the ends and threaded for nuts so that when the straps were fitted tight over the webs a pair of flat plates could be slipped over the reduced strap ends and the nuts applied to draw the U-straps snug about the webs.

An interior view of the repair shop proper is reproduced in Fig. 5. This view is chiefly of interest as representing a couple of old-time machine tools, many examples of which are still to be seen in the smaller shops, both East and West. The other equipment in the shop is of the general modern type, therefore only the one view is given here.

The lathe is of 36-in. swing. Although dating back a good many years, it has a headstock and carriage that would be considered well proportioned for a machine of say only 10 or 15 years back, or shortly before the advent of high-powered tools. Its chief feature of interest to those familiar with early designs of machine tools is found in the proportions of the shears. These show, as all old tools do, the influence of wood-turning machines of the period, whose light section beds and narrow shears were carried over into the design of metal-working lathes of that day.

Fig. 6 gives an idea of the proportions of bed and ways. It will be seen from this illustration that, although the swing over the bed is 36 in., the shears are formed with only $\frac{7}{16}$-in. bearing surface on each side of the inverted V, and the bases of the V's are only ¾ in. thick. The included angle is 80 deg.

This lathe is adapted for taper turning and boring by an unusual arrangement of headstock, which permits a swiveling adjustment of the head to throw it out of parallelism with the ways, the tailstock having the usual cross-adjustment of the spindle to suit the offset required for taper turning. The head is shown roughly in Fig. 7. As there indicated, it is provided with slotted lugs at the rear end and with a swiveling point at the front, so that it may be thrown around to the desired angle. When set as required, it may be locked by the screws passing through the curved slots into the bed.

It should be mentioned in this article that one of the important departments of the plant is a box shop for manufacturing shooks for packing boxes of all kinds. An immense quantity of such boxes is required for packing fruits by California establishments, and the greater portion of the output of this factory is absorbed by these packing houses. The factory has an output of 30,000 ft. of shooks per day, all of which are shipped in knocked-down condition to the purchasers.

Bushing a Loose Pulley

By W. E. Peskett

The scheme for bushing a loose pulley described by C. Hecker, page 414, of the *American Machinist*, appears to allow the lubricant to escape by reason of the saw cuts.

This objection can be overcome by the following means which I have used on several occasions: Rough bore, rough turn, saw into halves, sweat the two parts together, finish bore and finish turn. If the bushing is warmed, after completing the above operations, the two halves will come apart for the final fitting operation.

The Airplane Situation

SPECIAL CORRESPONDENCE

The mechanics of aviation, and it is a mechanical problem from start to finish, have always been keenly interesting to the mechanical engineer, even though not engaged in this particular line of work. The great utility of all kinds of aircraft in the war makes them of vital interest and it is gratifying to have an article from such an eminent authority as Glenn H. Curtiss. We would also refer those interested to his former article, which appeared in the "American Machinist," June 17, 1909.

NOW that airplanes have become as thick as birds in the skies around training fields, people give little thought to the various phases through which this new medium of transportation passed before its successful application and final acceptance.

A "scientific fact," says Agassiz, the celebrated naturalist, "passes through three stages." First, it is said that it conflicts with the Bible. Second, that it has been discovered before. Lastly, people say they have always believed it. Aircraft inventions and improvements have passed through similar stages. The work of the aircraft pioneer was first publicly ridiculed, then begrudgingly tolerated, but finally acknowledged with great acclaim, as the most marvelous achievement of the twentieth century.

In aviation three names stand out sharp and clear: "Langley, Wright and Curtiss." Of these three, Glenn H. Curtiss has done more to develop the practical side of aviation than any other man. To him must be given the credit of having trained more men and built more airplanes than any other individual in the world today. He is still a man under forty years of age.

After the declaration of war, he put nearly all his time and resources at the disposal of the Government. His vast experience and his knowledge of the art has made his counsel most valuable.

It is, therefore, with a great deal of pleasure that we print in this, our Anniversary Issue, a personal interview with Mr. Curtiss on the subject of airplane development, and its effect in the present conflict on the other side.

Deciding Feature of the War

"From conversations which I have had with military men who are familiar with conditions on the western front and from the published reports which I have read of recent advances made by the Allied forces, I believe if any one element can decide this war, that element will be the airplane.

"Success in trench fighting today is largely dependent on artillery superiority. The army which succeeds in pouring into the opposing trenches a sufficient amount of steel has a comparatively easy time of it when the infantry is moved forward. In some instances an entire divisional staff has been wiped out by a properly placed sixteen-inch shell—a shell directed by airplane. Heavy artillery is of little use unless it can be properly directed, and, for this reason, with the wider use of this type of ordnance, the necessity for airplane observation has been greatly intensified.

"Since the failure of the Zeppelin raids in England, Germany, it is understood, has been making feverish preparation to enlarge her air force by building great numbers of speedy airplanes. News which I have had from our men in London indicate that the Germans are employing these machines for 'moonlight' raids over England and for general patrol duty.

"While I believe it is generally allowed that the Allies have won supremacy on the western front, yet, to keep it and destroy the German submarine bases, and successfully prevent night bombing expeditions, faster and larger airplanes will be required. France and Great Britain cannot materially increase their aircraft production at the present time, and it is for this reason that they look to us in this emergency.

"The question of obtaining the proper machines is not, however, the only big problem, but how to get men to man them efficiently is an equally difficult task.

"The present plan for training aviators encounters a special difficulty. That is the lack of pilot instructors accustomed to fly the speedy fighting craft. There is no one to blame for this, as the United States up to this time has not needed men possessed of this special expertness. There is a problem, however, that the Government is successfully working out, and it should not be long before we shall be able, with the help of the experienced French and British airmen, to furnish a number of expert pilots, trained in America and flying American-made machines.

Types of Airplanes

"As to the type of planes which will be used to finish the war, I do not believe our possession of air mastery will be secured by the use of any particular size or type of airplane. All types will be needed: Flying boats for coast patrol and submarine hunting; small, speedy machines for combat work and scouting; large and powerful machines for raiding and trench bombing, and probably several types will be developed to take care of various other exigencies as they arise.

"In fact, the range is as extreme as that in the navy from torpedo boat destroyers to super-dreadnaughts. The discussion about particular types of aircraft is the same as that through which the navy passed. With a swing of the pendulum, some favored the torpedo boat almost to the exclusion of other craft; others demanded that only big-gun battleships be built. Just as an efficient navy does not consist of all big battleships, or of all submarines or all light cruisers, neither can an efficient air-service consist of only one type of plane, however successful its performance for its particular design or purpose.

"Actual fighting between men in the trenches and airplanes equipped with machine guns has been reported. Possibly a special type of machine will have to be designed for this purpose before the war is over.

"The Germans are wonderful refiners and exceedingly clever adapters. They very quickly copy French and

English machines whenever they fall behind their lines, and in many cases make improvements. They will, of course, do this with the American machines. The Germans, however, have shown little real inventiveness during the war, and for this reason I believe we can keep ahead of them.

"No one need doubt the ability of the American aëronautical engineers to produce craft which are more powerful and speedier than any of which have been used abroad. Best of all, we have the material and factory facilities for turning out a vast quantity of any kind of machines that may be required for use by the Allies or ourselves.

"The Government, through its many branches, has made wonderful progress in air work, and these French and English engineers with whom I have talked seem to be more than satisfied with the result of our efforts thus far.

"While I cannot, due to the Government censorship, tell much about the details of the newer type of airplanes, hydro-airplanes and flying boats, I can, without violating confidences, say that we are developing machines today that will be superior to anything now in use in Europe, and these in sufficient quantities to meet the demands of the program that is contemplated by the War Department."

Progress in Locomotive Building and Repairing

By I. C. NEWMARCH
Superintendent Shops, New York Central Railroad Co., Collinwood, Ohio

IN THINKING over the progress made in locomotive repairing and machine shop practice, I am carried back to my boyhood days, when I started to serve my apprenticeship in the Grand Trunk Shops, located in Montreal.

The experience that I received then has been beneficial to me all throughout my railroad career. When I think of the crude methods and means we employed for handling the different classes of work at that time, I realize the wonderful improvements we have made in machinery of all kinds and in all departments used for manufacturing and repairing locomotives.

In the year 1885, the majority of our machine shops knew but little about high-speed steel, consequently carbon steel was used throughout the world on all machines that required cutting tools. From this it can be realized that the output of the shops was limited to a considerable extent.

Introduction of High-Speed Steel

Tungsten as an alloy of steel had been known and used for a long period of time, it having been employed in the celebrated Damascus steel, but its actual effect was not known until Robert Mushet, after much experimenting, brought out the famous Mushet high-speed steel. This caused radical changes in treating the crucible steel, and much progress and great improvement has been made along this line up to the present time. Prior to the use of high-speed steel, it would take on an average of 18 to 20 hours to turn one pair of locomotive driving wheel tires.

In 1885, in some shops, they were able to turn out one pair of driving wheel tires in nine hours. This gain in time was also true with other machines used in the general machine shop.

In the year 1900, with high-speed steel much improved, the machines in operation were found to be almost useless. The machine builders began to realize what was required, and consequently, they at once began the building of machines to meet the requirements made necessary by the use of high-speed steel. Wheel lathes, engine lathes, boring mills, planing machines, etc., came on the market and greatly accelerated the output of the shop throughout the different departments.

In the year 1909, we ran a test on a new wheel lathe, that we received from the Niles people, and we turned 14 pairs of driving wheel tires in 10½ hours.

On other improved machines, the output has more than doubled. This is true in the average machine shop. This was all brought about by the use of high-speed steel and improved machinery, without which it would be impossible to build or take care of the heavy motive power that we have in this day and age.

Advent of Pneumatic Tools

About the year 1885, air drills, air hammers and air compressors were made and being experimented upon. A comparatively limited number of the drills and hammers were placed in shipyards and boiler shops, but their introduction to railroad shops did not occur until some years later.

In the year 1893, the Chicago Pneumatic Tool Company was organized and began actively to introduce its hammer in railroad shops. The air drills on the market at that time were made in Philadelphia, and called the Phoenix rotary air drill. They were light in construction and did not have much power. However, a piston drill was brought out, and at that time was considered almost perfect.

Several companies have come to the front with piston air drills having roller bearings, and which are considered strong and durable, and which will meet the requirements of any department. These air drills revolutionized drilling, reaming and tapping in locomotive shops. Previous to the use of air drills, ratchets were used. In many instances flues were rolled by hand. The flue holes were reamed by hand, and in a great many cases all work had to be done by hand. This has all been eliminated by the use of air drills or motors. The pneumatic tools have been the means of reducing the number of men that were usually required to do certain kinds of work to about one third.

The bulldozer and forging machines in our blacksmith department are great labor savers in the way of producing forgings of all kinds. Before these tools came on the market, forgings of all descriptions were made on the anvil. Today, it is only a question of the making and manufacturing of dies to take care of the various kinds of work in our blacksmith shop. In fact, hundreds of forgings, usually made by hand, are turned out on this machine, and the output has been increased one half.

BOILER SHOP METHODS PAST AND PRESENT

The work in our boiler shop back in 1885 was crude compared with the improvements of the present day. At that time, the boilermaker was obliged to do all of his work by hand, such as the removing of side sheets, stay-bolts, etc. They were cut out with the hammer and chisel. The holes were drilled in the fire box with ratchets and flat drills. The tapping of stay-bolts holes and similar work was done by hand. Later on, I recollect that we had what was known as a flexible shaft which was used for the tapping of stay-bolt holes. This has all been changed in every sense of the word. Removing of firebox sheets today is done by the use of the torch, which is also used for cutting off stay-bolts in quite a number of shops.

The engines were being built larger from time to time to the present day, and consequently new methods of handling work became necessary and have been adopted. As the material in boilers is getting heavier, it is necessary to have up-to-date machinery, such as shears, punches and rolls. The flanging of today in quite a number of our shops is done by hydraulic pressure. All rivets are driven by hydraulic pressure or with air hammers. This has increased the output in the boiler shop to a great extent.

At one time the welding of flues was done with a charcoal fire. As the flue was heated a man tapped the flue end with a tapper, and when brought to a welding heat, it was welded in a roller machine. The flue was then put back into the fire and swaged with a hand-swaging tool. Today, in quite a number of our shops, flues are welded with electricity, and in other shops they are welded by the use of oil furnaces, and under what is known as a Draper hammer.

In the years 1908 and 1909, Oxweld acetylene welding was adopted for boiler work. This brought about a complete revolution in the method of boiler repairing. By the Oxweld acetylene method, we are welding all horizontal seams in the fireboxes, doing away with the troublesome leaky seams. Patches of all kinds in the fireboxes are also welded. I believe today that the welding process has been adopted all through the country for many different classes of work throughout the locomotive departments. About the same time electric welding came into vogue. This was used extensively for the same class of work as the Oxweld acetylene welding, it being used extensively in the way of flue work, the welding of flues, beads and back flue sheets. By doing this, we get two or three times the amount of mileage from them over the old method of merely prossering and beading flues.

All these methods greatly increased the output of the shop in general and the schedule system for timeing engines in and out of the repair shop was soon adopted continues to be followed.

PROGRESS IN BRAKE EQUIPMENT

There has also been a radical change in the brake equipment on our locomotives. Back in 1885 we had what is known as a vacuum brake. Today, we have what is known as a Westinghouse air brake, and what a vast improvement has been made in it in the last 30 years. The Westinghouse air brake adopted what is known as the 6-in. air pump and straight air with the old three-way pump. We now have what is known as a cross compound air pump with the ET equipment. This in itself has made a wonderful improvement in the way of handling power.

Women Employees and Increased Production

BY JOSEPH A. HOLLAND
Employment Manager, Remington Arms Co.

IN THE past, employers were confronted with the problem of getting the right man for the right job; now it has changed to getting any man for the job. In these unsettled times, it seems impossible to get sufficient men of any description to meet the demands. The suspension of emigration, voluntary enlistments, the draft, have brought about such precarious conditions as to cause the manufacturers grave anxiety.

In view of the decreased man-power, how can they meet the enormously increased demand put upon them?

The partial solution of the difficulty lies in the introduction of female labor into the various industries hitherto monopolized by men.

The hiring of women calls into play all of the employment manager's ability. By the trend of his natural instincts, by intensive training, he has become a specialist in humanity. Through his daily contact with applicants, he learns to read the meaning of an unconscious gesture; the varied manners of speech; he studies the self-drawn lines of a countenance as a scholar pores over an ancient volume. There is no tone of the voice but echoes some feeling, no expression that does not mirror some hidden trait, and it has become the employment man's vocation to read them all. The detective has long used this art for the criminals' downfall; the employment man is now using it for the general uplift.

But when he deals with women applicants, he frequently finds his well-established theories at fault and his careful training ineffectual. Subterfuge may or may not be essentially more feminine than masculine, but the woman applying for a job all too frequently fails to appreciate the fact that now, as an integral part of the industrial world, she has new responsibilities. She does not realize that references are not only demanded but investigated. She seems to feel that a lie is well risked in the procuring of a job. Moreover, when once installed, she does not feel the same necessity of steady attendance as does the man.

All this on the one hand. On the other, outweighing it, are the really splendid results shown by our women employees. They demonstrate a dexterity, a perseverance in overcoming difficulties that has outdistanced their male predecessors. In some instances—the production of small, intricate and duplicate parts—they have increased the output over 400 per cent.

In allotting the women to the many positions now open to them, all the employment manager's discernment is needed. Girls, who are complete failures at one type of work, often make good at once when transferred. Not only their age, weight and height must be considered, but their temperaments and training.

The necessity of female labor has brought many radical changes into the old methods of factory life. For years these changes have been discussed and advocated, but it is only within the last decade that they have been effected. Rest rooms, restaurants, dormitories, a welfare department, healthful and hygienic buildings, are the common order now of the big, up-to-date factory. And it is due to these improvements that the personnel of factory women has been so much bettered. The stigma of the term "shop girl," has been lifted, and girls from every walk in life now seek employment in factories.

The two types that most harass the employment manager, are the wives who are working temporarily to earn a specially coveted sum, and the girls who come from homes where their earnings are not needed. Naturally, they do not display the earnestness or tenacity of purpose of the self-dependent worker.

The safe-guarding of the future industrial success lies in the hands of the employment manager to a marked degree. It is to his foresight, his choosing of faithful and competent employees that the manufacturer must look. If owners of factories have neglected or slighted the importance of this department in the past, they must now make good their omissions. They must inquire into and secure the best employment systems in use, choose a competent head, then give him freedom to work out his theories for their mutual benefit. The manufacturer who does not reorganize his factory, his methods of employment, his views, to accord with the change of the times, faces disaster.

The demand and supply of labor is the industrial barometer. Success lies in the ability to anticipate it.

Some Personal Recollections of the "American Machinist"

By FRED H. COLVIN

ALTHOUGH I am not quite a Methuselah, and the *American Machinist* is forty years old, it has been my privilege to be intimately acquainted with it for the greater part of its existence. And while I cannot boast of having read the first issues, being in short trousers at their particular date, the *Machinist* began coming to our house soon after its introduction to the mechanical public—and it is still coming. My father took the paper almost from its beginning, and as it was very much more general in its policy at that time than it is today, it contained more of interest to the mechanically inclined boy.

About five years later, at the age of fifteen to be exact, I went into the shop as an apprentice and began reading the magazine as a part of the business. Two years later our shop was visited by a special correspondent of the *American Machinist*, James F. Hobart by name—who by the way, still contributes occasionally to its columns. Mr. Hobart looked over some of the stunts we had devised for handling various kinds of work, including some special tools and fixtures, and urged me to prepare them for publication in the *American Machinist*. He little knew what he was doing, for this was the beginning of the writings of various kinds with which I have inflicted the mechanical public ever since. My initial effusion appeared in the issue of Apr. 3, 1886, and Hobart was the guilty man.

I soon after became acquainted with the editors and business managers of the paper, but not, however, until after the first editor, Jackson Bailey, had passed away. At the time of my introduction to the old office at 96 Fulton St., the business end of the *American Machinist* was being conducted by Horace B. Miller and Lycurgus B. Moore, while its editorial destiny was in the hands of F. F. Hemenway and Fred J. Miller. Not only an introduction, but a guide as well, was necessary to find the old office on Fulton St.; because although the office itself was on the corner of Fulton and Nassau Sts., the entrance was up a dingy pair of stairs about halfway down the Fulton St. side, and then through a still dingier hall to the one large office which held the whole establishment at that time.

Both Mr. Hemenway and Mr. Miller were particularly kind, and at once we became friends. Mr. Hemenway died long years ago, but the other friendship has remained.

Another member of the staff who has passed to his reward was J. G. A. Meyer, or "Prof." Meyer, as he was affectionally called by all who knew him. He it was, who wrote an exhaustive series of articles on the Designing of Locomotives, also Practical Lessons on Mechanical Drawing, all of these being illustrated from his own drawing, he being master of this art. The next office of the *American Machinist* was at 203 Broadway, and this seemed quite palatial in comparison with the older one on Fulton St. Here Fred J. Miller became editor-in-chief, and the paper also passed out of the hands of the original owners and into the control of Max Jaegerhuber, who ran the business end for a short time.

Previous to this the *American Machinist* had launched a new paper, the *Locomotive Engineer*, to fill the same field for the railway engineer, fireman, and shopman as the *American Machinist* did for the men engaged in making machine tools and similar machinery. And in looking around for a man to edit this new publication their attention was directed to a Western contributor who occasionally sent railroad articles to the *American Machinist*. This man was John A. Hill, who came to New York in November, 1887, to begin his work on the initial number of the new paper which appeared in January, 1888. This was first issued from the old office on Fulton St., and it was very soon after Mr. Hill's coming to New York that I made the acquaintance of this man who was afterward to leave such a lasting impress on the whole conduct of technical journalism in the United States.

The early history of the *Locomotive Engineer*, and the *American Machinist* are so closely allied that it is necessary to refer to both to get a bearing on the later developments of the *American Machinist*. After publishing the *Locomotive Engineer* for about four years, it was sold to Angus Sinclair and John A. Hill, who immediately changed the name to *Locomotive Engineering*, and although it reads like a fairy tale, it was only a few years after this, that Sinclair and Hill had the controlling interest of the parent paper.

During these years Frederick A. Halsey, and Frank Richards had become associate editors of the *American Machinist*, and later came Frank A. Stanley and E. A. Suverkrop. The latter is the only one of the staff as it existed under the leadership of Fred J. Miller, who is now directly connected with the staff. Mr. Stanley, however, is still a contributor and correspondent.

The changes which have since taken place are probably as familiar to the majority of the readers as they are to me, but it is particularly interesting to look back and see how comparatively few changes there have been during the past forty years. The business end has changed even less than the editorial, and from 1896 until 1916, when Mr. Hill laid down the reins, the whole policy of the *American Machinist* was in his hands; how well this succeeded is very clearly shown by the advances it has made.

A little chronology may help to make the changes more clear, and the appended list will not only serve to show just who has controlled the destiny of the paper at various times, but will also refresh the memory of many of our older readers, who, like myself, look back with pleasant recollections on the acquaintances of the former days:

EDITORS:	BUSINESS MANAGERS:
Jackson Bailey	Horace B. Miller
F. F. Hemenway	Lycurgus B. Moore
Fred J. Miller	Chas. W. Bigelow
F. A. Halsey	John A. Hill
L. P. Alford	Clarence P. Day
J. H. Van Deventer	N. C. Robbin
Fred H. Colvin	Mason Britton

Shop Messenger Service

BY H. M. FITZ

So many articles on the subject of shop messenger service have been written (theoretical and practical) that it is hard to present the same old story in a new way. At the same time, there is no end to efficiency, and every day we find old ideas applied in new ways.

When the writer was a machinist apprentice 25 years ago, we had shop messengers, and the first three months in the shop were devoted to this kind of work. One of the first things we were told was that in order to become good mechanics we would have to learn to chew tobacco. Most of us learned this first; and it so happened that if a mechanic wanted anything done, the quicker he came across with a chew, the quicker he got what was required. On the other hand: "Here is a chew, kid. Don't get back with that reamer for an hour." If the messenger returned in less time, something was wrong with the reamer and it had to be sent back to the toolroom. The planning, if any, was done by the man working on the job. The messenger service was in effect, not always to save time, but more for the reason that boys were available at 50c. per day.

But today the shop messenger service plays a very important part, and we wonder many times how we could get along without the messenger tooth in our system gearing. Before the messenger service was started in a certain plant, the toolroom and stockroom windows were noticeably jammed at certain times with mechanics, machine operators and others. Also, the rough-casting department had its expensive visitors; the blacksmiths, who dressed tools, were entertained regularly; and the drawing room was a regular recreation hall. All this lost time was recorded for several months to find out definitely what we were doing and, figured on a basis of 234 working hours with nearly 700 men, rates varying from 25c. to 60c. per hour, 81 per cent. of the time on piecework and bonus, it worked out as follows:

	Man-Hours		Machine-Hours		
	Daywork	Piecework Bonus	Daywork	Piecework Bonus	Total
Waiting for job or instructions	46.2	23.0	27.0	19.0	115.2
Machines out of commission for repairs	75.4	49.3	98.5	37.8	261.0
Waiting for material	52.0	19.4	44.0	17.1	132.5
After drawings, oil, waste, etc.	125.8	60.0	107.3	36.0	329.1
After tools, jigs, etc.	188.0	102.6	165.0	98.0	553.6
Total	487.4	254.3	441.8	207.9	1,391.4

The total lost hours, 1391.4, minus items 1 and 2, 376.2, which have little or no bearing on messenger service, show a balance of 1015.2. Items 3, 4 and 5, which are directly affected and have been practically eliminated, register as follows:

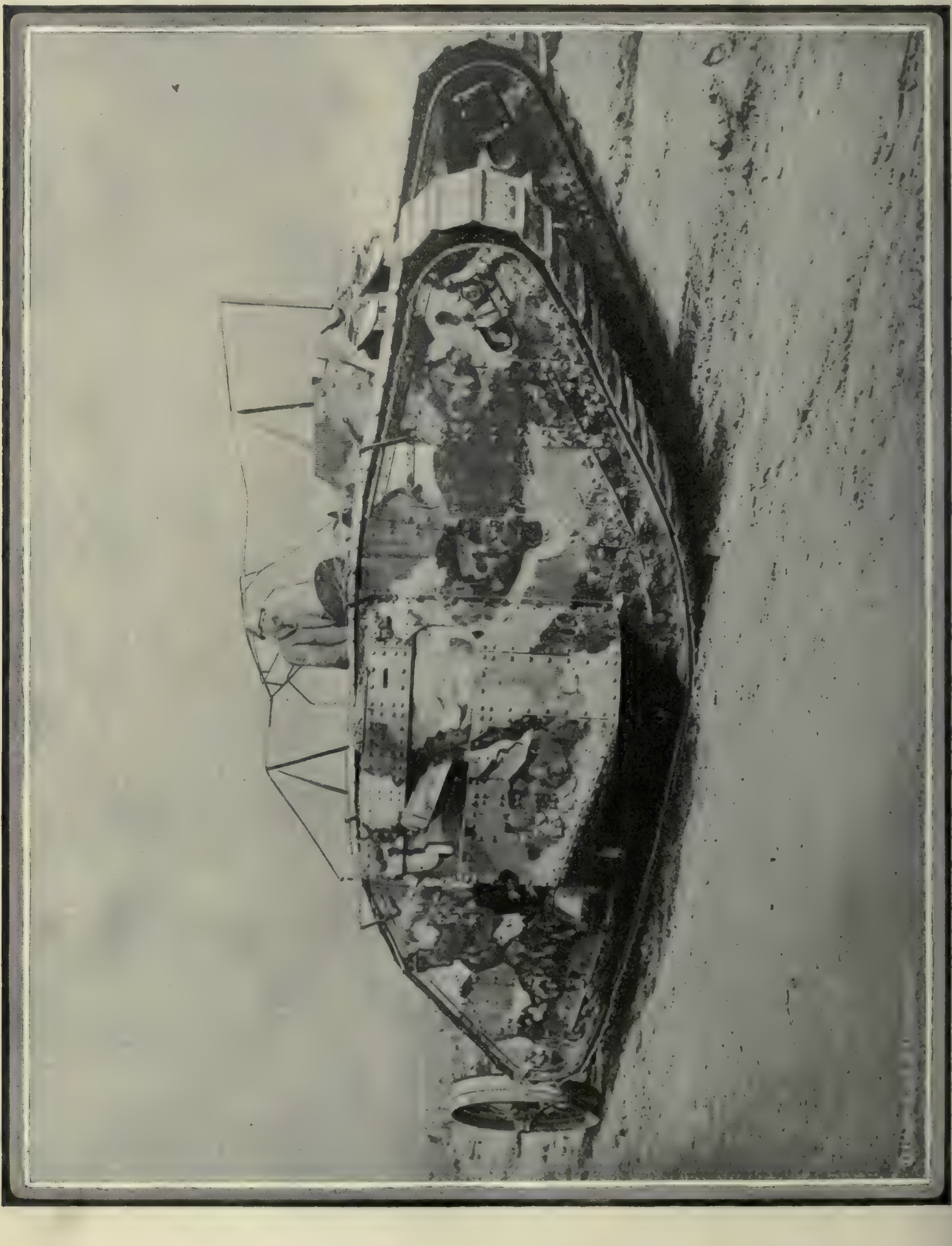
Man daywork hours, 365.9 @ an average 38c. per hour	$139.04
Man contract hours, 182.0 @ an average 71c. per hour	129.22
Machine contract and daywork, 467.4 @ an average 68c. per hour	317.83

Six boys were employed, coached and trained at 20c. per hour as messengers. For the 234 hours their pay equals $280.80. This gives a balance of $305.29. Although the actual saving in hours is but 87 per cent., it is far greater than the figures given in money, as the overhead cost must be considered. They also were able to reduce the contract prices 10 per cent. The saving here fluctuates according to the volume of business and can be figured every month accordingly.

I wish to call particular attention to time lost by the day workmen compared with those working contract. The remaining 19 per cent. of time not covered by contract shows a loss of time over 100 per cent. greater than the 81 per cent. of time covered.

The messengers work for promotion on a merit system consisting of number of trips, deportment, punctuality and cleanliness. At the first of each quarter the boy with the highest number of credits is given a substantial increase in wages or a contract job. This incentive makes the boys move faster and keeps them trying to do better to win promotion. Although not advertised, plenty of boys are available for this position, and boys performing other functions want to go back, as it were, and start as shop messenger. The duties of a messenger boy are both interesting and profitable; and instead of shopwork being a drudge, we are all trying to make it more interesting by turning the slow, long, loafing hours into a record of profits.

The British Tank *and the*



Man Who Suggested It.

Col. E. D. Swinton

VERY few, except those who have actually seen the great land battleships now being employed on the Western front can form an adequate idea of the huge bulk of these tanks. The view on the opposite page is a good sample of a tank camouflaged to hide it as much as possible from observers or airplane scouts. Painted cloths may be thrown over the framework on the top, making it practically immune from airplane detection. Colonel Swinton is credited with being the man to first suggest the modification of the American caterpillar tractor to form one of the greatest war engines known.

It is perhaps suggestive of the German temperament that they should not have originated these engines of war. But they do not seem to take the initiative in mechanical matters. The use of the caterpillar tractor was well-known as they had a number of United States built machines in their maneuvers long before they started the war. Such machines, used earlier in the war when the offensive was in their hands, might have broken through the Allied lines. Fortunately for us the initiative was on our side, and the battle of Cambrai shows what they can do.

In view of the recent achievements of these machines, the following English Tommy's account of his first view of a tank will be of interest. This is an extract from a book entitled "All In It," by Major Ian Hay Beith, and is published by permission of the Houghton Mifflin Co.

"Down in the forest something stirred. But it was not the note of a bird, as the song would have us believe. From the depths of the wood opposite came a crackling, crunching sound, as of some prehistoric beast forcing its way through tropical undergrowth. And then, suddenly, out from the thinning edge there loomed a monster —a monstrosity. It did not glide, it did not walk. It wallowed. It lurched, with now and then a laborious heave of its shoulders. It fumbled its way over a low bank matted with scrub. It crossed a ditch, by the simple expedient of rolling the ditch out flat, and waddled forward. In its path stood a young tree. The monster arrived at the tree and laid its chin lovingly against the stem. The tree leaned back, crackled, and assumed a horizontal position. In the middle of the clearing, twenty yards farther on, gaped an enormous shellcrater, a present from the Kaiser. Into this the creature plunged blindly, to emerge, panting and puffing, on the farther side. Then it stopped. A magic opening appeared in its stomach, from which emerged, grinning, a British subaltern and his grimy associates.

"And that was our friend's first encounter with a 'Tank.' The secret—unlike most secrets in this publicity-ridden war—had been faithfully kept; so far the Hush! Hush! Brigade had been little more than a legend even to the men high up. Certainly the omniscient Hun received the surprise of his life when, in the early mist of a September morning some weeks later, a line of these selfsame tanks burst for the first time upon his incredulous vision, waddling grotesquely up the hill to the ridge which had defied the British infantry so long so bloodily—there to squat complacently down on the top of the enemy's machine-guns, or spout destruction from her own up and down beautiful trenches which had never been intended for capture. In fact, Brother Boche was quite plaintive about the matter. He described the employment of such engines as wicked and brutal, and opposed to the recognized usages of warfare. When one of these low-comedy vehicles (named the Creme-de-Menthe) ambled down the hitherto impregnable village of Flers, with hysterical British Tommies slapping her on the back, he appealed to the civilized world to step in and forbid the combination of vulgarism and barbarity.

" 'Let us at least fight like gentlemen,' said the Hun, with simple dignity. 'Let us stick to legitimate military devices—the murder of women and children, and the emission of chlorine gas. But Tanks—no! One must draw the line somewhere!'

"But the ill-bred Creme-de-Menthe took no notice. None whatever. She simply went waddling on—toward Berlin."

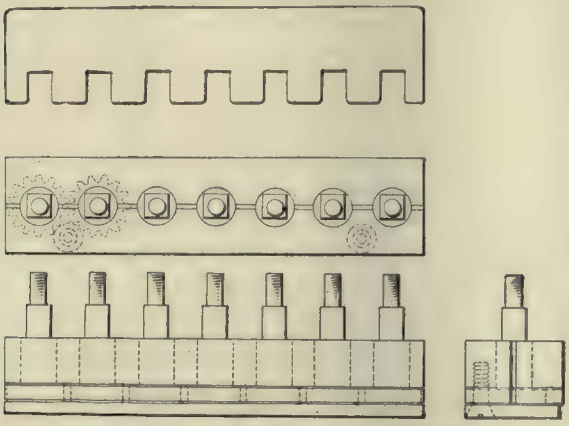
IDEAS FROM PRACTICAL MEN

Milling Jig for Pinion Shanks

By Frederick J. Todd

Having to square the ends of a large quantity of pinion shanks, the cost of which would not warrant an individual operation, I devised the jig shown for use with two straddle mills.

By consulting the illustration, the fixture will be seen to consist of a split block reamed for the heavy part of the shank. One-half of the block is fastened to the bottom plate The holes are so spaced that the pinions are in mesh. After the mills are run over once, the vise is loosened, a pinion on either end is turned, which, of course, turns all the rest. The slotted gage is then set in place over the milled surfaces, and the vise tightened for the second operation.



MILLING JIG FOR PINION SHANKS

Piston-Groove Sizing

By William Dunn

By adopting the following method for an unlimited number of automobile pistons to be grooved to a limit of plus or minus 0.0005 in., very satisfactory results were obtained. They were roughed out in the usual manner on a screw machine, leaving the grooves, four in number, about 0.015 narrow and the outside diameter about $\frac{1}{16}$ large, then they were passed on to an engine lathe and finish turned to grinding size. The next thing on the program was to finish the grooves to size.

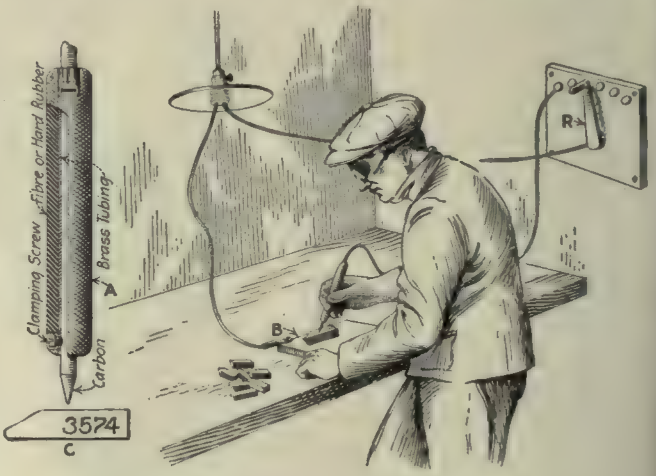
The piston was run between centers at not too hasty a speed, and a square-nosed tool the exact width of the groove was run in to the required depth. All would proceed well until a few pistons had been finish grooved, and then the tool would begin to cut small, so that the low limit gage would not go. This, of course, ordinarily necessitated a new tool being ground up. After grinding quite a number of tools, it became evident that some scheme must be found to save these pieces of $\frac{3}{8}$-in. square tool steel.

The idea suddenly suggested itself to peen the tools as they became small, instead of taking them out of the toolholder. By a very slight tap with a small hammer the trick was accomplished, and our trouble vanished. When a tool showed signs of wear, all that was necessary was a light tap with the hammer. In this manner it was possible to finish piston grooves day in and day out with scarcely a stop. Practically every groove was made a perfect fit for the piston rings, which were finished to size on a surface grinding machine.

Marking Stellite Tools

By Gustav Kopsch

Some time ago I was confronted with the problem of marking stellite tool bits, such as are used in large numbers and shapes in the rapid manufacture of shells, motor housings, etc. They are always ground to the carefully developed, most efficient cutting angles. After they become dull, the operator exchanges the dull one for a new one at the tool crib; the returned one is meanwhile reground by the tool grinder. For this reason it is very desirable to have identifying marks on the tools.



DEVICE FOR MARKING STELLITE TOOLS

I tried all different acids for etching, but none would attack the stellite. Sandblasting through a previously filed-out piece of steel proved to be too expensive, and the impresions were too shallow. At last I made the cheap and simple device shown.

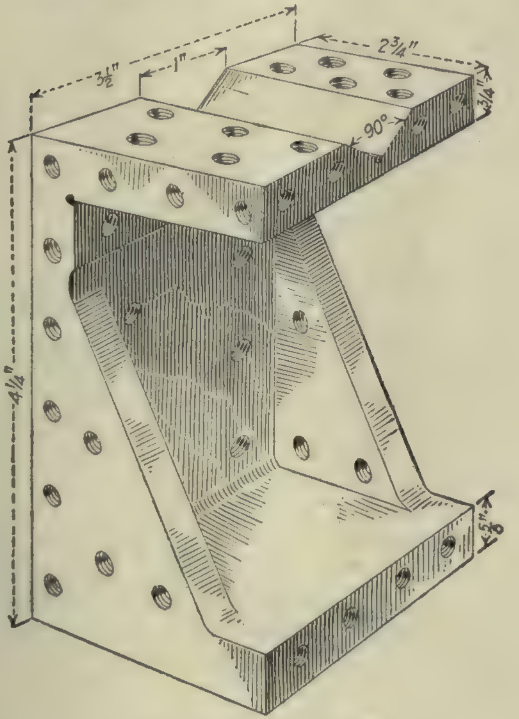
At *A* is an insulated holder in the shape of a pencil, and it is used the same way. The carbon, an ordinary carbon such as in arc lights, is pointed anew once in a while and does good work for many hundreds of stellite bits. The cable at the upper end of the holder leads to a resistance *R*. The other end is connected to a piece of flat cold-rolled steel *B*, which serves as a contact piece for the tool bit to be marked. The outgoing ends of the cable are connected to an ordinary lamp socket. In marking the tools I find it best to dot the figures slightly, so as to get a continous make and break of the arc.

An apprentice boy equipped with a pair of smoked goggles found a welcome change in the daily grind by marking the tools. He can do it almost as fast as ordinary writing. The whole outfit amounts to only a few dollars and saves much confusion, for the toolroom, the tool crib and the operators.

Useful Angle Plate

By Herbert M. Darling

Nearly every toolmaker carries a small angle iron in his kit. It is generally too small for most jobs, but, of course, it is made small, with the idea that it must fit into a certain space in the owner's tool chest. In a great many shops, it is hard to find an accurate angle plate for tool or gage work, so I made one, shown in the accompanying sketch. It is not too large to go into my chest, and yet it is large enough to use in combination with a 5-in. sine bar.



USEFUL ANGLE PLATE

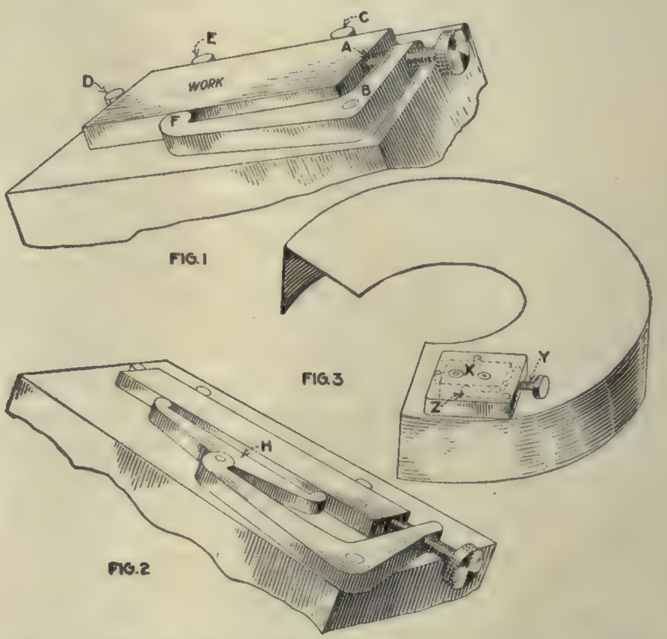
It is made of cast iron and planed and hand scraped so that it is dead square every way. The 90-deg. V-slot in the top adds greatly to its usefulness. It is handy around the surface grinding machines. In fact, on a great deal of accurate grinding work I would hardly know how to get along without it. All finished surfaces are provided with ¼-in. 20-thread tapped holes at intervals of ¾ in. to facilitate the clamping of work.

I notice that a good many toolmakers have angle plates made of steel, hardened and ground, but I prefer cast iron, as I find that a well-seasoned casting does not change shape so readily as the majority of grades of hardened steel. I have two other angle plates besides the one shown here, one being made of cast iron and the other of hardened steel. My experience has led me to prefer cast iron, not only because it is easier to work in the first place and retains its accuracy to a greater degree, but because in case of necessity it is easier to correct by hand scraping.

Clamping Flat Squared Work

By B. A. Tibbab

A very simple one-action clamping device for rectangular pieces is illustrated in the accompanying sketches. The principle is shown clearly in Fig. 1. The work is located by the stop-pins and is clamped against these pins by the screw *A* and the lever *B*. It will be readily seen from the illustration that by turning the clamping screw the work is forced against the pin *D* by the screw and against the pins *C* and *E* by the end of the lever *F*.



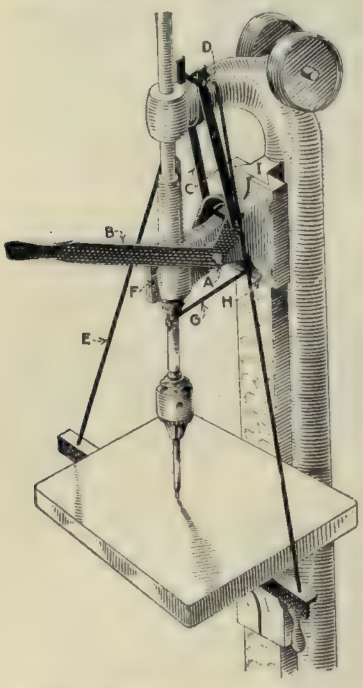
FIGS. 1 TO 3. JIG CLAMPS FOR RECTANGULAR WORK

When the work is long, the swivel piece *H*, Fig. 2, may be added to the device to insure clamping against both of the pins on the long edge of the work. This principle also works very successfully when applied to a plate jig for local work. In Fig. 3 is illustrated a gear guard with a spotted face for attaching to the machine. The small local jig is shown clamped to the spot *X* by the screw *Y* and the lever *Z*. The advantage of this device lies in the fact that by tightening one screw we secure a clamp in two directions at right angles to each other.

Drilling Machine Made Into a Press

By W. S. Quimby

Having to pierce a great many holes varying from $\frac{1}{8}$ to $\frac{7}{16}$ in. in diameter in strip brass from No. 20 to No. 14 gage and in sheet steel No. 24 gage, I considered drilling too long an operation. Therefore, I constructed the attachment here shown, making of the drilling machine a very serviceable and efficient punch press. I removed the pinion that engages the rack on the quill and bushed the hole, allowing passage for the $\frac{1}{2}$-in. bolt *A*. I then bent the piece of $1\frac{1}{2}$ x $\frac{5}{16}$-in. flat iron *B*, forming the handle and half the toggle. Two straight pieces *C* of the same stock completed the toggle. Another piece of the same flat was bent into a U and drilled for a $\frac{1}{2}$-in. bolt at *D*, so that it just rested on the top of the frame when the flat was up against the under side. A light tie-rod *E*, of $\frac{3}{8}$-in. round iron threaded on the ends for nuts, held a section of 2-in. angle iron, thus supporting and taking the pressure from the table. The spindle was raised to its limit and locked by the take-up screws *F*. To eliminate any further motion, a $\frac{1}{4}$-in. stud was passed through the tang slot and screwed into a tapped hole in the head *H*, the tightening screws of which were drawn up just so the head could slide on its ways *I*.



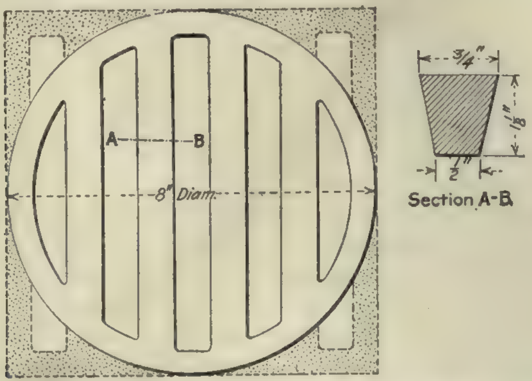
DRILLING MACHINE MADE INTO A PRESS

With this arrangement I secured a $\frac{3}{8}$-in. stroke and pierced $\frac{7}{16}$-in. holes in No. 20 gage brass without the slightest difficulty.

Designing To Simplify Work

By M. E. Duggan

Grates and strainer castings for sewer purposes are made round. They are so designed by draftsmen because it is the conventional way. A square or oblong grate would, in a great many instances, answer the purpose.



ORIGINAL AND SIMPLIFIED DESIGNS FOR THE PATTERN

The small bodies of sand that form the reduced openings at the sides must be secured with nails to prevent their being washed away during the process of pouring the casting and to insure a clean lift of the pattern out of the mold. The round design adds to the work of the patternmaker.

Twenty strainer castings were wanted for cement-floor drain purposes. The design was altered as shown, thus simplifying the work of the patternmaker and the molder and insuring a good clean casting.

Table of Angles for Dividing Circles and Laying Out Polygons

By G. A. MacGregor

The following table will be found convenient for the draftsman or toolmaker. It is not included in the most commonly used reference handbooks:

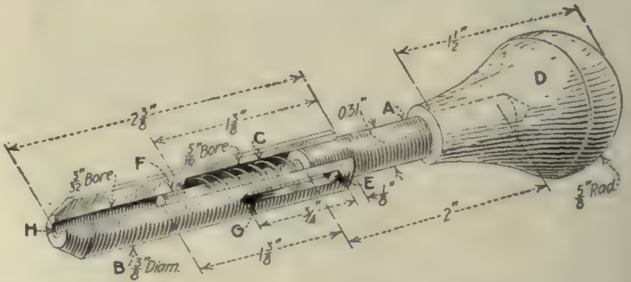
Number of Sides or Segments	Angle		Number of Sides or Segments	Angle	
	Deg.	Min.		Deg.	Min.
3	120	0	27	13	20
4	90	0	28	12	51
5	72	0	29	12	24
6	60	0	30	12	0
7	51	25	31	11	37
8	45	0	32	11	15
9	40	0	33	10	54
10	36	0	34	10	35
11	32	43	35	10	17
12	30	0	36	10	0
13	27	41	37	9	44
14	25	43	38	9	28
15	24	0	39	9	14
16	22	30	40	9	0
17	21	10	41	8	47
18	20	0	42	8	34
19	18	57	43	8	22
20	18	0	44	8	11
21	17	8	45	8	0
22	16	22	46	7	50
23	15	39	47	7	40
24	15	0	48	7	30
25	14	24	49	7	21
26	13	51	50	7	12

Tool for Driving Brads

By F. C. Mason

The tool illustrated herewith is for driving brads in places where it would be difficult to use a hammer. The sectional view shows all parts lettered.

The plunger or driver *A* slides in the case *B*. The spring *C* holds the driver up, leaving the opening *H* in the case to introduce the brad, which is attracted and held by the plunger point *F*, which is magnetized. The length of plunger movement is regulated in each direction by the slot *G* in the case *B* and the stop pin *E*. This tool is a most convenient one for the patternmakers' tool box.



THE BRAD DRIVER FOR PATTERNMAKERS

Editorials

Our Fortieth Birthday

AS SEEMS fitting in a national crisis, we are avoiding all display and unnecessary expenditure of time and money in celebrating the fortieth birthday of the *American Machinist*. We have merely invited a few special contributions from such of our friends as could spare a few moments from their work of making products for the Government, or of building machinery and tools used in their making. We very much regret that a number of our old friends were unable to favor us, as their names seem to belong in the paper on such an occasion. But the business of war preparations comes first, and we would not interfere in any way with the work which is being done. Nor have we sought to profit in any way by this anniversary, as not a single special advertisement has been solicited on its account.

* * *

The last three years have had a greater effect upon the machine tool industry of this country than any other similar period of its existence. The only period, which in any way approaches it, was at the time of the tremendous expansion of the automobile industry, which was by no means comparable with the effect of the present war. Just how great the increase in the number of shops building machine tools in this country may never be fully known, but it has been enormous, and from present indications, it seems likely that there will be a great demand for machine tools during the next few months. This is particularly true of large machine tools.

The immediate effect of this has been to have machine shops of various kinds turn their attention to lathes, milling machines and other machine tools, which are an entirely new product, and in many cases require special training of their men. Another effect was the development of a large number of special machines, single-purpose machines in most cases, for the rapid production of shells, fuses and munitions of various kinds. Some of these may be, and probably will be, available in our own munition work, with perhaps more or less modification. But after the war, it seems inevitable that hundreds of thousands of dollars worth of machinery will necessarily be relegated to the scrap heap unless it is deemed wise, as a precautionary measure, to have it slushed and stored for possible emergencies, which we all hope may never arise again.

* * *

But it is far too early to devote much time to what is to happen after the war, the most important problems at present being as to how it is to be won. Unless all signs fail, every resource of every machine shop of this country will be needed on some of the many kinds of work which must be done, and as soon as the various branches of the War Department are fully in motion, there seems little doubt as to the output of every shop being required in some way or other.

Aside from the special machines already referred to, it is probably safe to say that the greatest development of the last ten years has taken place along the line of automatic and semi-automatic machines for various purposes. In many cases these have been designed and built for specific pieces of work, and are excellent examples of single-purpose machines. Many of these have been developed for the automobile industry, and as a growing percentage of this is being devoted to airplane and other war work, these are likely to become war machines. The development of these machines includes the automatic screw machine of various sizes, and fully automatic bar machines have been manufactured to handle seven and one-half inch bars. The semi-automatics, both horizontal and vertical, usually handle castings or forgings, and in some instances, run into large sizes. The vertical semi-automatic machines are usually designated as the "station type" machine, and have worked marvelous changes in productive time in some cases. These include turning and boring machines, as well as machines for both drilling and tapping, and have been developed primarily to meet the great demand for production in the automobile field.

* * *

The grinding machine has also been considerably developed during the past few years, and there is an ever-growing use of the wide-face grinding wheel which has been so strenuously advocated by C. H. Norton, the well-known engineer in the grinding field. This is now being adopted to more uses than was originally deemed possible, and, in fact, the grinding wheel has gained a substantial position as a cutting tool, instead of a polishing device, as it was originally considered. Autogenous and electric welding and cutting are now regular machine shop processes, and are often found in shops so small as to make such equipment somewhat startling to an outside observer.

Another noticeable change is the consideration of the human element to a much greater degree than ever before. For, with the growth of the shop away from the older methods of the one man shop, the worker came to be considered as a part of the machinery in too many cases. This attitude is passing in turn and there is a gratifying improvement in this phase of shop management.

* * *

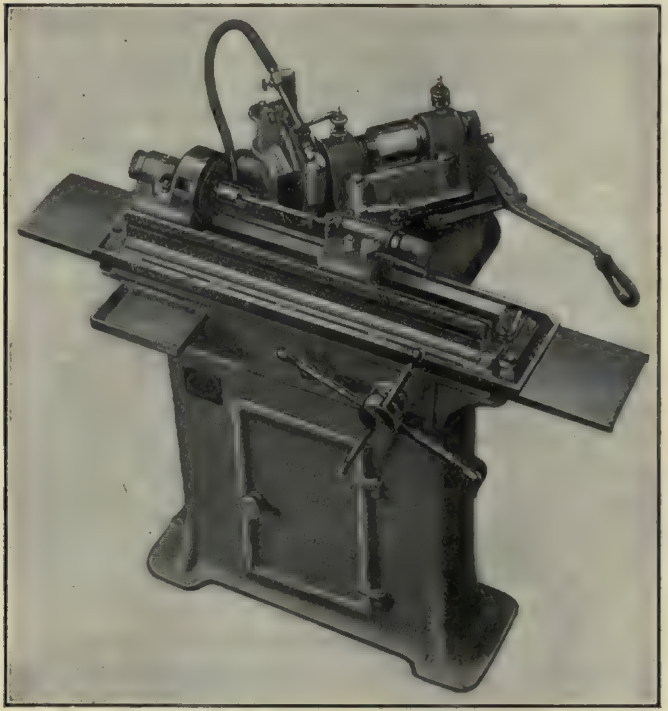
Our present duty is to produce enough machinery to turn out all of the many munitions of war which are to be required while the war lasts. We must turn our thoughts more to the present and to the future, than to the past. For unless the war ends in victory for ourselves and our allies, we shall have all too much time to consider a past which will be far from pleasing from any point of view. But we must not forget that maximum production depends on a broad understanding of all the factors which enter into shop management.

SHOP EQUIPMENT NEWS

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Ott Valve Grinding Machine

The machine illustrated is the product of the Ott Grinder Co., Indianapolis, Ind., being especially intended for grinding the seats of poppet valves for engines or other mechanisms. The wheel base may be set to grind any angle from 15 to 60 deg. The table traverse is operated by hand, and the valves are held either between centers or in a draw-in collet chuck. The grinding wheel used has a face parallel to the axis of the wheel and is traversed across the valve seat.

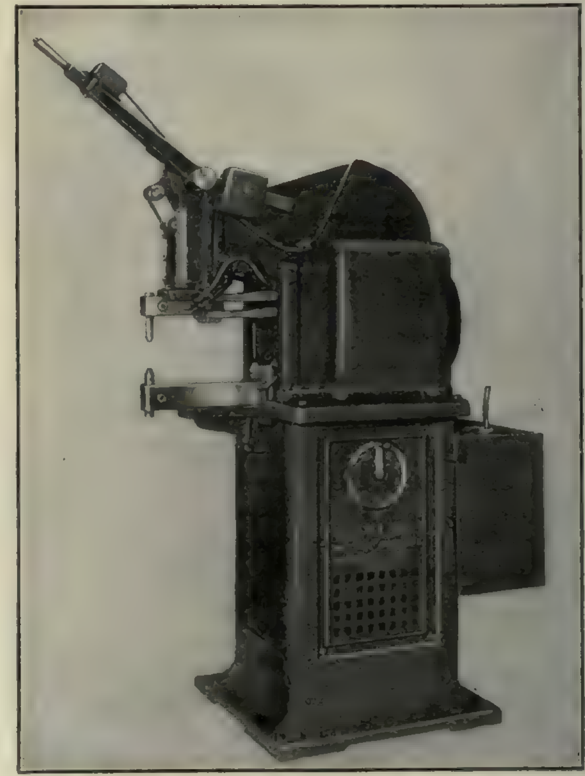


VALVE GRINDING MACHINE

Taylor Spot-Welding Machine

The illustration shows a new spot-welding machine placed on the market by the Taylor Welder Co., Warren, Ohio. Machines are being built in a number of sizes, the one shown being known as the type D-12-4, having a maximum welding capacity of two $\frac{1}{4}$-in. plates. The machines are built in sizes ranging from 3 to 50 kw., and will weld sheet metal from 30-gage up to $\frac{5}{16}$-in. plates. These welding machines involve a principle that has not been previously used for commercial machines.

The lower horn and the upper point holder together with the welding electrodes themselves are split, and a suitable insulating material placed between the parts. The secondary leads from the transformer are likewise separated, and cross where the connection is made to the lower horn, causing the current to be crossed. It is claimed that a weld so produced has been demonstrated to be stronger and also made in a shorter space of time than has heretofore been possible with the old process.



TAYLOR SPOT-WELDING MACHINE

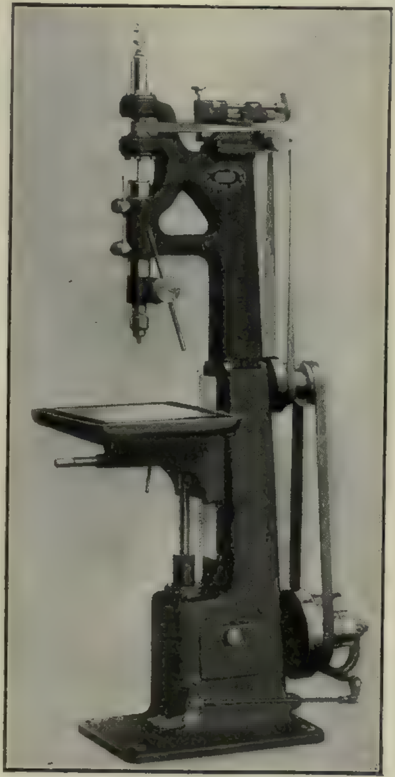
Welding capacity, two $\frac{1}{4}$-in. plates; depth of throat, 12 in.; distance between copper bands and lower horn, 8 in.; floor space, 28 x 54 in.; height, 70 in.; distance from floor to top of lower welding point, 44 in.; maximum opening between electrodes, 3 in.; weight, 1800 lb.; transformer, 25 kw.

By means of the new process it is claimed to be possible to spot-weld much heavier material than has been practicable to handle heretofore. As the electrodes may be separated and steel pressure dies used between, two or more separate currents of large volume may be passed in bias direction through the metal, and when the metal has reached a welding temperature additional pressure may be applied with the steel dies to complete the weld; all, without subjecting the copper electrodes to pressure beyond the need of a good electrical contact. In other words, the electrodes are used only to carry the current and not to sustain the heavy pressure required to force the plates together to complete the weld.

Another feature is that the machine can be arranged to operate on multi-phase current without unbalancing the line. This is a very important feature as other spot-welding machines are required to be operated on a single-phase current, as when operated on a multi-phase current have a tendency to unbalance the line which is very objectionable when the generator is of small capacity or the line is heavily loaded.

"Demco" Drilling Machines

The DeMooy Machine Co., Cleveland, Ohio, is now marketing two new sizes of drilling machines known as the "Demco" Nos. 31 and 32. These are built in either the single spindle or gang types, six spindles being the maximum number furnished. It will be noticed that instead of mounting the drilling head on ways on the column, a quill is used that may be raised, lowered and clamped in correct position by means of two screws. It is claimed that this feature insures more perfect alignment of the spindle than is otherwise possible. The machine is provided with an automatic device for taking up any slack in the belt. The machines are made in either bench or floor types, an extra set of cone pulleys being used on the latter. This gives the floor-type machine five speed changes. A depth stop is incorporated on the spindle.

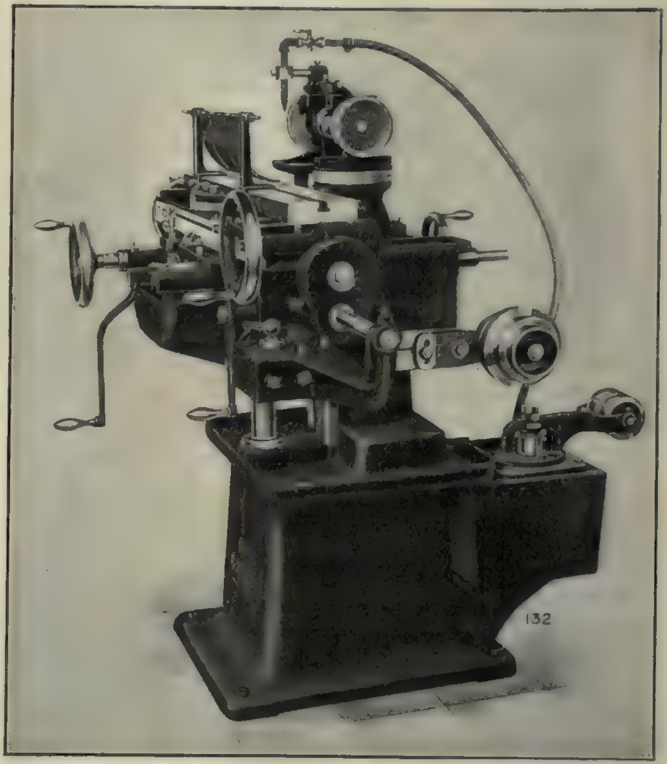


FLOOR TYPE DRILLING MACHINE

No. 31 machine—diameter of spindle, $\frac{7}{16}$ in.; distance from center of spindle to column, 8 in.; traverse of spindle, 8 in.; traverse of feed rack, 4 in.; traverse of table, 15 in.; width of belt, 1 in.; distance between spindle centers on multiple-spindle machines, $6\frac{3}{4}$ in.; number of speeds, 5; maximum spindle speed, 12,000 r.p.m.; width of oil groove around table, $1\frac{3}{4}$ in.; capacity in soft material, $\frac{3}{8}$ in. Specifications for No. 32 machine are the same as above except as follows: Diameter of spindle, $\frac{11}{16}$ in.; maximum spindle speed, 3500 r.p.m.; capacity in soft material, $\frac{5}{8}$ in. The weights of the various machines run from 350 to 1100 lb.

Oakley Cutter and Tool Grinding Machine

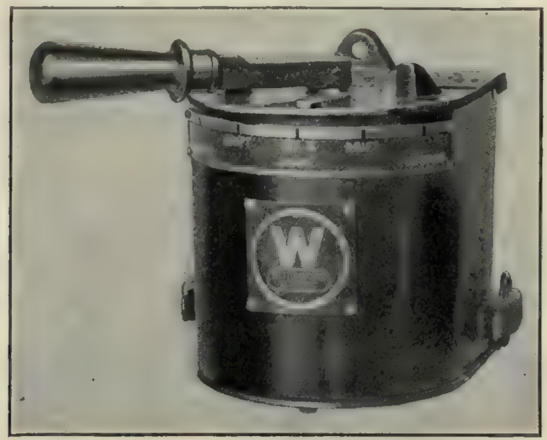
The illustration shows the No. 2 cutter and tool grinding machine manufactured by the Oakley Machine Tool Co., Cincinnati, Ohio. This machine is very similar to that described on page 85 except that it is equipped with longitudinal power feed and with wet grinding attachment. The power feed is operated through the table feed screw instead of the customary rack and pinion. The table pauses slightly before reversing, in order to allow the wheel to grind clean at shoulders. There are three table speeds, these being 6, $10\frac{1}{2}$ and 18 in. per minute. The stops are hinged so that the work may be run past the setting for measurement or for inspection.



CUTTER AND TOOL GRINDING MACHINE WITH POWER FEED AND WET GRINDING ATTACHMENT

Westinghouse Drum Reverse Switch

The Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., has recently placed on the market the drum reverse switch illustrated, which is known as type 810. It is intended for motors in machine-shops or other establishments where it is necessary to reverse motors of comparatively small size. The stationary contacts are mounted on the back board, while the movable ones are carried on cast-brass brackets clamped on the shaft but insulated from it. Good contacts are insured by phosphor-bronze springs on the movable contacts, these springs being protected by copper shunts. Adjacent contacts are separated by asbestos to prevent cross-arcing. All live parts are protected by a sheet-steel cover lined with asbestos and held in place by two ring latches. For alternating-current service and for direct-current service without dynamic braking the switch positions are forward, off and reverse. For direct current with dynamic braking the five switch positions are forward, drift, off and brake, drift and reverse.


WESTINGHOUSE DRUM REVERSE SWITCH

Helping the Foreman To Get Results

By E. Andrews

The article by George A. Sawitzke, on page 195, is interesting to me and should be of interest to all shop managers and foremen. It is timely and to the point. It illustrates a thorough understanding of human nature, which is so necessary to securing efficiency in production.

My experience as a foreman during the last 15 years leads me to give some of my views for good leadership which tends to obtaining results and is in my opinion one of the most important subjects to consider. This may also be said regarding the benefits of good foremanship to the youth of the present and future.

A foreman needs to be a man of great resourcefulness and foresight. Personal friendship must have no place in the workshop. All men should be treated alike. Moreover, the foreman must never be domineering, or manifesting a spirit and manner of knowing it all. If a workman offers a suggestion, it is tactful to listen; should the suggestion be thought beneficial, use it. It will make him feel interested in his work and tend to draw out the best that is in him, particularly if he is rewarded with a few extra dollars in his pay envelope. Furthermore, it will encourage the rest of the workmen to think. If the suggestion offered is not practicable, tell the employee in a kindly manner why it is not, then his confidence and respect will still be retained.

Oftentimes lack of attention to details by foremen is the cause of mental disturbance in workmen, which leads to inattention to work and methods of working, resulting in decreased output. Hence, the foreman's attention in instructing his men, together with providing them with modern conveniences for handling their work and with perfect tools, are essentials in these days of complex methods of construction, to obtain best results. In some machine shops it is quite common to watch employees trying to make headway with defective or antiquated tools, thereby clearly showing a lack of mechanical skill and mental judgment on the part of the shop foreman. It is needless to say, that business with such firms does not increase, but tends to decrease, as efficiency in production is essential to growth. The little things—the minor details should be closely watched—the big things do not need such minute attention.

Obituary

R. B. Dangeleisen, age 31, sales manager of the Globe Machine and Stamping Co., Cleveland, Ohio, died at Saranac Lake, New York, on Nov. 12. He entered the employ of the company in 1902, and because of his efficiency and executive ability, was advanced rapidly but deservingly to the position which he held at the time of his death.

Business Items

Goddard Tool Co., of Chicago and Detroit, announce the following promotions in their organization: H. L. Hochschild becomes vice president and purchasing agent; Samuel R. Swenson, assistant to the president; T. R. Swenson, master mechanic; E. E. Shirks, factory manager; G. W. Monks, sales manager; Card Hillyer, office manager: and LeRoy Rawson, plant manager at Detroit.

Personals

Ira J. Peat is now in the planing department of the Ordnance Division of the Watervliet Arsenal.

E. F. Shore, formerly located at 626 Flushing Ave., Brooklyn, N. Y., is now located at 541 DeKalb Ave.

Wallace T. Roberts has been appointed district manager at Denver, for the Sullivan Machinery Co., Chicago, Ill., succeeding **Captain M. R. Blish** of the Ordnance Department.

Norton A. Booz has resigned as secretary of the Machinist Supply Co., Chicago, Ill., to become vice president and general manager of the Machinist Supply Co. of Pittsburgh, Penn.

Joseph H. Brown, formerly assistant manager of the New York office of the Sullivan Machinery Co., has been appointed district sales manager at Chicago to succeed **William P. J. Dinsmoor,** who has resigned to engage in business at Denver, Colo.

Andrew L. Gath, formerly with Manning Maxwell & Moore, is now manager of the Machine Tool department of the Machinery and Metals Sales Co., 165 Broadway, New York City. This company has an office in Pittsburgh and has recently appointed agents in England, France, Italy, Australia, Cuba, South America, China and Japan.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Feb. 7, 8 and 9. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45, North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

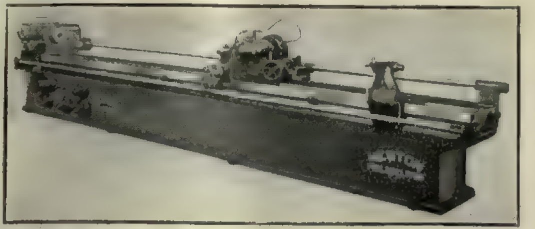
Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Milling Machine, Thread

Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Penn.



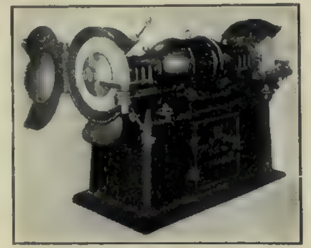
"American Machinist," Nov. 15, 1917

Used for cutting worms and screws, which are placed on a mandrel held in a taper draw chuck. Feeds and speeds are by means of gears. Capacity for work, 6 in. in diameter by 12 in. long; diameter of hole through draw chuck, 3 in.; leads, three, 1 to 3 inclusive; pitches, 1¼ to 9⅜ in.

Grinding Machine, Motor Driven

United States Electrical Tool Co. Cincinnati, Ohio

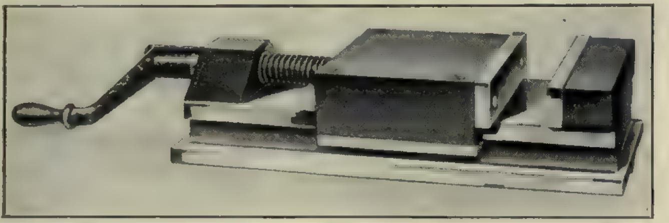
"American Machinist," Nov. 22, 1917



A new ball-bearing motor-driven grinding machine built in two sizes. The motor of the machine shown has a capacity of 5 hp. and the two wheels measure 18 x 3 in. The second machine has a 7½-hp. motor, and 24 x 4-in. wheels. The motors used are Westinghouse type CS. Guards are of steel, and can be furnished either with or without exhaust connections as desired. Furnished with a push-button switch for stopping and starting if ordered. The weight of the smaller machine is 2200 lb.

Vise, Machine

Cleveland Milling Machine Co., Cleveland, Ohio



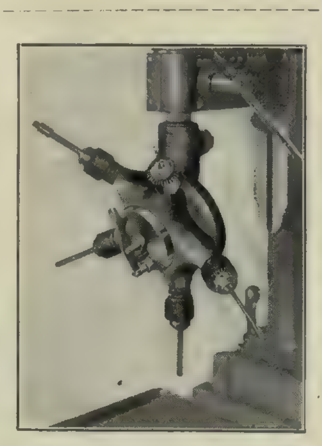
"American Machinist," Nov. 22, 1917

A machine vise having a finished flange on all four edges, and a tongue slot located an exact distance from the face of the solid jaw to enable two or more to be used on a machine table. Jaws may be readily removed in case of need. Weight, 50 lb. Solid jaw is cast hollow to prevent breakage at the corner

Drilling Head, 5-Spindle Turret

Spafford Tool Works, 10 Hoadley Place, Hartford, Conn.

"American Machinist," Nov. 22, 1917



The device is indexed to the various positions by pressing the lever shown at the front, when the turret may be moved around either way to any position whether or not the machine is in operation. Spindles are ball bearing, all those except the one in position for work remaining idle at all times. The spindles run at the same speed as the drilling-machine spindle and are central with it. The device is claimed to enable a considerable saving of time where tools of various sizes may be used on each piece of work. The head is built in three sizes, the largest having a maximum drilling capacity of 2 in.

Micrometer

Reed Small Tool Works, Worcester, Mass.

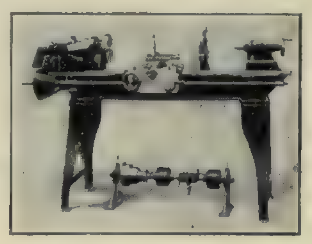
"American Machinist," Nov. 15, 1917

The frame is a drop forging, the web being concave to insure a good finger hold. Frame is finished in dull nickel to avoid enamel. A feature of the micrometer is a two-part thimble which allows instant adjustment for wear. By making the anvil stationary the width of the frame has been reduced allowing work to be done in close quarters. The micrometers are made in six styles measuring from 1 to 6 in. in steps of 1 in., and from 25 to 150 mm. in steps of 25 mm.

Lathe, Semi-Quick Change

Shepard Lathe Co., 217 East 8th St., Cincinnati, Ohio

"American Machinist," Nov. 22, 1917



A semi-quick-change screw-cutting engine lathe having a reversing clutch in the headstock rendering it unnecessary to reverse belts or watch a dial when chasing threads, the lead screw-nut and change gears remaining engaged. Change gears are in the form of a cone at the front as shown. All gears under 3 in. in diameter are of steel. Furnished in either the cone-head, cone-head with motor attachment or geared-head type

Toolholders; Types X4 and X5

Ready Tool Co., Bridgeport, Conn.

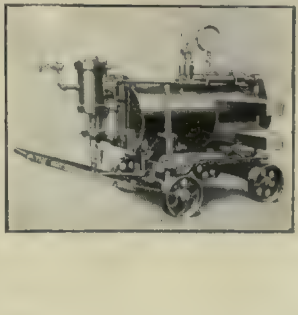
"American Machinist," Nov. 22, 1917

These holders, for ½ x 5-in., and ⅝ x 4½-in. bits, are larger than have previously been manufactured by this concern. The overall size is 1 x 2 x 12 in., and a tool-steel insert is electrically welded beneath the tool to prevent wear. Made either straight or with right or left offset

Press, Hydraulic Crankpin

Watson-Stillman Co., Aldene, N. J.

"American Machinist," Nov. 22, 1917



For pressing in locomotive crankpins and other similar work. The pump is operated by an air engine, and the operating valves are so placed that the man in charge can operate the press in addition to directing the work of the men. A gage indicates the pressure required to seat the pin, thus making it easy to detect a loose fit. The frame of the press is of open-hearth steel, the side forks being cast integral. The reservoir is mounted at the rear of the press. The presses are built with capacities ranging up to 300 tons

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Nov. 30, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	....	$20.00
No. 2 Northern Foundry, Chicago	33.00	$33.60	26.00
*Bessemer, Pittsburgh	37.25	....	29.95
*Basic, Pittsburgh	33.00	36.30	25.95
No. 2X, Philadelphia	33.75	33.75	25.00
*No. 2, Valley	33.00	33.00	25.00
No. 2, Southern Cincinnati	35.90	....	22.90
Basic, Eastern Pennsylvania	33.75	45.00	26.00

*Delivered Pittsburgh; f.ob. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Nov. 30, 1917	One Week Ago	One Year Ago	Nov. 30, 1917	One Year Ago	Nov. 30, 1917	One Year Ago
Structural shapes	$4.195	$5.25	$3.50	$4—4.035	$3.60	$4.195	$3.35
Soft steel bars	4.095	5.00	3.50	4—4.035	3.60	4.095	3.35
Soft steel bar shapes	4.095	5.00	3.50	4.135	3.60	4.095	3.35
Plates, ¼ to 1 in. thick	4.45	10.00	4.25	4.385	4.10	4.45	4.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Nov. 30, 1917	One Year Ago
Pittsburgh, mill	$3.50	$2.75
Warehouse, New York	4.25	3.50
Warehouse, Cleveland	3.95	3.45
Warehouse, Chicago	4.10	3.35

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Nov. 30, 1917	One Month Ago	One Year Ago	Nov. 30, 1917	One Year Ago	Nov. 30, 1917	One Year Ago
*No. 28 black	5.00	6.445	9.00	4.50	6.35	3.90	6.445	4.10
*No. 26 black	4.90	6.435	8.90	4.40	6.25	3.80	6.435	4.00
*Nos. 22 and 24 black	4.85	6.295	8.85	4.35	6.20	3.75	6.295	3.95
Nos. 18 and 20 black	4.80	6.245	8.80	4.30	6.15	3.70	6.245	3.90
No. 16 blue annealed	4.45	5.645	8.20	4.45	5.55	3.95	5.645	4.00
No. 14 blue annealed	4.35	5.545	8.10	4.35	5.45	3.85	5.545	3.90
No. 12 blue annealed	4.30	5.495	8.05	4.30	5.40	3.80	5.495	3.85
No. 10 blue annealed	4.25	5.445	8.00	4.25	5.35	3.75	5.445	3.80
*No. 28 galvanized	6.25	7.695	10.50	6.50	7.60	5.50	7.695	5.60
*No. 26 galvanized	5.95	7.395	10.20	6.20	7.30	5.20	7.395	5.30
No. 24 galvanized	5.80	7.245	10.05	6.05	7.15	5.05	7.245	5.15

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Nov. 30, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Nov. 30, 1917	One Year Ago
New York	$15.00	$6.00
Cleveland	15.30	6.30
Chicago	15.00	5.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*	
⅜, 11/32, 5/16, ¼, 7/32, 3/16 No. 8, 5/32 and No. 10 ⅛ No. 12 3/32, No. 14 and 1/16 No. 18 No. 20	21.00@30.00

*Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Nov. 30, 1917	Cleveland Nov. 30, 1917	Chicago Nov. 30, 1917
Tire	5.00	5.00	4.16
Toe calk	5.70	5.50	4.35
Openhearth spring steel	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Coppered bessemer rods	9.00	....	....

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	37.9%	23.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	41.9%	26.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Nov. 30, 1917	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	35.00
Tin, in 5-ton lots	80.00	62.00	45.00
Lead	6.50	8.50	7.00
Spelter	8.00	8.50	12.50

*Government price.

ST. LOUIS

Lead	6.37½	8.00	7.00
Spelter	7.75	8.25	12.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Nov. 30, 1917	One Month Ago	One Year Ago	Nov. 30, 1917	One Year Ago	Nov. 30, 1917	One Year Ago
Copper sheets, base	35.00—37.00	35.00	37.50	35.00	38.50	35—36	36.50
Copper wire (carload lots)	36.00	38.50	35.00	31.00	33.00	33.50	37.00
Brass pipe, base	38.50	43.00	47.50	46.50	46.00	42.00	46.00
Brass sheets	35.75	40.00	45.50	34.00	43.00	35.00	38.00
Solder ½ and ½ (case lots)	40.50	39.25	28.50	43.25	27.00	41.00	34.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Nov. 30, 1917	One Year Ago
Mill	$29.00	$42.00
New York	30.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Nov. 30, 1917	One Year Ago	Nov. 30, 1917	One Year Ago
New York	20.00	18.00	20.50	19.00
Cleveland	21.00	16.75	21.25	17.50
Chicago	21.00	17.00	21.50	18.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Nov. 30, 1917	One Year Ago
New York	14.00	13.50
Cleveland	16.00	13.00
Chicago	16.00	13.50

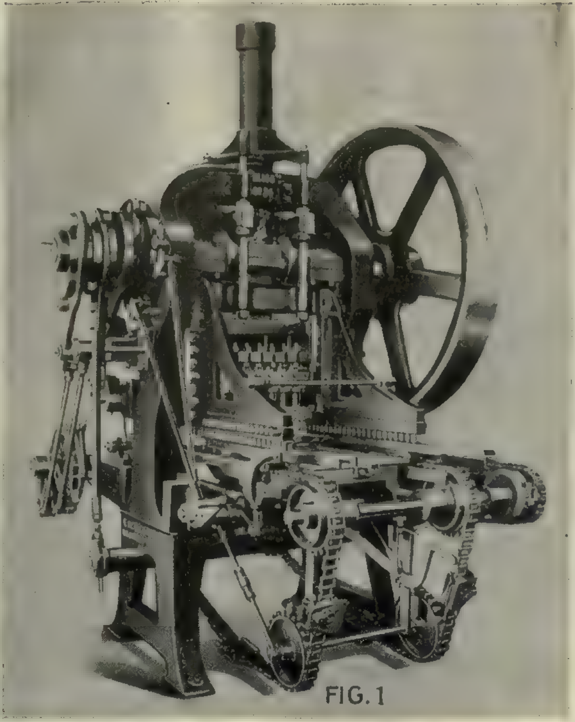


FIG. 1

THE CUT AND CARRY TYPE OF PRESS

By G. R. Smith

This article gives a brief description of the cut-and-carry type of press, together with illustrations of the machines and some of the work done. So great has been the strides forward in this line of machine design and construction that few manufacturers know just what can be done.

BEFORE going into detail regarding the cut-and-carry type of press it is best to explain the terms used, as they might be, in a way, misleading to those not thoroughly familiar with this line of work. By the cut-and-carry press we mean a press that cuts from the strip or coil of stock a blank or shell, and then by feed arrangements carries it on through several more dies, each doing an operation, thus performing several operations with one stroke of the press. In another case, the piece may be blanked and cupped in one press, and these shells fed into the carry press and several more operations performed.

There are so many variations of the automatic feeds, that to take up each would be an endless task, therefore, I shall only take up the more common, that are in themselves true types of the cut-and-carry, thus giving a general idea of all. They are simply a common punch press equipped with these special attachments, such as the automatic gravity feed, tube feed, the automatic ratchet-dial feed, automatic friction-dial feed, automatic friction-dial and lateral feed, friction-dial and push feed with ejector, automatic double-roll ratchet feed, friction-dial feed with automatic pick-off, combining several feeds on one press, automatic sheet carrier zigzag feed top and bottom press, and many others. The idea in all cases is the same: To do several operations with the one stroke of the press, the feed attachment carrying the work from one die to the other. The economy in some cases amounts to a great deal, as one ordinary operator can take care of three or four of these presses and in some cases even more than this. In floor space the saving is also great, as one press is doing the work of four or five common ones and an annealing oven, while the tool saving is no small item. Some of these presses turn out from 150 to 200 finished pieces per min., thus doing from 1200 to 1500 operations per minute.

In the case of the double-action gang press, two rows of seven or eight dies in each row may be used, which blank, stamp and do the subsequent operations on a production of 500,000 pieces per day.

It is understood that no more operations can be performed on the article than the metal will stand without annealing, but on the other hand more operations can be done on the article, especially drawing operations, than in the case of the one-die single-action press, as the article is carried from one die to the other so quick that the next operation is performed while the metal is still warm from the previous operation, thus an annealing between operations is not necessary. It is a sort of self-annealing system.

The working of the metal through several operations will finally reach a point when annealing must be done before any more operations can be performed, as in the case of several draws and redraws, but in work of one or two draws and several piercings, stampings, forming or lettering, the article can in most cases be carried to completion without annealing. Fig. 1 shows a true type of the cut-and-carry press, a double-action gang press with automatic chain feed, scrap separator and auxiliary skip feed. These presses are extensively used for the manufacture of the bottle caps shown at *A*, Fig. 2, and pieces of brass, steel or tin such as *B*, small cartridge cases, primer caps, boxes, etc.; *C* shows a piece made of plain brass sheet stock.

The common tin bottle cap is blanked, formed and completed in this press, generally from lithographed or decorated stock, but I have seen plain sheet stock run in this press and the caps blanked, formed and the bottlers name or monogram stamped on the top in continuous operations from the sheet to the finished cap. The cork blank used in the inside top of these caps is blanked and placed in position in another press. The stock generally used for this class of work is a sheet 20 x 28 in. of single XI American tin plate or CI; XXX or better is seldom used on this class of work. These are trade symbols used to designate the thickness or number of coats of the plate, thus single X is a black-iron sheet with one coating of tin, and XXX is three coatings. These symbols are read one X, three X, or five X, as the case may be. I and CI represent the temper, hardness and stretching ability of the stock, thus XI is a sheet of stock with good drawing ability and one coating of tin.

The sheet is placed on the automatic feed table in front of the press, and is automatically gripped and thus carried to the dies; the work and the scrap are automatically discharged separately. The auxiliary skip feed is provided to take care of the possibility of cutting half a blank at the start or finish of a sheet, allowing only full blanks to be cut. The feed attachment is a precision arrangement to handle sheets of decorated stock so that printed matter on the sheet will register accurately with the dies. This feed can be set so as to take care of just a certain number of blanks, thus if there are 15 blanks across the sheet, the operator places the sheet in position, trips the press and it blanks 15 times and stops. It can be set to take care of any number of blanks that can be cut from the sheet. The press is fitted with two rows of seven or eight dies in each row, dependent on the size of the blank, thus 14 or 16 shells are made with the one stroke.

The press shown in Fig. 3 is equipped with double-roll ratchet feed, dial feed and pick-off. All this feed arrangement can be removed in a minimum of time, and the press run as a single-action, single-stroke press when needed. This feed arrangement was designed to do such work as placing the cork blank in bottle caps, lining the inside of metal shells, boxes, etc., and crimping or curling over the edges to hold the linings in position. The shells are fed on to the dial in front of the press and the lining is cut from either rolled stock or strip, and the blank seated in position. The finished shell is picked from its recess on the dial feed and the dial thus left empty, ready to receive another shell. These presses are largely used in the manufacture of the round celluloid-covered buttons used at election time containing the pictures of candidates, advertising matter, etc. While they are not used so much in the manufacturing of metal goods, they fill a large need in lining and assembling work.

The press, Fig. 4, has friction-dial feed, lateral feed, double- or single-roll feed, tube feed, etc., to take plain blanks, cupped shells, or to blank and cup from roll stock, redraw, stamp and pierce before leaving the press. They also are extensively used in the manufacture of the smaller cartridge cases. The cartridge case can be blanked and cupped, redrawn, hole pierced in the end to receive primer caps and the caliber, maker's name, etc., stamped on the bottom with the aid of the cam-actuated bottom-knock-out, which may be arranged as a hammer to strike a blow sufficient to head the case and in the next blow die stamp the lettering.

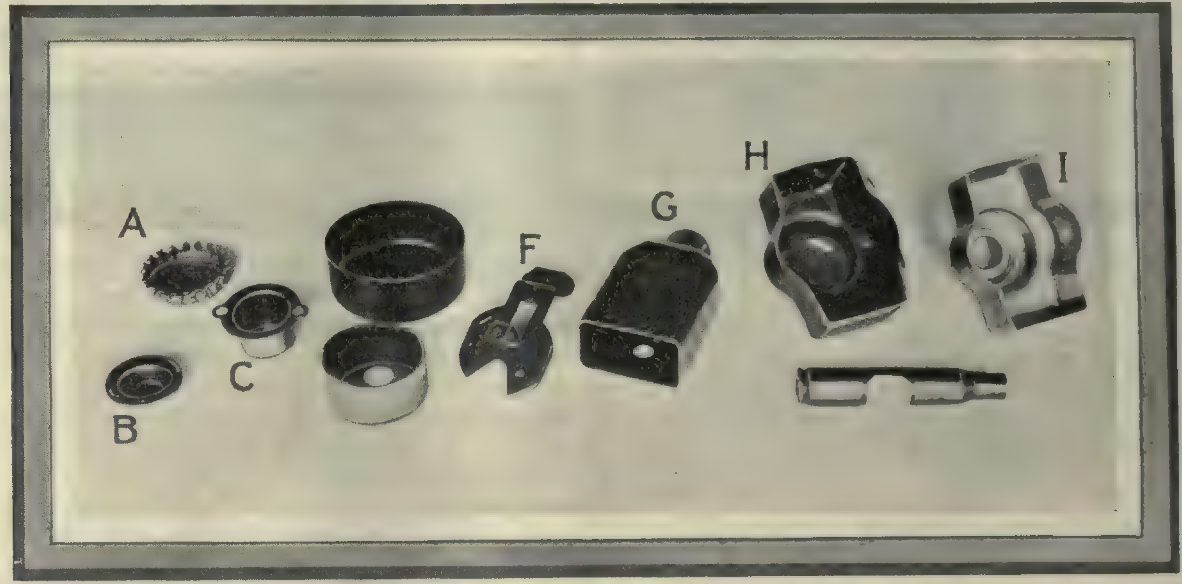
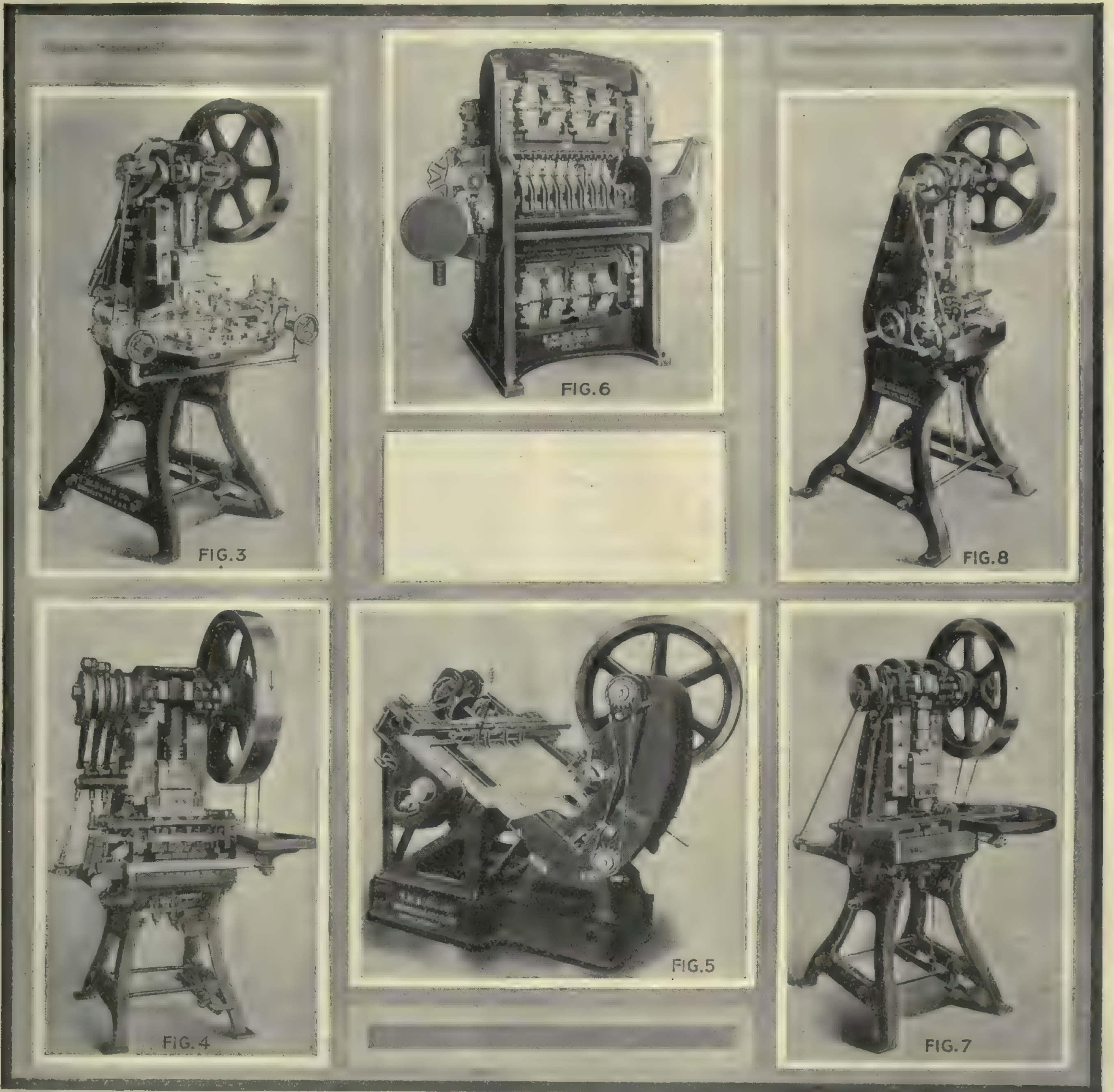


FIG. 2. EXAMPLE OF PRESS WORK

Fig. 5 shows the zigzag feed. In this arrangement but one or two blanks are cut at a time, either blanks, small shells of one draw, can covers, or armature punchings up to 4 in. in diameter. Standard size sheet is used and the feed is an automatic sheet carrier, which feeds the entire sheet into the press without any effort, whatever, on the part of the operator after the sheet is placed in position. The sheet is fed accurately, and decorated or lithographed sheets may be used; the scrap being cut off and separated from the punchings at each stroke and as soon as the last cut in the sheet is made, the plunger slide stops automatically and the sheet carrier returns to its initial position ready to receive the next sheet. One operator can take care of three or four presses and thus the daily wage of one man produces from 150,000 to 175,000 pieces per day without extra cost of shearing the sheet, rehandling, or bailing scrap, as the sheets are used as they come from the case or printing press, depending upon whether plain or decorated stock is used. Besides the regular round blank or armature punching, such work as shown at *A* and *B* in Fig. 2, is also done on the zigzag feed press. The shell shown at *C* is pierced on top in a dial feed press.



FIGS. 3 TO 8. VARIOUS MODELS OF CUT-AND-CARRY PRESSES

Fig. 3—Press with automatic double-roll feed, ratchet-dial feed and automatic pickoff. Fig. 4—Press with friction-dial and lateral feed. Fig. 5—Zigzag feed top-and-bottom press. Fig. 6—Automatic gang press. Fig. 7—Friction-dial feed, slide feed and ejector. Fig. 8—Automatic double-roll and lateral feed

Fig. 6 shows an automatic cut-and-carry gang press where accurate work and considerable power is required, producing from ribbon stock either in rolls or strips. This press does eight operations, or may be worked for any smaller number of operations as required. It will turn out upwards of 200 finished pieces per min. requiring from 1200 to 1500 total operations. Each of the dies are operated in independent subpresses, the top and bottom slides being operated by toggles driven from one shaft which is controlled by a friction clutch, thus placing the press under constant control of the operator at all times. The top and bottom connections are independently adjustable, allowing the changing of the timing of the operations. In this way the top or the bottom slide may finish its stroke first, and then dwell until the other finishes its operation. This movement of the slides in relation to each other is dependent on the nature of the work being done. The stock in rolls is placed on a reel at one side of the press, and the scrap is rolled up on the other. If stock in strips is being run each strip is fed separate and its scrap ejected on the other side.

The work shown at *F*, Fig. 2, is cut from strip brass, $1\frac{3}{8}$ in. wide, and several operations—blanking, piercing and three formings—are done before the piece is ejected from the press. The piercing is done in the first dies, the blanking in the middle and the forming in the last dies. There are six operations on this piece and the production is 200 per minute.

A DIAL FEED PRESS

In Fig. 7 is shown a press for handling work that has previously been blanked and cupped in a first operation, and is to be redrawn, formed, stamped, etc., such as burner parts, covers and ferrules. The shell is fed on the dial feed at the right of the press which carries it against a gage where it is gripped and fed to the die, the same stroke lifts the shell from the die, ejects it from the press, and places another in position. Its production is from 75 to 100 shells per min. These presses may also be arranged to receive blanks of any shape in place of a drawn shell, or with the double-roll feed to blank and cup from the strip, and then carry to completion the piece to be made. The shell shown at *H*, Fig. 2, has been blanked and cupped in another press, and is then fed to this press for the finishing operation. After the forming is complete and the piercing is done the top is trimmed off on an automatic circular metal saw. The finished shell is shown at *I*.. At *G* is shown another shell that has been redrawn and pierced on this press. It is blanked and cupped in a previous operation; this press redrawing and piercing the small end, which it also forms in the redrawing, and pierces the hole in the side.

Fig. 8 is an automatic double-roll feed for making metal tags from strip stock that have to be stamped, lettered or embossed, pierced and blanked to size and shape. While a cut-and-carry press in every sense of the word, it is not a new style, having been in use for sometime. Its production is largely from soft metal stock, and while it may be dismantled and used as a single-stroke utility press it is, nevertheless, a factor in the cut-and-carry system. It may also be arranged for dial feed, tube feed, side, single- or double-roll feeds, and has an approximate production of 80 to 100 pieces per minute.

One great factor in all of these automatic feeds, aside from the saving in floor space, tools, operators and increased production, is the ever-present safety factor. The operator's fingers never need to be close to the dies, and there is little if any cause for accident. Most of these presses are arranged with positive stop-motion safety attachment for stopping the press at any point of the downward stroke should anything happen, or if the stock is not fed to the desired position. In all of these presses the attachments may be removed and the presses operated as single-action, one-operation machines; while in the multiple-tool presses such as the 14-die gang press, any number of dies from 1 to 14 may be used. The feeds, stripper and knockout arrangement are all positive, the machines being full automatic and universal in every way.

Special V-Block for Grinding Work

BY E. D. BECKER

To me, at least, the V-block shown is in some respects new. Recently in a munition-shop gageroom in Canada I was called upon to grind certain gages upon all four sides as well as the end, at one setting of work; hence, the development of this V-block.

Fig. 1 shows a sample of work required to be ground upon all four sides as well as the end, and it also shows the V-block assembled ready for the grinding operation. The two 10-size 32-thread side-clamping screws can be seen. The ordinary clamping device shown over the small V is of course removed when rolling the block while grinding the work.

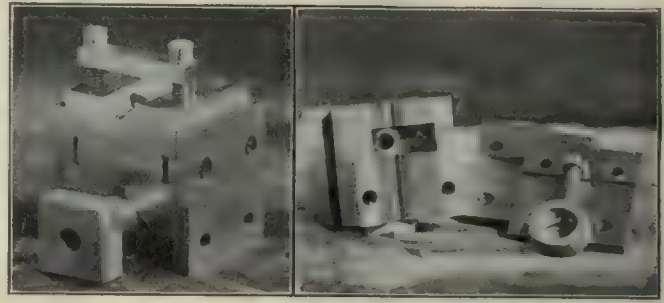
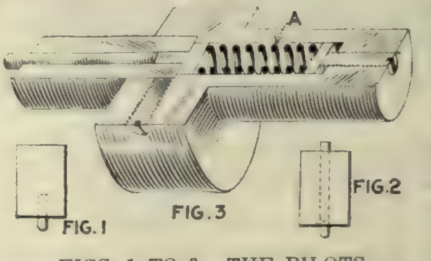

FIGS. 1 AND 2. V-BLOCK, WORK AND DETAILS

Fig. 2 shows an opening in the large V of the block for the yoke used. This opening is somewhat larger than the maximum-diameter yoke ring, so as to give a tightening movement of $\frac{1}{8}$ in. The yoke is made of rough stock $\frac{3}{8}$ in. wide and tapped for a $\frac{1}{4}$-in. by 20-thread screw. The yoke clamping screw, as well as the side pieces, is shown in this view. The side pieces are made with a gib, as shown. Everything is accurately ground; and without going into details, it may be said that the aim is to have the V's central with the sides of the block with or without side pieces.

Spring Operated Punch Pilot

BY GEORGE F. KUHNE

The blanking of some pieces of $\frac{1}{8}$ x $1\frac{1}{8}$-in. cold-rolled sheet steel, into which a hole was also pierced, resulted in a split punch, due to an error of the operator in not properly locating the stock. The pilot used when this occurred was inserted in the blanking punch as shown in Fig. 1. The punch was then drilled as in Fig. 2, which allowed the pilot to move backward into the punch in the event of a miss. This eliminated any further damage to the tools, but it was necessary to reset the tools whenever the operator made an error. In Fig. 3 is shown how all these difficulties were overcome. When a miss is made, the pilot is pushed back, and on the return stroke the spring *A* forces it back into position again.



FIGS. 1 TO 3. THE PILOTS

Market for Machine Tools in South America After the War

BY LUDWIG W. SCHMIDT

Past experience shows that the demand for machine tools in South America depends largely on the general prosperity there, and with the revival of business that certainly should follow this war. The demand for machine tools should be greatly increased, and under the conditions, in favor of American built machines.

THE total value of machine tool equipment in all the machine shops of South America has been estimated to be about $15,000,000. Taking this figure as approximately correct, and allowing for a depreciation of 5 per cent. a year, this would mean that every year South America has to buy machine tools to a value of $750,000 to keep up its equipment. This theoretical estimate for depreciation, while too low for Europe and approximately right for Chile and Argentina, is still too high as an average for all South America. Machine tools are supposed to have a long life in South American machine shops, and machine tools which would have gone to the scrap heap a long time ago in the United States are still in use. This does not make exactly for modernization in equipment. It has, however, the advantage that the country saves on renewal expenses, and can spend some money every year for additional machinery. This helps to increase the total equipment. The best estimate that can be made seems to show that approximately $600,000 are spent every year for the renewal of discarded machine tools, while about the same amount, or slightly more, is paid in every year for additional equipment.

It is difficult to give an exact figure as to the yearly demand for machine tools to go to South America, as the different countries do not publish any special statistics as to imports. The only way to get at the approximative values is to see how many machine tools have been shipped during each year by England, the United States and Germany. The total obtained in this way is probably the nearest estimate of the yearly needs for machine tools by the various industries. Using this method the value of the machine tools imported by the three leading South American nations from 1908 to 1913 is found to be as shown in the table:

VALUE OF MACHINE TOOL IMPORTS OF SOUTH AMERICAN COUNTRIES

	1908	1909	1910	1911	1912	1913
To Argentina.....	$297,000	$571,000	$455,000	$448,000	$410,000	$350,000
To Chile..........	73,000	89,000	115,000	142,000	156,000	150,000
To Brazil.........	176,000	235,000	417,000	733,000	757,000	399,000

All the remaining countries do not spend more than about $200,000 each year.

In Argentina the high-water mark of orders was reached in the year 1909. The real forward movement in the orders from Brazil started in 1910, and the highest point was reached in 1912. Chile reached its highest point in 1911, and continued to order from that time at a practically steady rate. The increase in orders for machine tools coming from Brazil during the years 1910, 1911 and 1912 is practically responsible for the large increase in orders coming from South America during these years. It is not difficult to ascribe this forward movement to the then favorable position of the Brazilian rubber trade. It certainly ended very rapidly with the breaking of the rubber boom, followed by a very serious breakdown of the whole commercial machinery of Brazil. Unfortunately, this breakdown was not confined to Brazil alone. In a very short time it had spread over the whole South American continent, having, however, its main cause not in South America itself, but principally in the unsettled economic conditions in Europe, accompanying the Balkan and preceding the present war.

FLOW OF CAPITAL ESSENTIAL

Since the beginning of the war there has been a break in the regular flow of capital into South America, an essential for the industrial development of those markets. Hence, the decline of orders for machine tools since the beginning of 1913. Regular financing of South American enterprises has a good deal to do with the prosperity of the machine tool business of this country. This close connection between the demand for machine tools and the general financial situation of the market is best explained by the fact that the railroads there are the best customers for machine tools. All the railroads have excellently equipped repair shops, where modern machine tools are in great need. Also, of course, many other industrial enterprises have use for machine tools, and their prosperity depends, more or less, upon the existence of easy money. The influence exerted by the railroads on the machine tool business of South America, however, appears also in another direction.

AMERICAN TOOLS GAIN IN FAVOR

In former years nearly all the machine tools in use were of European origin. Now, the situation is changing slowly in favor of American made machines. Of the $1,000,000 worth imported into South American markets in 1913 about 40 per cent. were of United States make as against 30 per cent. during the years 1911 and 1912. During 1914 and 1915 only a few tools of European make were imported, which has improved the American position. It is probably no coincidence that during the same period there has been an ascendency in the employment of American capital in South American railroads, which leads to the presumption that American engineers have taken the control of the repair shops of these railroads, and have exerted their influence in favor of American made machine tools whenever new equipment has been ordered.

Now, the war has wrought considerable changes in the South American market. As pointed out already, exports from European sources have been small since the outbreak of the war. Germany has not exported anything, England has exported few machine tools if any, and the American exports have declined below their former values.

What will be the demand from South America after the war, and how large a share of the demand will come to the United States?

In estimating the size of future orders the following facts offer some food for thought: The high-water mark in the orders for metal-working machines was reached during the years 1911 and 1912. The best year for the American exports was the fiscal year 1912-1913. The year 1912 was the culmination point of a great industrial movement which started during the years 1908 to 1909. The industrial boom ended in the autumn of 1912, and the year 1913 brought a decrease in the orders for industrial machines, including machine tools.

DEMAND FOLLOWS PROSPERITY

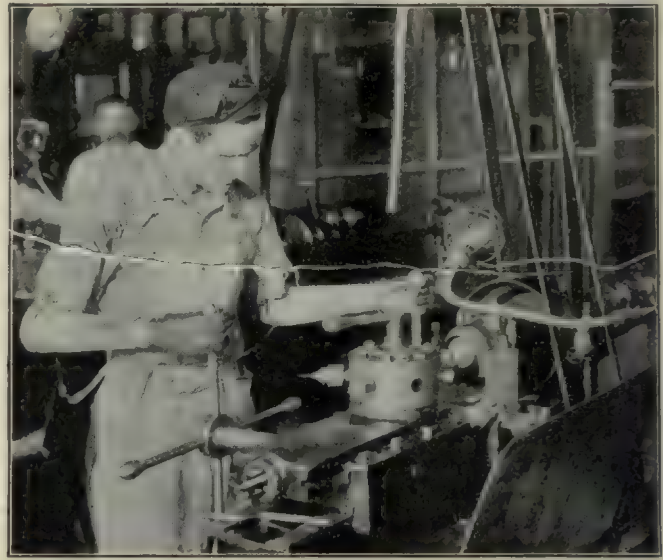
The large demand for machine tools, therefore, coincides with that period in history when South America was able to make good profits on the sale of its natural products. It seems now that the war, while having affected the financial situation of South America very seriously, has also brought a considerable increase in the prices of those materials and products South America has for sale. It is, therefore, most likely that the general forward movement in South American exports, which set in anew in 1908 and was cut short by the financial shortage in Europe and finally the war, will be resumed very soon, in fact, every indication points toward an increase of the movement when the war is ended. So, if the general rule that the demand for machine tools follows the general prosperity of the market holds true, this would mean that the end of the war will see at least a normal trade. Excepting American supplies the manufacturers have not had an opportunity to buy machine tools during the last two years, and on the base of a very low average they are now about $2,400,000 behind their normal orders. All reports coming from South America speak of an increase in the activity of the home industries. Many of those industries have suffered before under foreign competition. The lack of foreign supplies has driven customers in their direction, and they have shown their ability for filling orders. Industry will play a bigger part in the economic life of South America after the war than before, which in due course must bring larger orders for machines.

Under these circumstances a material increase in orders for machine tools can be expected in the early future. The liking for American made machine tools during the years immediately before the war will continue. It is, therefore, probably that a considerable part of the South American machine tool business will be handled by this country. How large this part will be, however, will depend greatly upon the enterprise of the American manufacturer himself, and also upon the willingness of our banks to step into the place of Europe as a money lender. In this case trade will certainly follow the money expended in the development of South American industrial resources.

The Maimed Man in Industry

BY C. L. EDHOLM

Science is restoring in part the wrecks caused by warfare and industrial accidents. The man who had lost a hand was formerly regarded as hopelessly handicapped in skilled manual labor, while the loss of both hands put a man out of active life if he was a mechanical worker. Today it is possible for a man to survive such an injury and take his former place in a shop, so marvelous is the perfection of the mechanical limb. The illustration of a Kansas City machine shop shows Louis Rondeau at his daily task, operating a machine with two artificial hands and arms. This man was an expert mechanic, drawing good pay, and after losing both arms he was able to take the same position with equal pay after being equipped with the wonderfully ingenious artificial arms and hands as shown in the accompanying illustration.


OPERATING TURRET LATHE WITH TWO ARTIFICIAL HANDS

Big Saving in Freight Cars Made by Increase in Loads

Fairfax Harrison, chairman of the railroads' war board, authorizes the following: On 77 of the principal railroads of the United States a saving of 114,109 cars was effected in one month this year, solely by increasing the average loading of "less-than-carload" freight. The reports on which these figures are based—the latest that have been compiled—cover the months of July this year and July, 1916. They show that the average loading for that class of freight during July this year was 13,927 lb. as compared with an average of 11,619 lb. during the same month last year.

The 77 railroads from which reports have been received were able to move the total volume of less-than-carload freight last July in 579,180 cars. Had the average loading per car been at the same rate as during July, 1916, they would have been compelled to use 693,289 cars.

In addition to increasing transportation efficiency through intensive loading, the railroads are also waging a vigorous campaign to reduce the number of cars and locomotives under repair.

The July reports show that the average number of freight locomotives in shop or awaiting repairs was 4122, against 4460 in the same month last year, a decrease of 7.6 per cent. Freight cars under repairs in July numbered 135,831, which was 8647 less than in July, 1916, a decrease of 6 per cent.

Series for Executives

A Fair Royalty Contract for Employees

BY ROBERT G. PILKINGTON

Motor Traffic Engineer, Chicago

The writer of this article tells of a possible way in which a man, who is wide-awake, may increase his income by improving machines or methods with which he is familiar, and which his employer will welcome if properly presented.

A FRIEND of mine, frightened by the increasing cost of living, came to me not long ago and asked me how he could increase his income or whether he should look for another job. I knew he liked his work, so I told him that in my opinion many men make the mistake of their lives by quitting a good job, just because someone wanted them bad enough for a short time, to offer fifty cents, or possibly even a dollar a day more than they got. Nowadays, more than ever before in my experience, men should study the possibilities of the company they are with. Forget entirely the fact that at present you are the chief pilot of a Jones & Lamson, or a Cincinnati milling machine, or a big electric welding machine. Look away out and up. Take a lot of time and see what your company is going to do in the future. I told him that, with one or two important exceptions, I had been an absolute failure as a prophet, but that one thing I felt sure of was that when this war is over, the world will be stripped clean of everything that goes to make life worth living. America will not only have to sell to other countries more than she ever has before, but she will have to provide for years the very machines to make their products. I suggested that he take some unit of production that he knew something about and study it thoroughly, to see if there was not some way in which he could lessen the cost of production. What would it mean to him, if he could tell Ford or Willys or Dodge how they could make their motors for a dollar less, or Goodyear or United States Rubber how they could pare twenty-five cents off the cost of a tire. Any one of them would give him anything within reason, that he might ask.

I told him I thought the old idea that the employer had rights to an employee's invention had some legal standing but was very dead and any one of the really big fellows was glad to see an employee living in a fine house and getting rich off the employer's product, if in so doing the employee had worked for the interest of all concerned. In other words, the employer would rather allow the employee to patent whatever he had that was worth it, and pay him a fair royalty, than to have him keep it "under his hat," and sneak away to try it on someone else. Give the company you work for the first chance at whatever you have that is good. Make a clear free-hand sketch of it and have two of your shopmates sign a statement, that should be written on the sketch, that you have explained it to them and that they understand how it works. Be sure that you sign it as its originator, and be doubly sure that you all three date your signature. It is better to do all the signing and dating on the same day, as it will be easier remembered, but this is not necessary.

LET AN IDEA SEASON

After you have made your sketch, you feel absolutely sure that it will work and revolutionize all known methods—but it wont, not once in a thousand times. Put the sketch away for a little and let it "season." A surprising number of them spoil entirely during this seasoning process. After you get what you think is a new idea, you study the state of the art harder than ever and learn a lot of things that you had no idea existed. Do not degenerate into that supreme pest of mankind, the professional inventor with the dirty collar. You do not need to be that kind. Any bright young man is just as apt to spring a million dollar idea as is his boss.

Assume that you are working for Henry, in his big shop in Detroit, and that your machine does the most expensive single detail of the whole manufacturing routine. If I know Henry, and I think I do, he will never turn down without reward an idea that will cheapen his product, if by so doing he can maintain the quality. John and Horace feel the same way about it, too.

Study the expensive job until you can beat it, and beat it as thoroughly as you can. When you feel sure you have it, keep your mouth shut until you and your witnesses have had your session. Again, I say keep your mouth shut. I have seen a sparrow rob a robin, because the robin's head was way up in the air. Then after you have thoroughly seasoned your idea, take the sketch in hand and show it to Henry. Probably he won't look at it, but he may. More likely he will pass you on to some lower light—and right here listen carefully. Do not allow yourself to be passed too far down. Henry is square, and if he had time to settle the matter at one sitting you would be the gainer. But when you begin to pass down the line you get in among the relatives of the foremen who are just as anxious as you are to get ahead. Remember the sparrow and the robin, and peck away at the biggest fellow that will stand for it.

The first thing the big man will ask you, very pointedly, is if you do not think the idea belongs to Henry. Show him your witnessed sketch again. He has to ask you. That is what he is paid for. He does not expect you, at the final showdown, to allow yourself to be robbed. He is a good bluffer. Has to be. Try and go him one or two better. He will like you better for it. The bigger the man, the more he enjoys having something of this kind put over on him. Then, after the usual lot of good-natured bluff, he will come down to brass tacks and ask you what you think you ought to have.

I went to one of my attorneys, a well known and highly successful corporation lawyer, who is, withal, a Christian gentleman, and asked him to write me what he thought was a perfectly square and moderate royalty contract, one that neither side could find fault with and it has stood some knocks. The contract is given at the end of this article. It is fair to both sides. The royalty rate may be altered if desired, but not without thought. I told my friend that if I were he, I would plan to get along some way on my salary, and put every cent of the royalties into stock of the company. If your company is willing to pay you royalties but not to sell you stock, as most but not all of them are glad to do, some other company may be just as good for your purpose. The officers of a company like an employee that acts as though he wanted to be modest about it, but really expected after a decent interval, to be an officer of the company himself. Owing to the demand for skilled men in all departments of the motor car business, with which the writer is best acquainted, some of those who are now the most prominent started into it with only their mouth and a thick skin as assets. But you; if your company accepts you as a stockholder in return for your investment of royalties, continue to wear the same size hat. It really fits as it is.

Unless your idea comprises an important sales unit in itself, the company will probably refuse to put your name on it, or to put you in charge of it entirely, but you have a right to ask some important connection with either its production or sale. By means of this connection, if it has any pronounced faults, you find them out at least as soon as any one else, and are ready to correct them by the time the demand for improvement becomes really serious.

A ROYALTY CONTRACT

THIS AGREEMENT, made this...... day of.............1917, by and between John Doe, of the City of Chicago, County of Cook, State of Illinois, party of the first part, and.....................
....
a corporation of the State of...
party of the second part,
WITNESSETH,
Whereas, said party of the first part is the inventor of a new and useful article of manufacture known as a headlight for motor vehicles, and is desirous of making application for patent or patents upon the same, and of having the same manufactured and placed on the market for sale, and,
Whereas, the said party of the second part is desirous of securing the sole and exclusive right to manufacture and offer for sale the said headlight,
Now therefore, it is agreed by and between the parties hereto, as follows:

First—In consideration of the sum of One ($1.00) Dollar, and of the rents and royalties hereinafter reserved, and of the agreements hereinafter entered into by the party of the second part, the party of the first part hereby grants to the party of the second part the sole and exclusive right or license to manufacture and offer for sale in the United States of America, Canada, Great Britain, Australia, France, Belgium, Argentina. Brazil, Chile, Japan, and Russia, for the entire term of the patent or patents, the said headlight.

Second—In consideration of the grant or license hereinbefore made to the party of the second part, said party of the second part agrees:

(a) That he will at once cause application to be made in the name of the party of the first part for the issuance by the governments of the beforementioned countries of such patents as shall be found necessary to protect the said headlight, and shall himself pay all attorney's fees and patent office fees necessary to procure such patents; such patent or patents, when issued, to be the sole and exclusive property of the party of the first part, subject only to the rights expressly given by this contract to the party of the second part.

(b) That he will not make any change in construction or appearance of the said headlight, except on the written consent of the party of the first part, covering each such change.

(c) That he will pay to the party of the first part a royalty of seven and one-half per centum (7½%) of all sums received in payment by him for all headlights manufactured by him under this license, it being agreed that the attorney's fees and patent office fees connected with the obtaining of the patents above provided for shall be paid out of the first royalties earned, and it being further provided that, in case the validity of the patent* or patents issued hereunder is attacked in court, and the party of the first part does not protect the same, the party of the second part shall have the right to protect said patents, and to charge the cost of protecting the same against the royalties herein provided for, and it being agreed that said protection is to be obtained in court in the most economical manner.

(d) That he will at all times keep an accurate account of all sales of products manufactured under this agreement, and will render a full statement of the same in writing to the party of the first part every month, beginning on the first day of the month next after the said products are first offered for sale, such statement to show the total of such products made under this license up to a date three days before the end of the month, and the royalties called for by such statement to be paid within ten (10) days after the date of the statement.

(e) That he will mark all such products manufactured by him under this license with an inscription stamped thereon as follows:

The Doe Headlight.
Patents Applied For.
........................Sole Licensee

(f) That he will allow the party of the first part to invest all or such part of the beforementioned royalties as the party of the first part may elect, in the (preferred) (common) stock of the company, such investment to be made in such manner and at such times as the party of the second part may elect.

Third—The party of the first part shall be employed by the party of the second part to be in full and sole charge of all matters pertaining to the manufacture and sale of the said headlights, subject only to the orders of the officer of the company highest in executive authority, and said party of the first part shall give all of his time and attention during business hours to furthering the interests of the party of the second part.

If at any time hereafter, during the continuance of this agreement, the party of the first part shall make any further improvement in said headlight, or shall become the owner of such improvement, then in every such case he shall communicate such improvement to the said party of the second part, and shall give him full information regarding the same, and the party of the second part shall be entitled to use the same without paying any additional royalties on account thereof. Said party of the first part shall be entitled at all times during business hours to visit and inspect the offices and shops of the party of the second part, to inspect the work being done under this agreement, and to examine the original books and records upon which the statements as to the total of the headlights manufactured are based.

Fourth—It is further agreed by and between the parties hereto, that if the manufacture and sale of the products covered by this agreement do not prove profitable to the party of the second part, he may, at the end of the second year after the date of this agreement terminate and cancel this agreement by the service upon the party of the first part of a notice to that effect, also that if the royalties paid to the party of the first part, including those applied to the cost of the original issuance of the patent or patents, and the necessary defense of the same against attack in court, shall, for any year after the second year following the date of this agreement, amount to less than ....dollars, the party of the first part shall have the right to terminate and cancel this agreement and of all rights of said party of the second part under it, by the service of a written notice to that effect upon the party of the second part, such notice to take effect thirty days after the date of the delivery thereof. After the cancellation or termination of this agreement by notice by either of the parties hereto, the patent or patents above mentioned, and the right to manufacture and sell manufactured goods under them shall be the sole and exclusive property of the party of the first part, subject only to the right remaining in the party of the second part to sell any products already manufactured by him under this agreement, and upon which he shall have paid to the party of the first part the royalties hereinbefore provided for.

IT IS FURTHER AGREED, by and between the parties hereto, that the party of the second part shall pay to the party of the first part, a salary for his services in charge of the work hereinbefore mentioned, this salary to continue for a period of two years from the.....day of.........................191... and to be paid in equal installments on the first and sixteenth day of each month thereafter. For the first year under this agreement the said salary shall be $................ and for the second year $.................

IN WITNESS WHEREOF, the parties hereto have set their hands and seals, the day and year first above written.

..........................(Seal.)
Party of the first part.
..........................(Seal.)
Party of the second part.

[*It would seem that in paragraph (c) of the royalty agreement the obligation of the party of the first part should be *to bring an action for infringement* rather "than if the validity of the patent be attacked," etc. Non-validity might be set up as a defense, as also non-infringement, but only after infringement proceedings had been instituted.—Editor.]

Foundations for Planers[*]

BY TERRELL CROFT[†]

An adequate foundation is necessary if a planer is to produce good work. The installation of concrete foundations has become standard practice. The requirements for accurate planer work are given, and modern planer foundations and the method of installing planer beds on them are described.

IT IS essential for accurate work that an adequate foundation be provided under every planer. This statement, in general, holds not only for planers, but for nearly all other machine tools, particularly the larger ones. Often a tool is held responsible for inaccurate production when actually the tool itself is capable of doing the work, but the foundation on which it rests or the method adopted in setting it up is the cause of the difficulty. Although it does not appear to be well recognized, it is a well-established fact that foundations supporting a planer and the accuracy of leveling and alignment of its bed are as important elements in the production of good work as are the workmanship and construction of the tool itself. Planer tables are in reality quite sensitive and may with relative ease be warped so that the close machining, of metal held on them, is impossible. It follows that the practice of using a planer table as a plane surface upon which to hammer things in order to straighten them, is reprehensible. When castings are to be placed on a planer table, they should never be permitted to fall on it, but should always be let down easily.

If a planer bed is not given adequate support, it may warp out of shape, due to its own weight. Thereby, the alignment of the ways will be affected and the accuracy of the product will be decreased accordingly. The concrete foundations, the installation of which is now standard practice, will, if properly designed and installed, eliminate the possibility of difficulties of this character. It is the purpose of this article to describe modern planer foundations and the method of installing planer beds on them.

The requirements for accurate planer work, in so far as the foundations are concerned, are these: (1) A planer bed should bear uniformly on the foundation and should be adequately supported by it; (2) the bed must be true and be set level on the foundation and must have its center line located at right angles to the lineshaft that will drive the planer.

Planer tables are now given the final planing before the machine leaves the factory. It was the general practice several years ago to make no endeavor to plane the face of the table accurately, until after the tool had been erected finally in the position in which it was to operate. Then the final cut was taken. Experience has shown that with the modern accurate manufacturing methods it is much more satisfactory and economical to arrange to have the tool plane its own table before it leaves the factory. It is generally quite unnecessary to have a modern tool plane its own table after it is set up in position, if the methods of leveling the bed (which are described below) with leveling blocks or wedges are followed. In fact, if it appears necessary to have a planer plane its own table, it may be taken as an evidence of inaccurate installation.

In installing the planer bed on its foundation the longitudinal center line must lie exactly at right angles to the lineshaft. This is the first consideration. If it is not satisfied, driving-belt difficulties will be encountered. For the next step, the bed should be leveled both longitudinally and transversely.

It is often desirable to remove the feet from a planer (assuming that the planer was provided with feet, as some small ones are) before installing it on its foundation. This is particularly true if chip, or shaving pockets are provided. The wedges or leveling blocks used for leveling the bed should be located at the points from which the feet were removed. Fig. 1 shows a small planer, from which the feet were removed, which has been mounted on a foundation. Usually, where the feet are taken off, it is necessary to extend the foundation above the floor line for a distance equal to about the height of the feet, so that the planer table will lie a sufficient distance above the floor line to insure convenience in working.

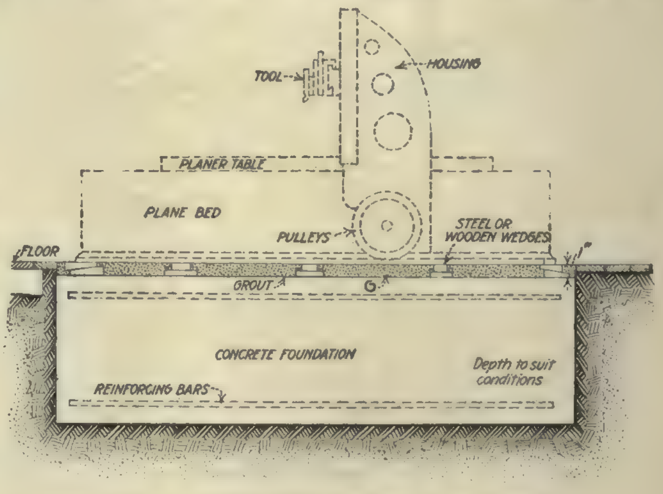


FIG. 1. GROUTING UNDER A PLANER

A planer bed should never be bolted down to its foundation. In the words of George Langen, works manager of the Cincinnati Planer Co., "The objection to bolting down a planer is that it forces the bed to settle with the foundation, no matter in what direction it may distort, and even the best of foundations are continuously changing." If a planer has enough metal in it satisfactorily to perform its functions, it will not shift at reversal, nor can any stress that its belts will impose upon it raise it from the floor. If anchor bolts are provided, an ignorant mechanic may endeavor to draw the planer bed into alignment by turning the nuts on these bolts. Obviously, the only effect of such a procedure is to warp the bed, which will render matters worse, rather than better. Nor should a small planer, for which it may be deemed inadvisable to provide a foundation, be bolted to a wooden floor. If it is so bolted, a heavy weight placed on the floor near the tool may distort the floor boards and they will, by virtue of the bolt connection, bring down a portion of the planer bed with them. Distortion of the bed and excessive internal strains in the metal will result. It follows that if a planer bed is bolted to its foundation, and this applies particularly to the very long beds (possibly 80 ft. long) which are now in use, a settling of one corner or portion of the foundation will result in a corresponding distortion of the bed of the tool. At one time it was the practice to place pins, possibly ½ in. in diameter and extending above the surface of the foundation 1 in., around the planer bed to prevent it being shifted during reversal or by belt pull. Such provision is now seldom if ever made, because it is unnecessary.

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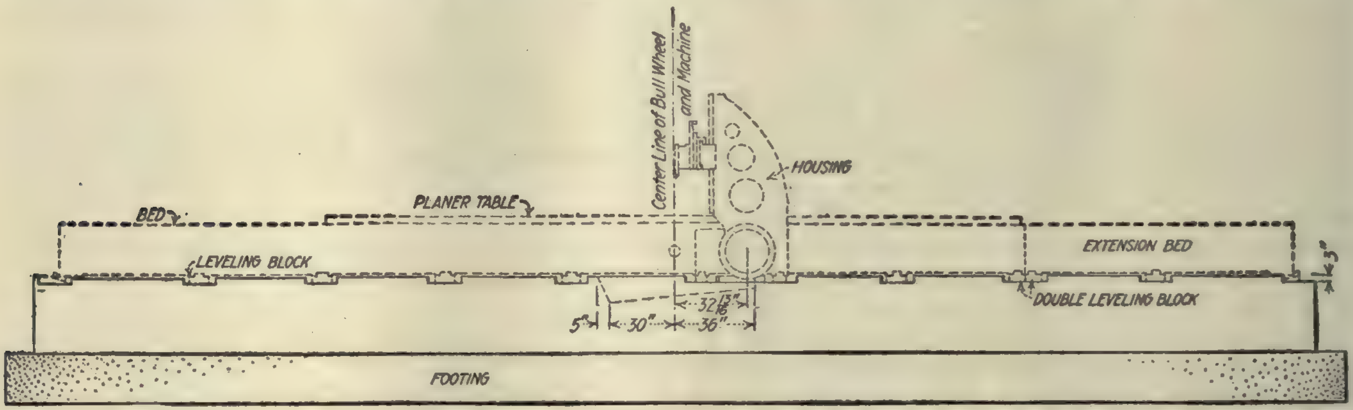
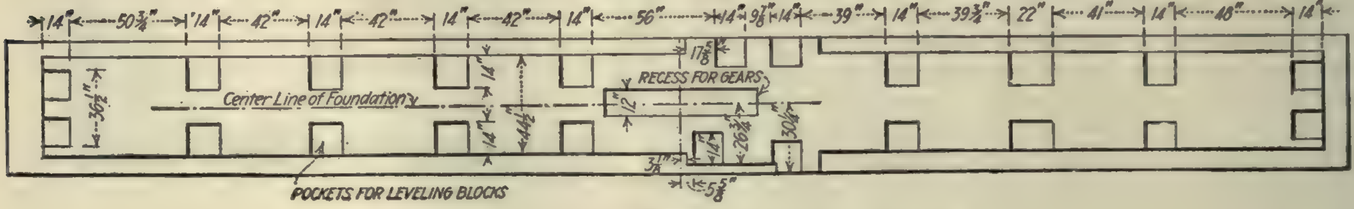
[*] Copyright, 1917, by Terrell Croft.

[†] The author desires to acknowledge the assistance rendered by Arthur Pierce, foreman of the Fulton Iron Works, of St. Louis, Mo., in the preparation of this article. Mr. Pierce has just returned from a trip through the machine-tool building plants in the East, whereby he became acquainted with the very latest developments in planer-foundation construction. He kindly offered a number of valuable suggestions and read critically the rough draft of the manuscript.



Elevation

(NOT DRAWN TO SCALE)



Plan

FIG. 2. FOUNDATION FOR A 42 x 36-IN. PLANER

Most planer manufacturers furnish foundation plans for the machines that they build. These plans, as a rule, indicate only the general proportions of a suitable foundation and the locations of the planer feet or leveling blocks. Ordinarily, they do not indicate the detailed construction that should be followed. Some of the foundation plans that have been furnished by manufacturers for planers appear to be unnecessarily complicated.

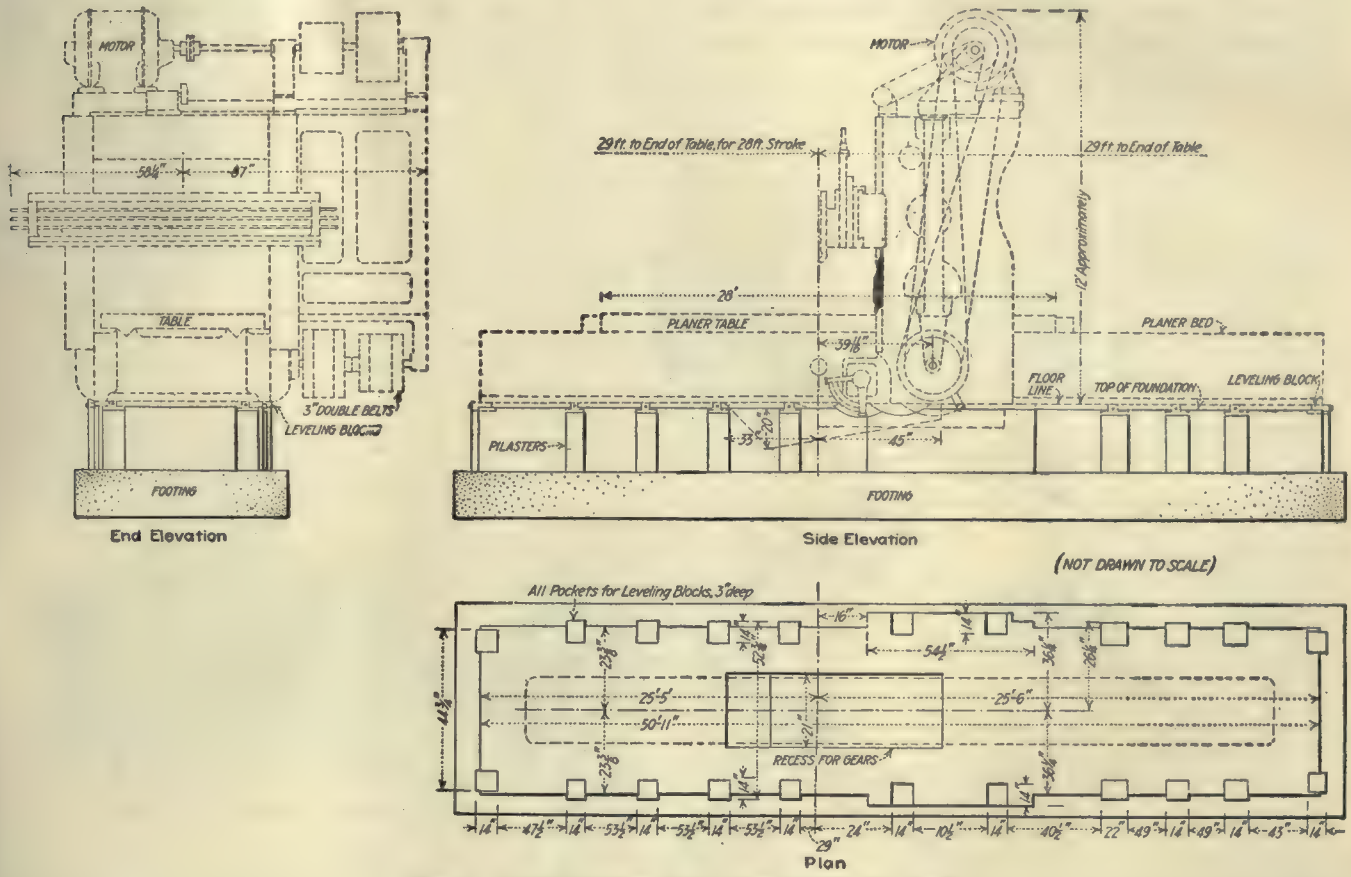
In leveling the planer bed, the procedure to be followed will depend on whether or not the surfaces on the top of the bed are machined parallel to the ways, inasmuch as the table does not bear on any surfaces except those in the grooves. In any case, no attempt should be made to level the bed until either leveling wedges or leveling blocks (which will be described later) have been inserted under the bed at the proper locations. The leveling is effected by adjusting these wedges or blocks. It is not essential for accurate work that the surfaces on the top of the bed be accurately parallel with the ways. If the top surfaces are not parallel with the ways, the transverse leveling may be effected by placing two cylinders, each of exactly the same diameter, in each of the V-grooves and laying the level across them.

To level such a bed longitudinally, the level may be placed, at different locations along the length of the bed, in the V-grooves. However, it is the practice of some of the planer builders to machine the surfaces on the top of the bed accurately parallel with the ways. If this procedure has been followed, the transverse leveling can be done by laying the level across these surfaces and the longitudinal leveling by placing the level along at different locations on the surfaces. For a medium- or large-sized planer it is necessary, in leveling it longitudinally, to place the level at a number of different locations along its length on the top surface of the bed. Any adjustments that are necessary may be made by manipulating the wedges or the leveling blocks, if such are used. Accurate longitudinal leveling is not so essential for a small planer, particularly one that rests on only two legs, one at either end, because, even if the bed is not exactly level longitudinally, the accuracy of the work will not be affected appreciably, provided the bed is level transversely.

The bed of a medium- or large-sized planer is usually first left a trifle high at a location under the point where the tool will cut. The reason for this is that the pressure of the tool and the mass of the housings tend to make the bed low at this location. After the housings have been bolted on, the final adjustments may be made.

The spacing of the leveling wedges or leveling blocks under a planer bed is determined by the size of the planer. Figs. 2 and 3 indicate the recommendations as to leveling-block spacings made by the Cincinnati Planer Co. for two of its planers. In general, the blocks or wedges should be located approximately 4 ft. apart along each side of the bed.

In setting wedges or leveling blocks they should be placed at the points where the wedges were set by the machine-tool manufacturer when the planer bed was finally lined up and scraped in the factory. Some manufacturers make a practice of marking each bed with an *X* at each point where a leveling block or wedge was located when the bed was scraped in the shop. If a foundation drawing is furnished for the planer it will, as suggested above, indicate the proper locations for the leveling blocks. If the leveling blocks are not placed at the points where blocks were located when the bed was scraped in the factory, it is obvious that, due to deflection, the ways will not be exactly level.



End Elevation

Side Elevation

(NOT DRAWN TO SCALE)

Plan

FIG. 3. FOUNDATION FOR A 60 x 48-IN. PLANER

Wedges grouted in a foundation top are found satisfactory for leveling small- and medium-sized planers for ordinary commercial manufacturing. On the other hand, for accurate machine-tool work it appears that leveling blocks are always desirable under the planer bed. Figs. 1 and 4 illustrate the method of grouting metal wedges under a bed. While iron wedges are preferable, wooden ones—pieces of shingles—may be used in an emergency. Wedges are first placed at the proper locations on the foundation, and then the bed is mounted on them and leveled by adjusting the wedges. There should be a space of ⅝ to 1 in. between the top of the foundation and the bottom of the planer bed. Then into this space the grout is poured so that it rises within the bed and supports the planer along its entire edge. A dam, arranged by assembling boards and sticks around the outside of the planer bed, is provided to confine the grout. After the grout has partly set, the surplus extending outside the lower edge of the bed can be cut away with a trowel. While this method of using wedges and grouting may be satisfactory for the conditions specified above, it is not recommended for important work, because it is, all things considered, uneconomical.

A grout in which leveling wedges or blocks may be set consists of one part sharp sand and one part cement by volume, first sifted and thoroughly mixed and then made to the consistency of thick cream by adding water.

Proportions for iron wedges may be those specified in Fig. 5, which have proved satisfactory in practice. The pitch of such a wedge should not be too great—that is, the wedge should not be too "steep"—because if it is, the jar and vibration around an ordinary machine shop will often cause the wedges to slip on one another after the bed has been leveled. This shaking down may occur before the bed has been grouted, in which case difficulties due to inaccurate work will ultimately result.

Leveling blocks for leveling planer beds are of the general construction suggested in Fig. 6, which shows the block manufactured and recommended by the Cincinnati Planer Co. The bottom face of the lower plate *L* has a relatively great area, so that it will provide an ample bearing surface and rest solidly on the grout on the top of the foundation. The upper plate or wedge *W* provides an ample bearing under the planer leg or bed. The capscrew *A* permits rapid and fine adjustment. Fig. 7 indicates the method of its application. It will be noticed that where these blocks are used the planer bed does not touch the foundation, but rests entirely on the leveling-block wedges. There are two decided advantages which the leveling blocks have over the primitive method of leveling with wedges: (1) When the blocks are used, the planer bed may be easily releveled at any time, if such procedure becomes necessary, due to the settling of part of the foundation or to any other cause, and (2) a planer bed may be leveled much more rapidly and accurately where the leveling blocks are used. As indicated in Figs. 2, 3 and 7, leveling blocks are, where the bed has no feet, located under it at suitable points. Where the bed has feet, as in Fig. 8, one block is arranged under each foot. It is evident that by operating the adjusting screw *A*, Figs. 6 and 7, very fine gradations of level can be obtained.

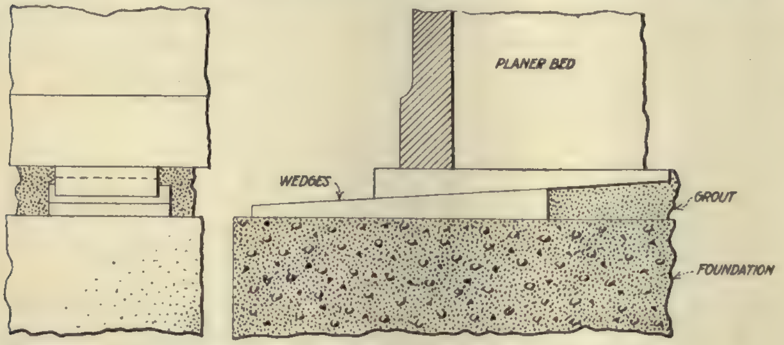
In setting leveling blocks, Fig. 7, the block is arranged in a grout bedding in a recess, Figs. 2 and 3, provided for it in the top of the foundation. Blocks are set in the grout so that the top faces of all the wedges are approximately in the same plane. Then, after the planer bed has been set on the wedges, the final adjustments are made by turning the screws in the leveling blocks until the planer bed is level in all directions. Graphite is used for lubricating the faces of the wedge and bottom plate, which slide in contact.

Leveling blocks are almost essential where a very accurate product is to be manufactured—that is, for the building of machine tools and similar work where the accuracy must be within 0.001 in. per foot of length. Foundations may settle individually, as outlined above, so that leveling blocks are essential to maintain the planer beds permanently in accurate adjustment. Leveling blocks are almost imperative for very long planer beds, some of which extend for 80 ft., because a foundation of this length, if constructed with a reasonable regard for cost, can hardly be built so that it will not deflect or settle to some extent.

The economy of an adequate planer foundation provided with leveling blocks is unquestioned where accurate output is imperative. It is of course somewhat cheaper in first cost to install a foundation of small volume and to use iron wedges instead of leveling blocks; but if the lost time that will be involved, due to inability to work close to dimensions is considered, the investment for suitable foundation equipment will be found more than justified. The results of a test made on a planer by the Norton Grinding Co., of Worcester, Mass., after the tool had been used for a year, give an indication of the effectiveness of adequate foundations. The planer was an 18 x 36-in. by 18-ft. machine. It was tested with its table in place on the bed with a 15-ft. straight-edge. Under this straight-edge, tissue paper could be held at any three points on the table, indicating that the table had maintained its level both longitudinally and transversely.

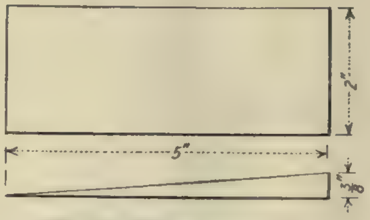
Concrete is the standard material for planer foundations, because usually, all things considered, it is the most economical. Masonry—that is, brick and stone—is seldom, if ever, used now. Another advantage of concrete is that it can be reinforced with steel. Masonry cannot be so reinforced effectively.

Simplicity of design is desirable for the foundations, because a simple foundation can in most cases be made to sustain its load just as well as will a complicated one. Straight sides should always be used in preference to inclined ones, so that the cost of forms may be made a minimum. Bevels and miters in forms are expensive

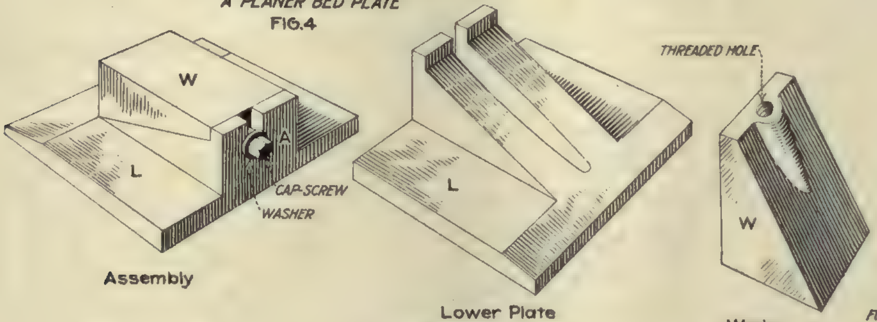


Front Elevation Section

HOW WEDGES ARE USED FOR LINING UP A PLANER BED PLATE
FIG.4



WEDGE FOR LEVELING MACHINES
FIG.5

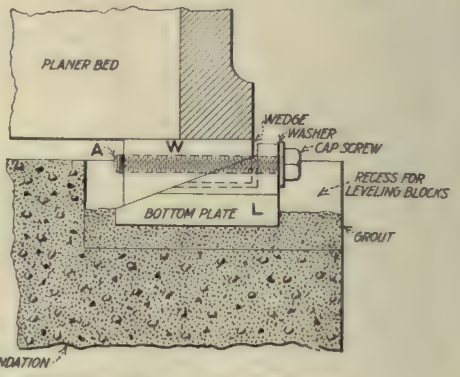


Assembly

Lower Plate

Wedge

PLANER BLOCK
FIG.6



APPLICATION OF PLANER LEVELING BLOCK
FIG.7

FIGS. 4 TO 7. THE USE OF WEDGES FOR LEVELING and in many cases wholly unnecessary. It does not appear to be generally recognized that it is often cheaper to use a little more concrete in a foundation than to construct a complicated form. Regular outlines, without offsets or recesses, should therefore be used wherever possible. Figs. 1, 2 and 8 show examples of simple, sensible planer foundations.

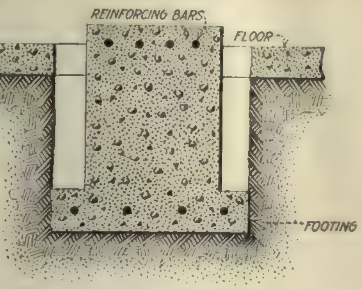
A foundation for a small planer is shown in Fig. 1. This foundation is simply a rectangular prism of concrete reinforced with steel. Wedges instead of leveling blocks are shown on the top to support the planer bed, although leveling blocks are usually preferable. Where the earth is self-sustaining, a foundation like that of Fig. 1 can (as is described below) be built without any forms by merely filling with concrete a rectangular excavation in the earth. Where the earth is not self-sustaining and forms are necessary, it is ordinarily desirable to provide a footing, Fig. 3, upon which the forms can be erected, under every foundation.

A foundation for a planer with legs is detailed in Fig. 8. In constructing this the hole was excavated and the bottom filled with a slab of concrete which provides the footing and which distributes the weight over a wide area so that settling will be a minimum. Then on this footing the forms were erected for the piers, which extended almost to the floor level. On the top of each pier, the leveling blocks were set in grout, as indicated in the diagram.

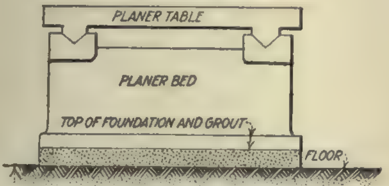
A foundation for a medium-length planer with pilasters for the leveling blocks is diagrammed in Fig. 3. Foundations of this type have been constructed in certain shops. The provision of the pilasters, however, requires expensive formwork, the excess cost of which does not appear to be justified. Apparently the reason why the foundations have been constructed in this manner is so that the foundation will at no point extend beyond the outline of the planer bed except at the location where the leveling blocks are to be placed. The appearance of the resulting foundation is very satisfactory. But it hardly seems that it would earn greater dividends than one built in accordance with the simpler scheme shown in Fig. 2.

A straight-sided foundation for a long planer is delineated in Fig. 2. In this design, simplicity is the keynote. The cost of the forms and of the foundation itself will be a minimum, and at the same time the structure has an attractive and business-like appearance.

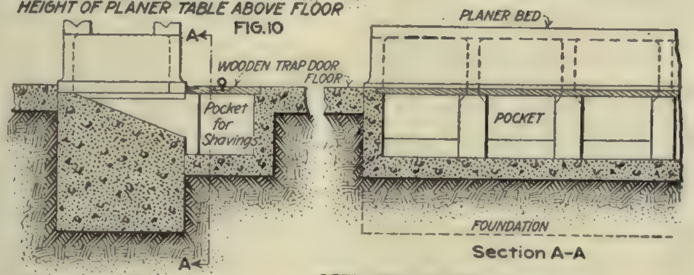
FIG.9



SECTION OF A PLANER FOUNDATION



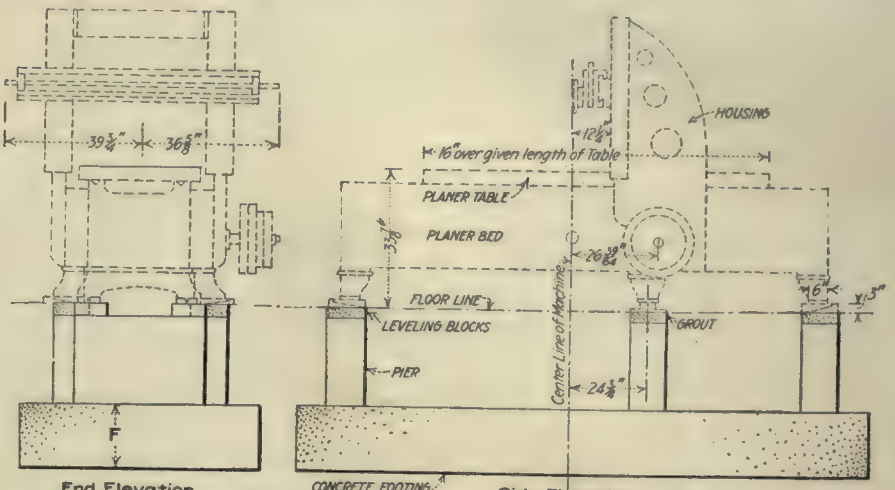
HEIGHT OF PLANER TABLE ABOVE FLOOR
FIG.10



Sectional Elevation

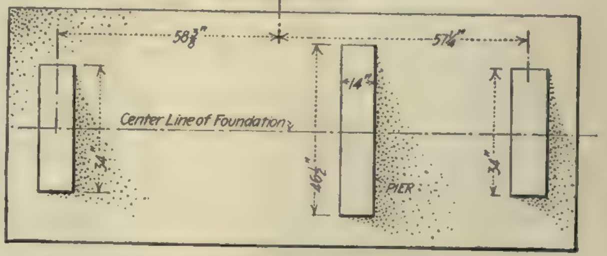
Section A-A

DETAILS OF A PLANER FOUNDATION
FIG.11



End Elevation

Side Elevation



Plan

FOUNDATION FOR A SMALL PLANER
FIG.8

FIGS. 8 TO 11. VARIOUS PROBLEMS RELATING TO FOUNDATIONS

Note that offsets, pockets, angles and inclined surfaces have been avoided in so far as possible.

Steel reinforcing may often be used effectively, as suggested in Fig. 9. There may always be some tendency for long, narrow foundations, such as those that are necessary for long planer beds, to deflect in about the same way that a beam deflects. This is particularly true if the soil at the middle or the ends of the foundation yields. Just as a concrete beam may be reinforced with steel rods, so can one of these foundations be reinforced, as indicated in the diagram. With a beam, however, the load is always imposed from the top, while the ends of the beam are supported. Hence, the top of a beam is always in compression while the bottom is in tension. But with a planer foundation either the top or the bottom may be in tension. If the earth under the center of the foundation settles, the bottom of the beam will be in tension; whereas if the earth at the ends of the foundation settles, the top will be in tension. For these reasons it is well to locate reinforcing steel rods both near the top and near the bottom of the foundation. For reinforcing steel, pieces of light rails, pipe or rods—scrap material is entirely satisfactory—can be utilized.

The height of the planer table above the floor is a thing which must be determined on the basis of the work that the planer is to do and the size of the planer. The table of a large planer should not be so far from the floor as that of a small one, because the machinist has little difficulty in seeing the top of any piece of work on a small planer; but on a large planer, where the castings being machined may be a number of feet high, it is desirable to arrange the foundation so that the planer table will not be too far from the floor. By following this procedure, the use of a step-ladder by the machinist so that he may see the top of his work may in many cases be avoided. No rules that apply generally can be given. It is, however, usually considered good practice to locate the planer tables about the distances from the floor shown in Fig. 8.

The proper depth for planer foundations is always a thing which must be determined by local conditions. As a general rule, however, it is not necessary or desirable to make any planer foundation deeper than about 5 ft., if good solid "bottom" is found at this depth. On the other hand, any foundation should, unless its footing is extended over a relatively large area, extend down to "good bottom." The foundation for a smaller planer need not, in good soil, be deeper than a couple of feet. In filled ground, trouble is liable to be encountered unless the foregoing precautions are rigidly observed.

The area of base necessary for a planer foundation depends upon the character of the soil. In good solid earth it appears that it is seldom, if ever, necessary to have the area of base of the foundation greater than the area of the base of the planer bed. However, spread footings are often used merely because of the convenience in form construction which they afford. Under such conditions a foundation like that of Fig. 1, with perfectly straight sides, will suffice. Where it is deemed desirable, because of poor soil, to increase the area of base, this can usually be best accomplished by putting a spread footing under the foundation, as suggested in Fig. 2.

Shaving, or chip, pockets may be provided in planer foundations, as suggested in Figs. 11, 12, 13 and 14. Such pockets provide a recess into which the chips brushed from the planer table may fall and from which they can be shoveled without sprinkling them over the V-ways in the planer bed. This method of providing chip pockets in planer foundations applies particularly where the table has the stop holes and the bolt holes passing entirely through it, so as to permit the chips to fall through the table into the bed. The tables of some planers are so designed that chips may pass through the upper part and be taken out of the side of the bed, in which case the bottom of the bed may have no holes through it. With such construction, chip pockets are obviously unnecessary. Where the planer foundation does not extend above the surface of the floor, the construction detailed in Figs. 11 and 12 may be adopted. There is a pocket with an inclined face under each opening in the planer bed. Along the side of the bed, extends a trough. The chips drop from the pocket into the trough. A wooden trapdoor is provided over the trough. At the end of each day's work, the door is taken up and the chips that have accumulated are shoveled out. Such a provision will more than pay for itself for two reasons. The first is that the ways of the planer are protected from the sprinkling of chips that might occur if it was necessary to remove the chips from the recesses in the bed with a shovel. Second, the chips can be removed from the trough at almost any time, even when the planer is running, so that overtime need not necessarily be involved. Where the planer foundation extends above the surface of the floor, the construction outlined in Figs. 13 and 14 may be used. With this construction there is no possibility of tools or small parts that might be lying on the floor being kicked into the shavings trough.

A foundation may be built without forms in soil that is self-supporting. In such a soil it is merely necessary to excavate the hole of the size desired and fill it with concrete, as suggested in Fig. 15. If a spread footing is necessary, this can be made by undercutting, with a

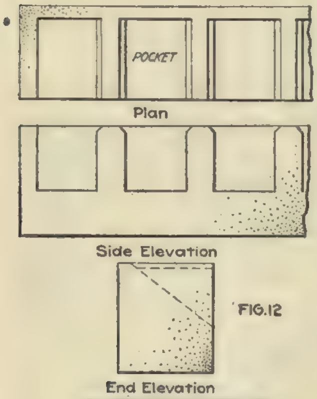
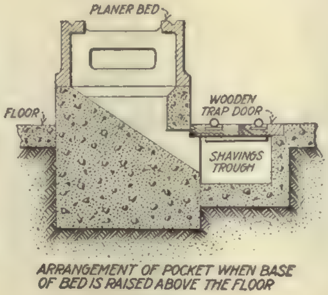


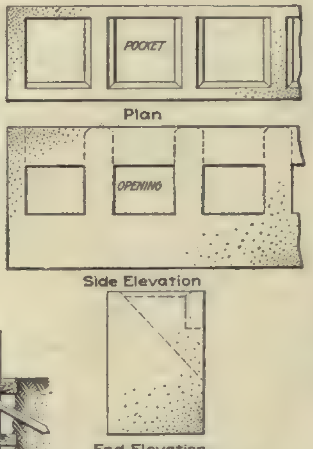
FIG.12

POCKETED FOUNDATION FOR A PLANER WHEN THE BASE LIES BELOW THE FLOOR LINE



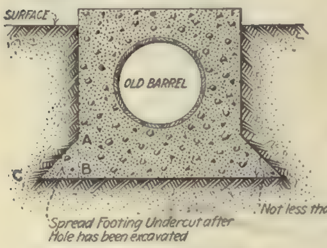
ARRANGEMENT OF POCKET WHEN BASE OF BED IS RAISED ABOVE THE FLOOR

FIG.13



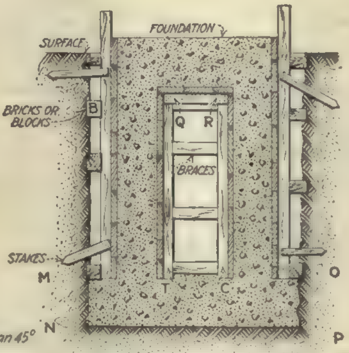
POCKETED FOUNDATION FOR A PLANER WHEN THE BASE LIES ABOVE THE FLOOR

FIG.14



HOW TO SAVE CONCRETE WITH OLD BARREL AND HOW TO UNDERCUT FOR A SPREAD FOOTING

FIG.15



FORM CONSTRUCTION FOR A PLANER FOUNDATION OF CONSIDERABLE DEPTH, SHOWING METHOD OF SAVING CONCRETE BY MAKING FOUNDATION HOLLOW

FIG.16

FIGS. 12 TO 16. VARIOUS PLANER FOUNDATIONS shovel, around the bottom corner of the excavation, as shown at *ABC*. Where the soil is not "stiff" enough to support itself, forms for the foundations are necessary.

Methods of saving concrete in planer foundations are shown in Figs. 15 and 16, in both of which illustrations the foundation is made hollow so that the total volume of concrete required is very much less than would otherwise be necessary. In Fig. 15, old barrels, laid end to end, are placed in the foundation, providing the form for a sort of double arch. The barrels are of course buried and left in the concrete. In Fig. 16 a form that may remain in the concrete is erected to provide the hollow space or tunnel within the structure. Another scheme for saving concrete which may often be utilized effectively is to fill the interior of a foundation with large boulders or rocks. If such boulders are carefully placed, so that there is concrete between them, the resulting construction will be about as effective as if the foundation were of solid concrete.

Forms for planer foundations may be constructed in accordance with the general plan outlined in Fig. 16. The hole is first excavated, and then the concrete for the footing *MNOP* is poured. On this footing the forms are erected. The vertical pieces may be held by stakes driven into the earth and by blocks *B* wedged in between them and the vertical surfaces of the excavation. The form boards are then nailed to the verticals, as shown. The form for the hollow center *QRCT* is, if such is to be used, now erected. Finally, the concrete is dumped into the remaining space.

An Expanding Mandrel

By A. R. Jones

The illustrations show an expanding mandrel, which we have had in use for about three months, and which we have found to be a considerable time saver.

Fig. 1 shows the mandrel assembled and Fig. 2 illustrates the mandrel apart. *A* is the main shank, which is turned to a Morse standard taper to fit the lathe spindle, and has the left-hand threads *B*, 12 per in. There are three slots *C*, ¼ in. in width located on the shank *A*, and extending from its inner end through the threads *B*. These slots are milled 10 deg. taper. The counterbore *D* in the end of the shank is 1 1/64 in. diameter and ¾ in. deep. The shank is tapped out ¾ in. standard for about 4 in. in depth. The outside of the end is slightly underturned to permit facing the casting. Collar *E* is 3 in. outside diameter, ⅜ in. thick, and is bored and threaded to fit the left-hand thread on the shank *A*.

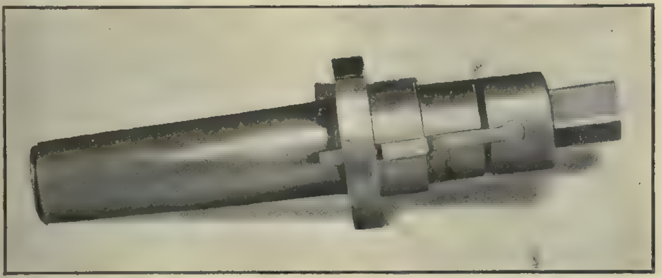


FIG. 1. AN EXPANDING MANDREL

The three slots *F* are filed at a 10 deg. taper to correspond with the slots *C* in the shank. The collar *E* serves to hold the jaws *G* in place at their outer ends, and *H* is a collar for holding these jaws in position at their other ends. Jaws *G* are three in number, of a good quality of steel and hardened, and are ground 10 deg. taper to fit the slots in the shank collar *E* and collar *H*. The slots in the collar *H* are rounded at their inner ends and the jaws correspondingly shaped to fit this formation. *I* is a small set collar which is secured on the operating screw *J*, and which moves the jaws *G*. The screw *J* is ¾ in. standard thread, about 3½ in. long, with a ¾ in. square end, hardened for receiving a wrench. *K* is the casting to be machined and is made from bronze about 3¼ in. outside diameter. The mandrel holds it for turning and threading.

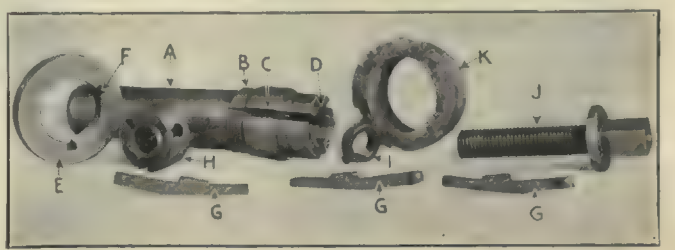
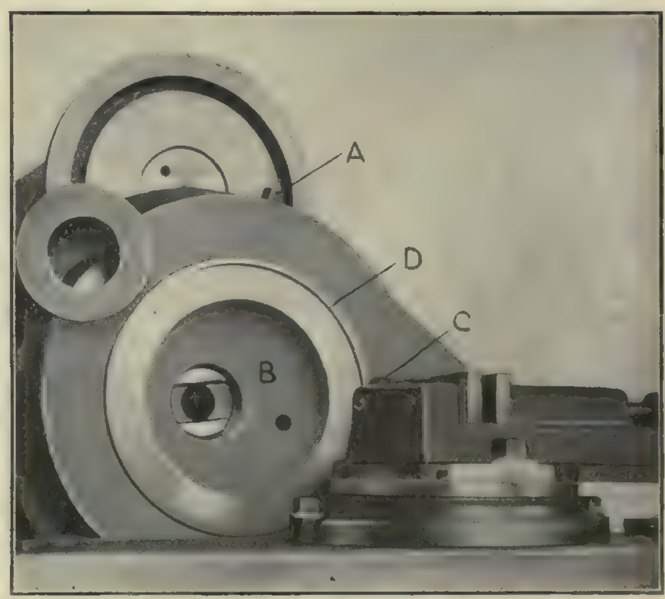


FIG. 2. DETAILS OF EXPANDING MANDREL

A Lathe Job on a Milling Machine

By H. R. Selby

A great deal has been written about the adaptability of the lathe. The accompanying illustration shows what can be done on the milling machine when a lathe is not available. The illustration speaks so plainly that I think nothing need be said about the job other than to call attention to the fact, that the work was held for the first operation by four setscrews, one of which *A* is shown. These screws were equally spaced *A* in the housing, and had their bearing against the outside of the plate *B* which is about 1½ in. smaller in diameter than the work *D*. A lathe tool *C* is held in the vise.



A LATHE JOB ON A MILLING MACHINE

Duration of Shop Tests on Tool Steels

By A. LEWIS JENKINS
Associate Professor of Mechanical Engineering, University of Cincinnati

In order to quickly obtain comparative data on the life and cutting qualities of steel tools, it is the practice of some shops to test tools by running them at very high speeds, and causing them to fail in from one to three minutes. In some tests the travel of the tool is less than one hundred feet and the total life less than one minute. Results of such tests are of little, if any, practical value in selecting a tool that is to work under ordinary conditions.

According to Dr. Frederick W. Taylor, the failure of a tool may be due to one of three different kinds of wear, and he classified them as follows:

1. Wear of the first class, which occurs when the cutting speed is very low and does not produce heating or softening of the tool, the wear being caused merely by abrasion.
2. Wear of the third class is due to the high degree of heat and the softening of the tool that occurs when the cutting speed is so high that the tool is ruined in from 1 to 3 minutes.
3. Wear of the second class is produced at a cutting speed which is not sufficiently high to produce much, if any, softening of the tool until the tool has become sufficiently dulled by the abrasive action of the chip. When a certain degree of dullness is reached the friction of the chip on the tool produces sufficient heat to cause the tool to soften and rapidly fail. Wear of the second class is a combination of wear of the first and third classes, and failure usually occurs in a short time after wear of the third class begins.

Hence, under ordinary working conditions, the life and also the permissible cutting speed of a steel tool is largely dependent upon its resistance to the wear of the first class, even when raised to a considerable degree of heat, and not to any appreciable extent upon its resistance to burning at speeds far in excess of those used under ordinary working conditions. A test that causes a tool to fail by softening within 1 to 3 min. does not give a measure of its practical wearing qualities, and any test that eliminates the influences of wear of the first and second classes can not be representative of the conditions met in ordinary operation of the machines. Tests must be of sufficient duration to produce failure by wear of the second class, which is more a result of abrasion than softening by heat, and such tests involve the element of time. Tools ruined by first- or second-class wear are consistent in that a set of uniformly treated tools of the same material will last about the same length of time when subjected to the same tests. Results of tests on tools ruined by wear of the third class are inconsistent in that a uniform set of tools will show a wide variation in the length of time they will run before they are ruined. When tested at such high speeds as to cause failure in from 1 to 3 min. it is not uncommon for one tool to last three times as long as another of the same set when subjected to the same test. To quote Dr. Taylor's "Art of Cutting Metals," paragraph 183:

"It is this irregularity of ruining time of tools, belonging to the third class, which has led us to adopt a trial period of 20 min. as being the shortest ruining time from which it is safe to draw any correct scientific conclusions from tests in the art of cutting metals."

If a tool be made of a material having physical properties, which differ widely from those of steel, particularly as regard resistance to friction wear when subjected to a rather high degree of heat, it is quite probable that its behavior would be different from that of a tool made of steel. Possibly, it might offer much greater resistance to wear of the third class without having any great advantage over steel when subjected to first- or second-class wear. It is easy to see that comparative ruining tests of short duration on such a material and steel would give results which would favor the former, even though the steel might be a better tool material when subjected to normal working conditions.

Another important consideration in interpreting or comparing results of tests run at slightly different speeds is the relation between cutting speed and life of tool. According to Dr. Taylor this relation is expressed by the equation

$$\frac{V}{v}=\left(\frac{t}{T}\right)^{\frac{1}{8}}$$

where t is the time in min. that a tool will run at a cutting speed of v ft. per min., and T the time it will last if the cutting speed be changed to V ft. per min. Suppose two tools were tested by running one at 80 ft. per min. and it lasted 20 min., and the other at 75 ft. per min. and it lasted 30 min., and it is desired to know which of these tools would last the longer if they were run at the same speed. If run at 75 instead of 80 ft. per min. the first tool would last

$$T=t\left(\frac{v}{V}\right)^{8}=20\left(\frac{80}{75}\right)^{8}=20\times 1.675=33.5\ min.$$

if the second tool should be run at 80 instead of 75 ft. per min. it would last only

$$30\left(\frac{75}{80}\right)^{8}=17.9\ min.$$

Hence, the first tool is probably the better one of the two.

In conclusion, the writer wishes to again call attention to the inadvisability of using data from quickly made tests, and ventures to suggest that tests of this nature should be conducted in such a way as procure a duration of at least 10 minutes.

Threading Dial—Erratum

By C. Ross Lewis

In the seventh line of the second paragraph on page 702 the figure should be 30 instead of 38 as originally printed.

Series for Draftsmen and Designers

Technical vs. Practical Tool Designers

By DONALD A. BAKER

I HAVE noticed discussions in our trade journals of recent date relating to the toolmaker or machinist draftsman comparing them with technically trained draftsmen, and their relative efficiency, when applied to tool and machine design.

Having been in charge of a number of drafting departments, and having had experience with both classes of men I would like to add a word of encouragement to the men, who perhaps have not had the opportunity, or the advantage of a thorough technical training, and yet who have devoted the greater part of their lives to the practical application and study of machine and tool work.

TECHNICAL AND PRACTICAL TRAINING

Let us consider their training in general. The technical man we will assume enters school without previous experience with shop work or conditions. His studies at the best can be but little more than theoretical. The actual shop work that he gets, while good, is only of a superficial nature. The real fine points lie too deep to be acquired in the short space of time that he has at his disposal. But worst of all, in my estimation, is the fact that, unlike the average mechanic, he is constantly under the eye and guidance of a trained instructor. He is hardly given a chance to make a mistake as he is so closely watched and corrected, and as a result any element that would tend to make him more self-reliant is almost entirely lacking.

On the other hand, you will find that a great many of our best mechanics left school very early in life, and probably with less than the ordinary grammar school education as a basis on which to start life. These men start at the bottom, usually at wages so small as to hardly board and clothe them. They start at a point where education counts for less than the ability to perform certain kinds of manual labor. They first learned to do a thing well, from constantly watching their fellow workers, quicker than from any instruction lavished upon them by the boss. After learning first to perform their work well, they next acquire speed. The hope of a raise being the principal inducement. Little by little as they acquire skill and are advanced to better work they begin to realize the necessity of an education in which they are deficient. Possibly the wish to express certain ideas, which requires a good knowledge of drawing, impels them to take up a course of instruction. This may be done at home, or at any of the night schools which have been established for the purpose of helping this type of men. A knowledge of drawing will aid them in their work and soon they will be instrusted with a still finer grade.

Sooner or later comes a job which will require more advanced mathematics than they possess. Usually a problem in angles which requires a knowledge of simple shop trigonometry. One of their fellow shopmen will very likely volunteer to help them out and will take sufficient interest to explain to them something of the simple rules involved. Once they are interested, it becomes a pleasure for them to conquer the scarecrow with the big name that the college man gave it to keep them at a distance. At this stage of advancement a handbook becomes a necessity. This book, filled from cover to cover with the language of our trade, is studied, and assimilated, and every scrap of information applied to the daily work. They learn to use the public library, or begin to collect a library of their own. Usually both. The books they buy are directly related to the work in hand, or the next job ahead. The knowledge gained by reading and the theory acquired, is at once put into actual practice under regular working conditions. The underlying fine points which are impossible of expression in writing are discovered and are added to their fund of practical experience, and this is what stays with them and counts long after books and rules are forgotten.

DIFFERENCE IN TRAINING OF THE TECHNICAL AND THE PRACTICAL MAN

How different from the training of the technical graduate is that of the practical man of whom we have just been speaking. The student takes up a course of studies of which he knows practically nothing, and with little idea of what part of those studies will prove of value to him in later life. The practical man, on the other hand, finds out his limitations in the beginning, and, through his own initiative and spirit of self-reliance, puts himself to work to overcome these limitations. His studies are for the immediate purpose of overcoming the difficulties at hand or to meet any future ones. There is but little or no guesswork in the course that he is pursuing. Unlike the student he has not had time to forget his studies before they could be put into actual practice and test. This result, added to his experience, is what counts for rapid progress. To the old saying, "practice makes perfect" might be added that it makes for self-assurance; a knowledge and satisfaction in one's own ability, rather than blind and half-trusting faith in the teachings of others.

What is the result when we put men of these opposite types in competition?

Suppose we have a change to make in our present shop equipment. It is necessary for them first to get some idea of the intended changes to be made, to make sketches, and get measurements of things as they are before they can go ahead with the work. The technical man goes out into the shop and makes elaborate and over dimensioned sketches, because to him drafting is more of an art than a ways and means of conveying definite and concise information to the working man.

While the technical man is making his sketches, his mind is entirely taken up with them. He is perfectly satisfied to wait until he gets back into the drafting room where he has a felt-covered stool and a rest for his elbows, before he does any real designing.

On the other hand, the practical man goes out with his sketch pad, looks the machine over, and nine times out of ten mentally has his design worked out before he takes a single measurement. He does not waste time making beautiful sketches, nor does he add a lot of useless dimensions to them. On the contrary he hits the nail on the head with one good well-directed blow, and thereafter the drafting board is only used as a means of adding assurance, and perfecting details.

TECHNICAL METHODS

In the meantime our technical man has been thinking it over, and wondering what might be the best method. If the work is a little out of the regular line it is apt to daze him and then he usually busies himself in a handbook to keep the boss from getting wise until he has a chance to catch his breath. He hits upon an idea and he commences his drawing. If the arrangement happens to be at all complicated there will be many parts and the necessary machining operations on them will be a mystery to him. It will be lucky if they can be handled at all. He is unable to put himself in the place of the machine operators, and being incompetent to distinguish between good and bad shop practice his work will go through the shop as a costly proposition. Usually this doctoring up is done by the shop foreman, and later comes back to the drafting room requiring costly changes on tracings.

This is no more than one should expect. It is like trying to learn a complicated musical composition without first learning the notes and getting the fingers into shape by long and constant practice.

The practical man in making his designs is seldom troubled with the necessity of working out tedious problems in strength of materials. Nor does he have to make a guess at the proper size bolt, nut or other standard part to use. He has his strength of materials learned by heart. He has been breaking, and repairing breaks for a good many years. And he has been using thousands of the required bolts, nuts, etc., in the places for which they were best adapted. He knows there are standards for all these things and he knows the why and wherefore. Added to this he has an intimate acquaintance with various forms of cutting tools. Clearance, and rake, and lack of clearance and rake, all have their meaning to him. He knows the difficulties that are apt to be met in the reaming of holes to an accurate size, and the harder problem of machine reaming taper holes. He understands the limits that it is possible to work to, and the limits that it is practical to work to, and while to the techincal man there might seem but little difference it would mean a matter of dollars and cents to the shop. He knows how the machine hand will handle a given piece, also how the man at the bench and the assembler will handle it; the information that they will require, and the points from which they wish to measure, etc. Therefore, he adds to his drawing only the dimensions necessary, and the proper explanatory notes where they are required. He knows when a thing should be ground, something of the amount it is apt to spring in hardening, and therefore makes proper allowance for it, and he also shows the clearance for the grinding wheel instead of the sharp corners whereever possible. He does not design odd shaped pieces that require machining all over when plain shapes are sufficient. The result is that he is able to accomplish from two to four times more in a day's work than the purely technical man, or even the technical man, who, after his school training, goes into the shop for four, five or even six years.

Therefore, let no man, who now feels that he is tied to his bench or machine, imagine that his case is hopeless because he finds it impossible to avail himself of the education furnished by a first-class technical school. He can by a little application and the sacrifice of an evening or so a week, to the study of the things which interest him, get himself out of the rut and upon a road where the traveling is easier. The literature he will require will cost less than his membership fees in the I. W. W., and he will stand a much better chance of reaching the goal which used to be expressed by their slogan: "Eight hours work, eight hours play, eight hours sleep, and eight dollars a day."

Length of Belting in Coils

BY HARRY GWINNER

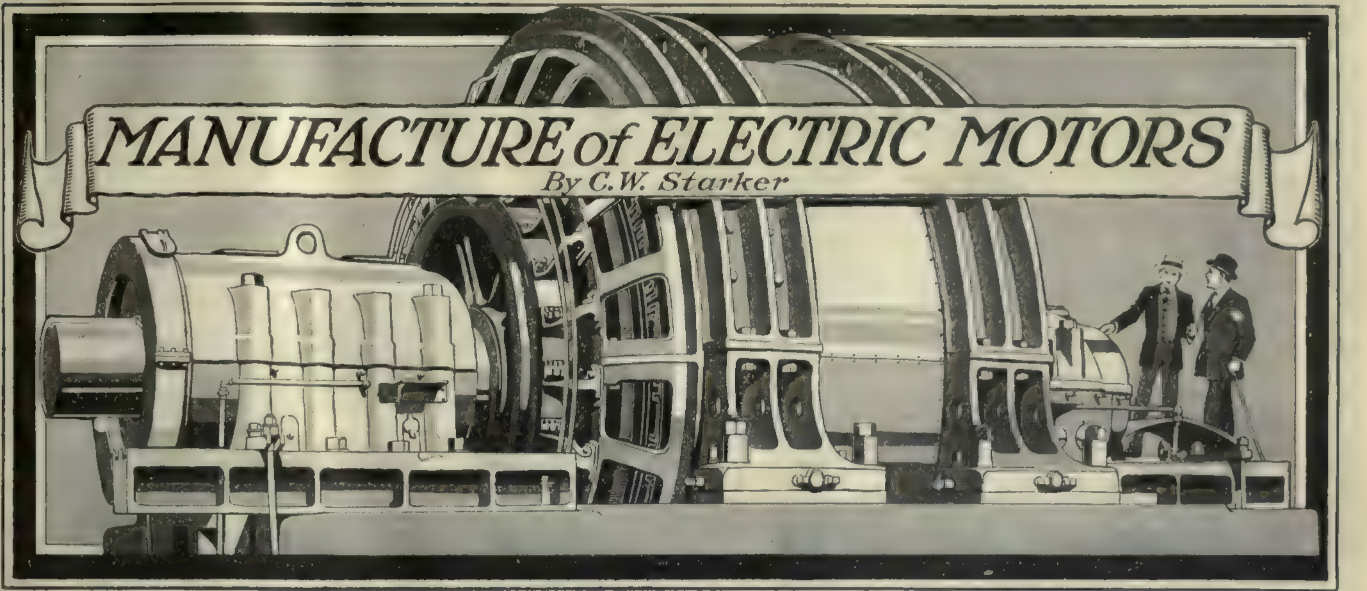
To find the approximate length of a belt in a roll when closely coiled: Add together the diameter of the roll and the diameter of the center hole, both in inches. Divide by 2 to get the mean diameter. Multiply by the number of coils in the roll and by 3.1416, which will give the result in inches. Or divide by 12, and the result will be in feet.

Example—How many feet of belting in a roll 48 in. in diameter with a 6-in. center hole and 60 coils?

$$48 + 6 = 54;\ 54 \div 2 = 27$$

$$27 \times 60 \times 3.1416 = 5089\tfrac{3}{5} \text{ in., or about } 424 \text{ ft.}$$

An abbreviation of the above method is as follows: Add together the diameter of the roll and the diameter of the center hole, both in inches; multiply by the number of coils in the roll and by 0.131. The result will be the approximate length in feet, regardless of the belt thickness. The 0.131 is obtained by dividing 3.1416 by the 2 and the 12 first mentioned.



MANUFACTURE of ELECTRIC MOTORS

By C.W. Starker

VII. Commutators and Collectors

IN MODERN motors the commutator is no longer the nightmare of the operator. Many of the original difficulties have been fundamentally remedied. There is hardly a problem in electrical engineering that has been given so much scientific study as the complicated problems surrounding commutation, and the result has been the invention of a commutating pole motor, the greatest single item of progress in the electrical art in many years. Some eight or ten years ago it appeared for a time as though the simpler squirrel-cage alternating-current motor would, to a large extent, supersede the direct-current motor on account of the commutator and brushes required for the latter type. However, the advent of the commutating-pole construction has given the direct-current motor a new lease of life, and today the sales of this type are far in excess of the sales enjoyed by direct-current motors in the best years of the old noncommutating-pole type.

The general construction of the commutator is well known and practically identical for different makes of motors, so that a few words in explanation will be sufficient. A commutator consists of a large number of bars, or segments, made from hard-drawn copper and assembled with sheet mica between them. The bars and mica strips are punched with a V-shaped indentation at each end and then assembled in the form of a ring, clamped together by a temporary clamping fixture, then placed between the V-shaped ends of the commutator bush and a cast-iron or steel V-ring. The bars are insulated from this V-ring and the bush by mica V-rings molded to the proper shape. The whole is then clamped together by means of a steel nut. Fig. 59 shows a complete commutator and its component parts.

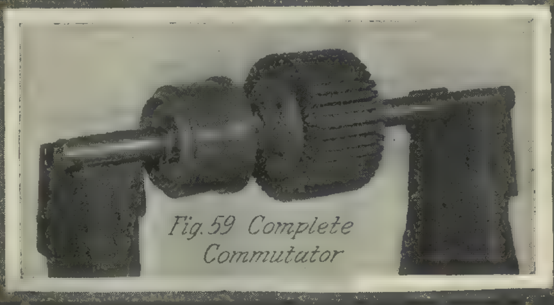


Fig. 59 Complete Commutator

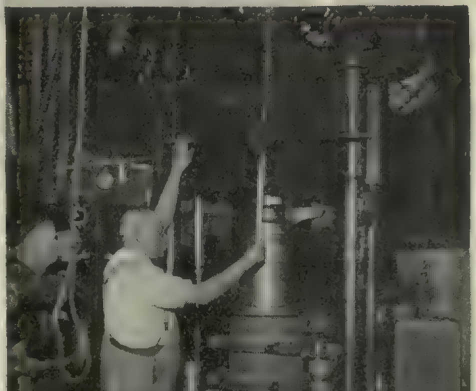


Fig. 60 Pressing Commutators

The best understanding of the reasons for the construction and manufacturing methods used, is gained by considering what troubles have been or are being experienced on commutators. A shifting or displacing of bars may occur in service under the influence of heating and expanding due to the friction of brushes and the carrying of current. This difficulty is now rarely found; it has been overcome by the seasoning process and pressing in assembling. Fig. 60 shows an hydraulic press which is used for this purpose; assembling pressures varying between 5 and 25 tons are used, the lower figure applying to small commutators of approximately 5 or 6 in. diameter with gradually increasing pressure up to the higher figure for commutators of 12 to 14 in. diameter. Fig. 61 illustrates the baking oven in which the commutators are baked at a temperature of approximately 253 deg. F. for 2 hours.

A second difficulty experienced at times is high mica, by which is meant a condition of uneven wear of the mica segments and the cop-

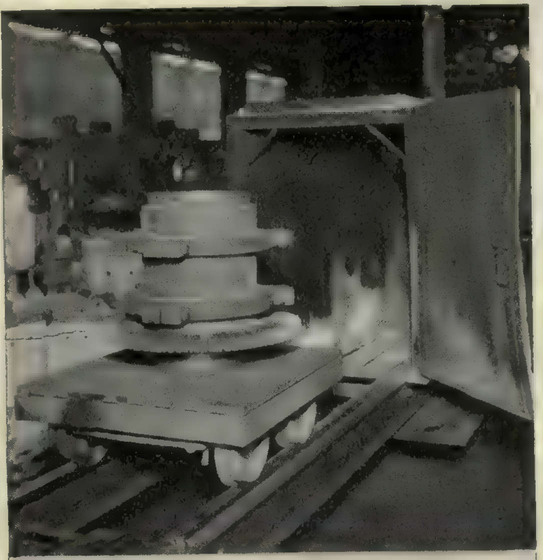


Fig. 61 Oven for Seasoning Commutators

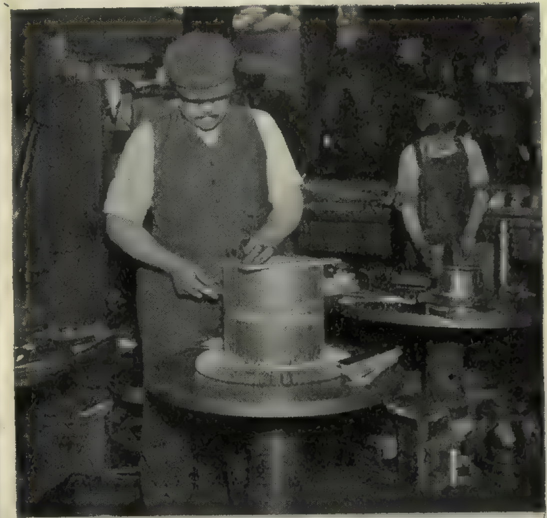


Fig. 63 Assembling Copper Bars and Mica Segments

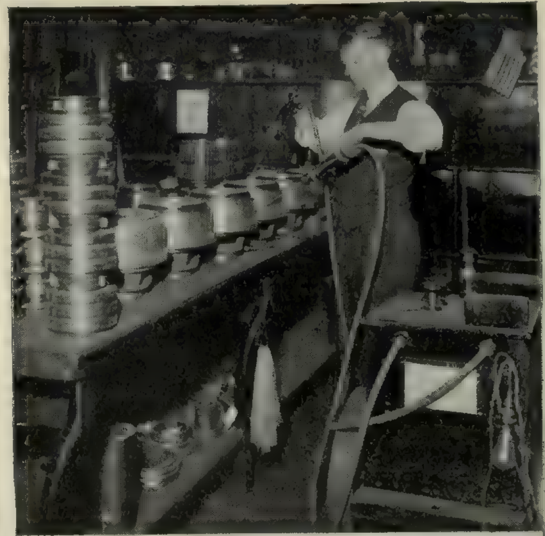


Fig. 65 Testing Commutators

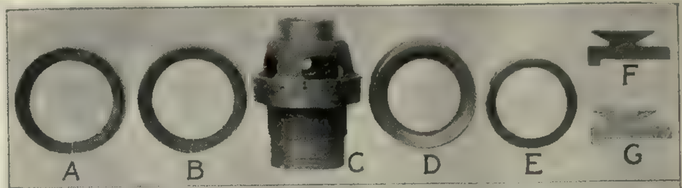


Fig. 62 Parts of a Commutator

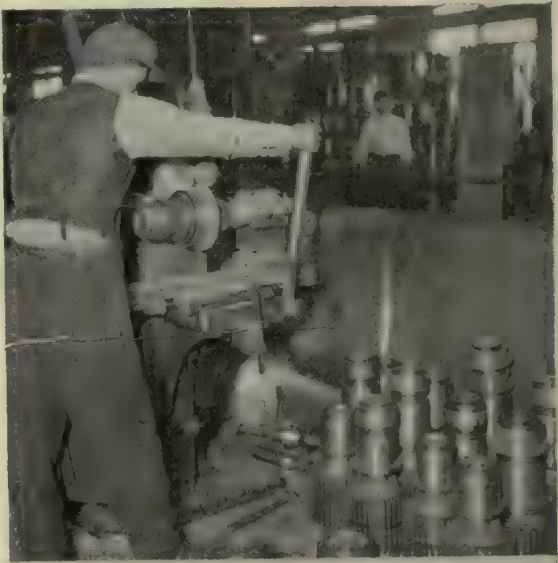


Fig. 64 Slotting Commutators

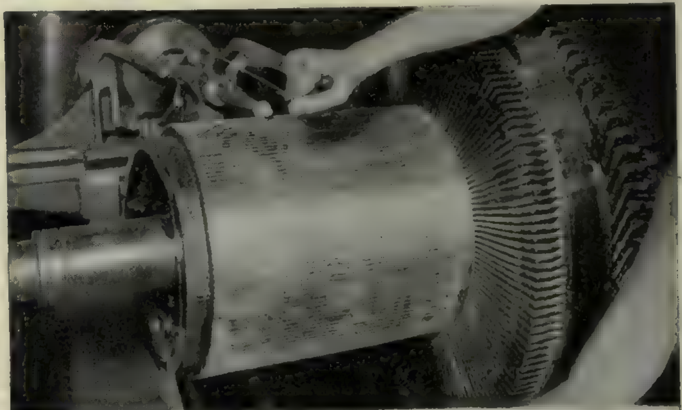


Fig. 66 Undercutting Mica

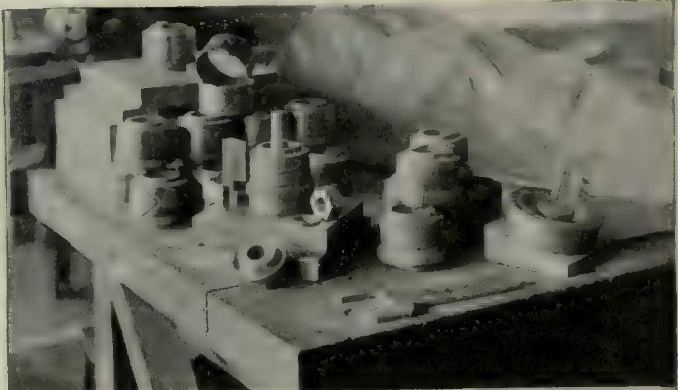


Fig. 69 Parts and Tools for Molded-Bakelite Commutator

per. This is most likely to occur with a large number of bars and with thin bars; that is, where the percentage of mica to copper along the periphery of the commutator is large. The result is to be seen in fin-pin sparks in service together with a blackening or burning of the copper. In the manufacture of commutators this trouble is overcome, as it is not due to the grade or hardness of the brush used, by keeping the percentage of mica along the periphery of the commutator below 20 per cent. The usual thickness for mica segments of 0.032 in. is reduced in these cases to 0.025 in. Further, it is essential to use mica of proper grade (amber mica) and to avoid variations in the hardness of the mica by suitable annealing if possible. Where the condition of high mica is due to the brush, a hard abrasive carbon should be substituted.

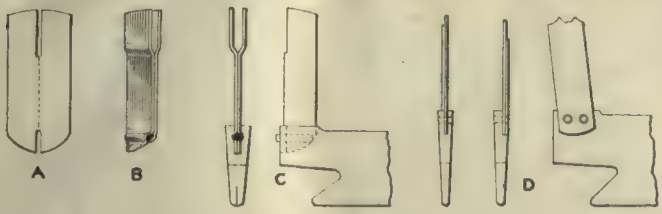
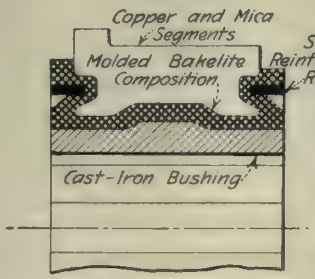
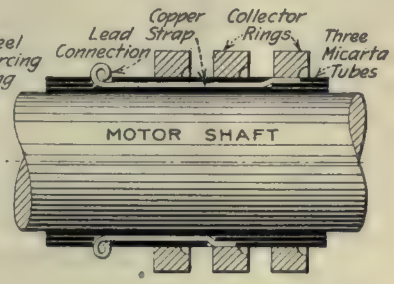


FIG. 67. COMMUTATOR NECKS

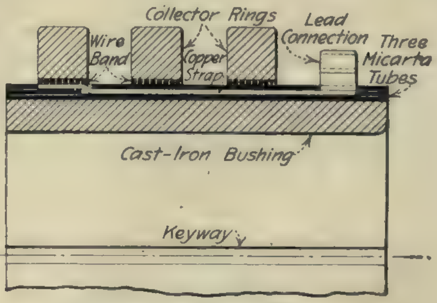
Trouble, due to unbalance which results in jumping of brushes and injury to the commutator is rarely met with on average speed motors; and for the higher peripheral speeds a careful static or dynamic balancing of the complete armature including the commutator is part of the manufacturing process. The principal source of commutator trouble on the old motors was (aside perhaps from an incomplete understanding of what actually takes place under the carbon during commutation) the necessity of altering the brush position with changing load. Where the brushes are shifted they are frequently shifted to a wrong position, and where the brush is fixed in a permanent position a "biting" of the copper will result, due to excessive currents caused by the changing load. With the commutating-pole motor all this is overcome. The brush remains, and is fixed by the manufacturer in a definite position for all loads, and for either direction of rotation.



MOLDED BAKELITE-TYPE OF COMMUTATOR
FIG. 68



SMALL-SIZE COLLECTOR
FIG. 72



LARGE-SIZE COLLECTOR
FIG. 73

FIGS. 68, 72 AND 73. COMMUTATORS AND COLLECTOR RINGS

Some local roughness on the commutator occurs at times, and is the result of periodic loads due to faulty gears, or due to service conditions such as reciprocating pumps, air compressor, etc., where maximum loads repeat themselves at regular intervals. This may eventually result in a burning of the copper at one point and then in aggravations due to poor contact. The remedy for this is not found in the manufacture, but in improving the service conditions. Often a change in gear ratio, or even a better splice in the belt will take care of the trouble. However, with the perfected brush-holder construction used on modern motors, with comparatively many carbons of relatively small cross-section, and with proper brush-spring tension this difficulty also is largely a thing of the past. Commutator turning tools therefore are dropping out of use, and a small wearing depth of the commutator bar is used and is permissible on the modern commutating-pole motor. The thing desired is that the commutator shall take on a so-called polish or glaze of dark brown color.

One more difficulty needs to be mentioned; it is that oil from the bearings will get upon the commutator. The action of the oil is to dissolve the bond in the mica, to carbonize the mica, and thereby, cause "shorts" between adjacent bars, or so-called "pitting." Keeping oil from creeping out of a split bearing, particularly if it has become very fluid or even formed oil vapors, is a difficult matter. Air suction due to the fan action of revolving parts, or careless filling, aggravates the condition. For this reason solid bearings instead of the split type have come into general use even where quick taking apart of the motor is very essential, as in steel mill or street-car motors. Not only longer life of the bearing is obtained, but the oil leakage may safely be said to be eliminated, provided of course, that all the other conditions of good bearing design are properly taken care of as described in connection with motor bearings and brackets. As it is not possible to keep the commutator free from oil, relief can be provided by rounding the corners of the bars, by proper clamping and sealing of the joint between mica V-ring and bars, and further by painting this joint and the bar-ends with several coatings of shellac.

Mention must also be made of the undercutting of the mica between bars, a practice quite frequently employed and at times wrongly resorted to as a panacea for commutator and brush troubles. In good practice undercutting is used for high-speed motors and generators, and for cases where the percentage of mica is particularly high, and where a large number of bars is used, and also where a hard grade of mica (white unannealed mica) is used. The undercutting must be done very carefully or trouble is likely to occur from copper or carbon dust collecting in the undercut and short circuiting the bars. The width of the cut should be approximately $\frac{1}{32}$ in., or equal to the thickness of the mica. The depth should be approximately $\frac{3}{64}$ inch.

The commutator bush and V-ring are made from cast iron, malleable iron, or cast steel as centrifugal stresses may require. For smaller sizes the V-ring is preferably made from a drop-forging. The machining operations for these parts consist of boring, facing and turning with a threading operation and keyseating in addition for the commutator bush. The commutator nut is drop-forged, the center punched out and then followed by boring, facing, and turning operations, and drilling of holes for the spanner wrench. These are all straightforward machining operations which need no further description. All parts of the commutator must be machined accurately to gages so as to be perfectly interchangeable. Of particular importance is the accuracy in the V which is turned at angles of 3 deg. and 30 deg. These angles have become a standard as giving the most reliable fit between bars and rings. These parts are shown in Fig. 62. In this cut *A* and *B* are mica V-rings; *C*, the bushing; *D*, the V-ring; *E*, the nut; *F*, the mica segment, and *G*, is a bar.

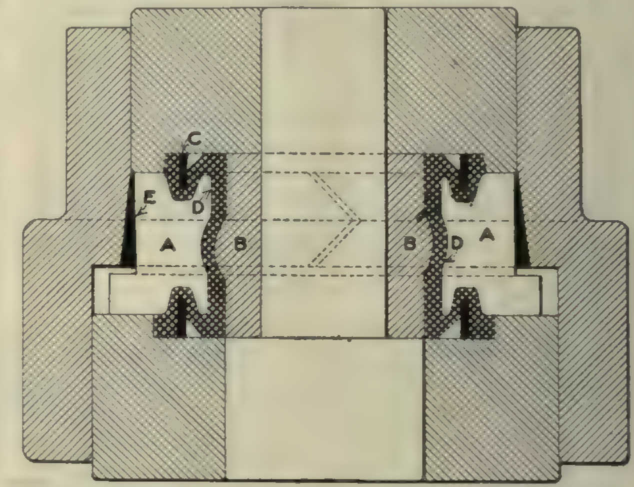
After assembling, shown in Fig. 63, then follow the baking and pressing operations previously referred to, and a rough turning of the commutator surface. The finish turning is not done until after the commutator has been assembled on the shaft and the armature wound completely. The commutator necks are slotted to receive the armature connections. This operation is shown in Fig. 64.

The manufacture of mica segments and mica V-rings is of special interest. The first step is the splitting of the mica as received from the mica mines, and pasting these splittings to bond paper with shellac, making the so-called mica plate. This process is well adapted for girl-labor. The thickness of these plates is accurately gaged as any variation in the thickness would result in uneven building up of the commutator and insufficient thickness might result in electrical breakdowns. From this mica plate the mica segments are punched and a similar plate is used for hot forming of the mica V-rings.

TESTING THE COMMUTATOR

The complete commutator after rough turning is subjected to voltage tests. A test-voltage of 3000 volts alternating-current to ground, and 250 volts between bars is used. In actual service a maximum voltage of about 20 volts between bars is not exceeded. The testing device used is shown in Fig. 65. The mechanical inspection covers accuracy in diameters, bore for shaft, etc., but particular attention is paid to the axial alignment of the bars; a deviation of not more than one-half the thickness of mica—that is less than $\frac{1}{64}$ in.—is permitted. The spacing of the bars along the periphery also is given special inspection for uniformity. Undercutting, if such is specified, is done last—that is, on the complete armature. The shaft is held between lathe centers, and a circular saw of small diameter operated by an individual motor is used in this operation as shown in Fig. 66.

For wire-wound armatures and also for motors using the smaller sizes of copper ribbon for the winding, it is possible to imbed the armature leads in slots sawed directly into an extension of the commutator bar. But where either the bars are too thin to permit a slot wide enough to receive the wire, or where a single turn-strap coil is required separate necks become necessary, inasmuch as extending of the bar itself to the proper diameter would involve excessive waste of copper. There have been a multitude of different types of neck constructions during all the years direct-current motors have been manufactured, but only two really practical types are extant so far as industrial motors of the sizes under consideration (2 to 125 hp.) are concerned; namely, the pin-connected neck and the riveted type. These necks are made from tinned sheet copper and punched out. In Fig. 67, *A* is the punched blank for the one-piece pin-connected neck and *B* shows the neck as it appears after bending. The finished piece is then inserted into the slot of the bar and a pin driven into the hole indicated at *C*. All this is done after the commutator is built up completely, and by soldering neck and bars together in addition to the pin, whereupon a solid and satisfactory connection is obtained. The armature leads are soldered in at the top of the neck as indicated in the illustration. In cases where the bar is too thin to permit this construction a neck consisting either of two thicknesses of sheet copper, or if necessary only one thickness at the point where the neck is connected to the bar, is riveted to the commutator segment which latter has been milled down so as to bring the riveted-on neck flush with the bar. This is shown at *D*.



A = *Commutator Bar*
B = *Cast-Iron Bushing*
C = *Steel Reinforcing Ring*
D = *Bakelite Composition*
E = *Split-Steel Band*

FIG. 70. MOLD FOR BAKELITE WORK

As the latest development in commutator construction, the molded bakelite type has come into prominence. This construction is applicable particularly to the smaller sizes which are manufactured in large quantities and where the question of repairing and centrifugal stresses is not predominant. Fig. 68 shows a cross-sectional view of a commutator of this type and Fig. 69 shows the tools used in this construction. Bakelite, named after its inventor, Bakeland, is a chemical composition based in principle upon the chemical reaction between formaldehyde and carbolic acid, which when heated and pressed forms a substance similar to amber or hard rubber. The bakelite composition used in commutators is obtained by mixing this bakelite with short-fiber asbestos or wood flour, and then pressing the article being made at pressures varying between 3 and 100 tons, depending on the size of the article, and subjecting it at the same time to a temperature of about 300 deg. F. From two minutes to one hour or more is required, the amount of time as well as the pressure necessary to perform the pressing operation depending on the size of the manufactured article.

Bakelite has satisfactory insulating qualities and considerable mechanical strength. In the commutator construction under discussion the composition is pressed around the bars at their ends and inner periphery. A center bushing of cast iron is used as indicated in the illustration, and steel reinforcing rings are inserted in molding where required by speed conditions. Fig. 70 shows a mold such as used in this manufacturing process. To make the action and construction of this mold readily understood we have indicated by the letter *A* the commutator bars, *B* the cast-iron center, *C* the reinforcing rings, *D* the Bakelite composition. The commutator bars and mica segments are assembled separately and held together by a tapered split ring *E* and then inserted into the mold. The composition is added in powdered form and in exactly the required quantity. The pressing and heating is done on special hydraulic presses. One of the 10- and 20-ton electrically heated presses used in this work is shown in Fig. 71. While this manufacturing process requires considerable care and time in working out, as well as a large investment in equipment excellent results have been obtained on many thousands of commutators of this construction in actual service. With this commutator there is no danger of insulation breakdowns in service or of oil entering into the commutator, and the need of repairs is practically eliminated until the commutator is worn down completely. On the other hand, repairing would not be feasible short of remolding the commutator. Experience indicates, however, that with the smaller sizes of commutator up to about 6 or 8 in. in diameter, repairs are seldom made in the field, but instead the old commutator is exchanged at the factory for a new one.

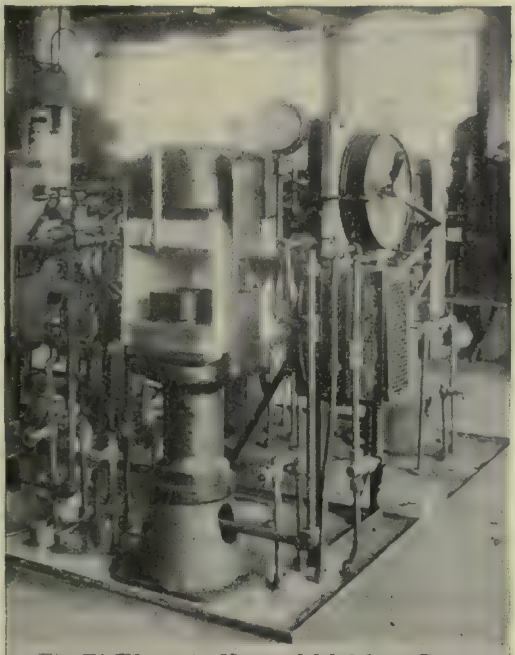


Fig. 71 Electric Heated Molding Press

Closely related to the direct-current commutator are the collectors used on alternating-current motors of the wound-rotor type. Where particularly high-starting torque is required, as for instance in hoisting service, it is desired to insert resistance into the rotor circuit at starting. Collector rings are, therefore, required as a connection between the revolving element of the motor and the outside resistance, 3 for 3-phase and for 2-phase current. There are two general constructions of collectors used in industrial motors of the range of capacities under discussion. The one, a particularly simple construction for the smaller sizes, 2 to about 25 hp., the other a more expensive and stronger construction, logical for motors of larger capacity. In the former the collector rings are shrunk directly to a series of concentric micarta tubes as shown in Fig. 72. This illustration also shows the simple manner of connecting each ring to the cable leading outside. Three tubes are used; the inner one solid, the others with suitably spaced openings to receive a tinned copper strap which projects through the tube directly under one of the rings, and is soldered to the ring while the latter is being shrunk on. The other end of the strap is curled up to receive the outgoing cable. There is one copper strip connected to each ring, and thereby an effective construction and simple manufacturing proposition is obtained. For the larger type a cast-iron bush is used which is machined all over. Over the outside, three micarta tubes are pressed and copper straps lead through these tubes in the same manner as the smaller sizes, except that steel wire is wound tightly over the outer insulating tube at the place where the rings are to be mounted in order to secure a steel-to-steel shrink fit. Before shrinking the rings on, the wire bands are soldered and turned accurately to diameter. This construction is shown in the illustration, Fig. 73.

As for the material to be used for collector rings, cast iron, if free from hard spots and well polished in machining, makes a quite satisfactory ring. Forged steel rings may also be used successfully and with little danger of burning if the current densities in the brushes are not too high. Both of these materials have, however, the disadvantage of rusting if exposed to moisture, and if used in very intermittent service. For this reason brass rings are generally used for the collector rings of the standard slip-ring motor.

Appointing Agents for Belgium

By Henri Benedictus

The reply of Mr. Woods, page 256, to the article which appeared on page 140 regarding the question of agents in Belgium was only published in the European edition of the *American Machinist* of Sept. 22, page 256.

I will not follow Mr. Woods in his attack against the French dealers in machine tools. They will no doubt take this matter up, but I will strictly adhere to the subject of my first article, namely, What are the best means of appointing agents in Belgium after the war is over?

It is necessary, however, to state that my article was not meant to be personal, and I did not have in mind any particular firm.

As to his statement arguing my first objection regarding the considerable overhead expenses of a firm with a head office and branches, this may hold good for firms selling staple articles, such as tobacco, sewing machines, cash registers, groceries and similar articles, but I maintain that the sale of machine tools is somewhat different and has nothing to do with what Mr. Woods calls a "fundamental merchandising proposition." He seems to view the situation from the exceptional point of view created by the war.

In normal times, which I have known for many years in Belgium, it is quite a different proposition to sell machine tools to selling the staple article, and this is so obvious that any further comment is useless. I maintain that in normal times which are bound to come again, the dealer in machine tools who controls one market only and represents manufacturers directly, has considerably less expense than the firm with numerous branches in various countries, with different customs and languages. Many instances can be quoted to this effect, and in regard to Mr. Woods' argument that in some cases international machine houses have quoted cheaper prices than individual merchants, I am sure that I can quote a good many instances to the contrary, proved by facts.

The Stocks Carried

In reply to the query as to whether there was any Belgian agent now in existence, who did not carry German machines as well as American before the war, I will say that it was better to have machines in stock both of American and German make, than to have none at all as was the case with the only American firm established in Belgium in pre-war days. There was a market for German machines and there was no earthly reason why the Belgian merchant should not have sold them. Even certain German machines were imported into the great machine tool producing country of America, and therefore one cannot blame the Belgian merchant for having sold some German-made machines in a country which was not a manufacturing center for machine tools.

Purchasing for Stock

The next argument brought forward is rather amusing, especially from a manufacturer's point of view. "Is the small Belgian merchant sufficiently in touch with the business movements to know how to purchase advantageously for stock?" Of course the small Belgian dealer has not the financial power to obtain, with large cash advances, special concessions from the manufacturers. He does not want to buy "advantageously for stock." He wants to do justice to the manufacturers he represents; he wishes to give them the maximum amount of trade that can be obtained in his country by treating both suppliers and customers fairly, and not forcing business by the mere strength of capital. This may be done by concerns dealing in staple articles, but the sale of machine tools should not be considered as the sale of groceries, and I am rather afraid that Mr. Woods is rather confusing the two. The old established American manufacturers know what happens to firms who "buy advantageously for stock"; there have been enough examples in the European market. Any firm who desires to succeed in the machine tool business should leave speculation alone, and it does not follow that if during the war some speculators in machine tools have been successful that this is going to be the case in coming years. As to the question of retaining technically trained machine tool men, I cannot see why the individual merchant cannot have these, the past has proved he can. Several Belgian firms had most capable trained salesmen, and the international houses had by no means the monopoly of the best men in the trade. If Mr. Woods was in the employ of his company before the war, he must be pretty well aware of this.

Regarding the third point in relation to which Mr. Woods prophesies that after the war the most necessary factor will be the ability of financing the customers, I agree, but, my worthy contradictor does not seem to know the Belgian law. There is a law in Belgium which gives the machine tool dealer a mortgage on machines sold on credit, and it is an easy matter to obtain bank advances on such mortgages. The bank charges are extremely small, as the security is perfect, and legally protected. The "native son" of sound standing, and with sufficient capital can, therefore, take care of his business financially, without requiring inflated means which are only useful in exceptional times, as during the war, but may become a most serious burden when things are normal again. A very large capital in a merchant's business requires large returns, hence, inflated prices to consumers. This does not apply to large manufacturers I agree, but it is always the case with the middleman.

The Controlling Capital

I would be extremely interested to know from Mr. Woods, the names of the biggest shops in Belgium controlled before the war by French and English capital. I venture to remark that the most important engineering concerns in Belgium were purely Belgian, few had French capital and I know, perhaps two or three with English capital, but they were by no means important. To the contrary, Belgian capital was considerably invested in agriculture, railway enterprises and manufacturing schemes in the North of France, Russia, Spain, Argentine, China and many other countries.

While I will not contest that the American salesman in machine tools is as a rule capable, I would be rather sorry for the American manufacturers if they were only able to use the service of American agents for selling their machines. The American manufacturer is too practical to make machines which would require such exclusive selling system, and the past has shown that Europe possesses enough capable men to satisfactorily fill the position.

Mr. Woods believes in American machines as well as myself, but where I differ from his opinion is that it requires a little knowledge of the markets catered for, before tackling them, and that there is such a thing as psychology of people, which Mr. Woods brushes completely aside, and I maintain that the best policy for any American manufacturer who desires to do business in Belgium after the war, is to be represented by a native house, on the lines indicated in my previous article.

Machine Tools in Belgium*

By E. G. Todd
Member of the firm of E. Isbecque & Co., Antwerp, Belgium

BELGIUM has never been a country which has produced any great number of machine tools, even though it is one of the most industrious and densely populated countries on the globe. Aside from a few shops which produced heavy lathes for railroad work, which were not of a modern design, and two or three lathe constructors, the country was devoid of machine tool builders. To give you an idea of the industry of this country, there were situated in the district of Liége alone 250 machine shops, including, of course, both large and small.

Now, dealing with the prospects of exporting American machine tools at the present time, this is not quite as hopeless as most of the American manufacturers think. While, of course, it is impossible to ship directly into Belgium, it does not mean that the Belgian manufacturers are just being idle, but there are at the present moment several large live inquiries for machine tools to be delivered as soon as ever circumstances permit. In other cases certain Belgian firms are actually placing these orders, giving the American manufacturers where necessary the deposits asked for, and upon delivery of the machines becoming due paying fully for them and storing them either at the manufacturer's plant or in a public warehouse in the large cities.

Germans Have Stripped Plants

Another point which you are probably not aware of is that for the first two years of the war certain factories in Belgium were working, not at full capacity, but were keeping fairly busy, and were allowed by the German government to export their products to Holland and other countries. This, however, has since been discontinued, as the British government would not allow the full value which the Belgian manufacturers received for their goods to be remitted to Belgium. Also the Germans have now stripped every plant in Belgium of all the machine tools they could find.

There are absolutely no machine tools left in that country today, and they, therefore, must all be replaced. In some of the large factories the Germans have taken as many as 1500 tools, and in some of the medium-sized factories 500, and so on all the way down to the smallest shops in which they have only taken two or three. Some persons assume that the Germans will be compelled to give these machines back after the war, as they have been very carefully tagged and tabulated to show the various works from which they have been taken. Personally, I think these machines will be useless after the war for performing any high-class precision work, as we all know the very intense usage which they have had during the war, and even the highest class of tools cannot stand up for any length of time against this rough usage unless they are properly taken care of, which, of course, the Germans have not had time to do.

There will, however, be certain second-hand tools available in England and France after the war, and I would imagine that some of the best American tools which are shipped just before the conclusion of peace will find their way to a certain extent into Belgium, as they will have had very little wear and will be in first-class shape; but the earlier machines which have been delivered, I do not think will be in such great demand, as they will not be in a very good condition; also the Belgians do not look with favor upon the purchasing of second-hand tools, and I am convinced they will prefer to commence over again with new machines.

The English firms, I think we shall find, will be the biggest competitors against the American firms in the exporting of their machine tools into Belgium after the war, as they will be very much nearer the seat of action and have at the outset a great advantage over the freight rates which will necessarily be high from America.

They have also commenced to form various combinations for the sale of their tools, not only in Belgium but in other countries, and are prepared for a very active and extensive campaign for the Belgian market. After the war they will specialize a good deal more than they have done in the past, and they will, therefore, be in a position to compete very much more favorably than they have done heretofore.

I do not think the Swedish manufacturers will bother the American manufacturers to any extent, as before the war they did not make a very great variety of machine tools, and most of these were of the cheaper class.

Prospects for After-War Trade

There are two more items, to my mind, that enter into the prospects for the exporting of American tools to Belgium after the war; one being the question on the part of the American manufacturers as to whether the Belgian manufacturers will be able to pay for their goods, and the other on the side of the Belgian manufacturers as to whether the American manufacturers will be able to obtain anything like reasonable freight rates for the shipping of their goods from America to Belgium.

Certain Belgian manufacturers have already put up the necessary cash for payment of their goods, and it may interest you gentlemen to know that all the gold which was held at the National Bank in Brussels has been saved, as well as the gold in a good many other banks, and this is now deposited in the Bank of England in London, so that the Germans did not obtain any great amount of gold when they overran Belgium. This will, therefore, again be put in circulation, and it remains to be seen as to whether it is enough to make the Belgians' credit as good as ever.

Another point in regard to the question of finance is that a lot of the large Belgian firms have sister firms operating either in France or other countries, and they will no doubt help to restore their plants in Belgium. I know that one firm in France has already set aside the sum of three million francs for the reëquipment of their plant in Belgium.

I learn on good authority that should credits be necessary to the Belgian manufacturers after the war, plans are already afoot and likely to be consummated at any time by which the American bankers will give their correspondents in Belgium credits such as they did before the war, and the Belgian bankers in turn will give certain first-class responsible Belgian firms all the credit they require, so that it will become practically a cash against bill-of-lading proposition in New York for the American manufacturers for these firms

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*Extract of paper read at convention of National Machine Tool Builders Association, New York City, Oct. 30-31.

Tools of all descriptions will be in great demand after the war, and the Belgians will of necessity have to purchase more labor-saving machinery than they have done in the past, as labor will be scarce in this country as in all others after the war. This will include heavy railroad tools. There were no less than 19 railroad shops in Belgium before the war which were producing locomotives for all parts of the world, and most of the tools required for the production of these machines were supplied by Germany. These were very costly and intricate tools which were not at all well received by the workmen. The others were supplied mostly from England; also some were manufactured in Belgium, but these were not of a very modern design. I would strongly draw your attention to this fact, as boring machines, axle lathes, slotting machines, wheel-turning lathes, etc., for this heavy type of work will be in very great demand.

A certain number of new firms will naturally spring up in Belgium after the war for the manufacture of machine tools, but I do not think you need give them any great consideration, as they will not be in shape to compete very seriously for some time until they have their own shops equipped and working, and before this time comes most of the orders for the reëquipping of shops will have been placed.

Appointing of Belgian Agents

Regarding the appointing of agents in Belgium, I would like to offer one or two suggestions. Certain manufacturers think of sending over their own representatives and being directly represented in that country, and not using established agencies, which, of course, is a good idea where the volume of business is sufficient. I would, however, warn them not to send over, as certain firms have done in the past, highly trained men who cannot speak the French language, as Belgian manufacturers have not the time to spend in receiving them and having their views interpreted for them by a third party. You cannot succeed in Belgium without being established there. Close coöperation will be needed between the American manufacturer and his agent. Fortunately this feeling was developed by most of the large firms before the war.

The best agents for Belgium, or any other country, are those who specialize and devote all their time and energy in the country where they have the agency, just the same as American tool manufacturers have confined themselves and specialized in their branches of tools, which has made them so successful and enabled them to bring out the most efficient machines.

There should be a very rosy future for American machine tools in Belgium after the war. A report recently published states that the Belgian government estimates that $400,000,000 worth of tools, machinery and raw materials have been taken out of that country by the Germans. American tools will be looked upon with a good deal of favor by the Belgians, as they will always appreciate and feel very warmly disposed toward you, not only on account of the very good tools you manufacture, but also due to the very excellent and liberal manner in which you have contributed to their relief and kept that poor nation from starving.

Forging Ball Levers

By Herman F. Salomon

I believe it will be of interest to those who have the problem of rapid and economical production confronting them to know how the Franklin Automobile Co., Syracuse, N. Y., is making two of their forgings. When these forgings, Fig. 1, leave the hammer and the sprues are cut off, they are ready to be assembled into their respective places, and act as moving parts, glass-smooth and to within limits of a few thousandths without a bit of machine work, except cutting a thread on the small piece. The larger piece *A* is a gear-shift lever and the small end *B* is of gear-tooth shape. The flat section *C* rests in a slot to keep the gear-shift lever from turning, and the ball *D* moves in a two-piece socket, forming a smooth ball joint. The smaller piece *E* is a steering connection ball; four being used on each car. The ball acts as part of a ball joint, and the taper end is driven into a reamed hole where there can be no play. Both pieces are nickel steel.

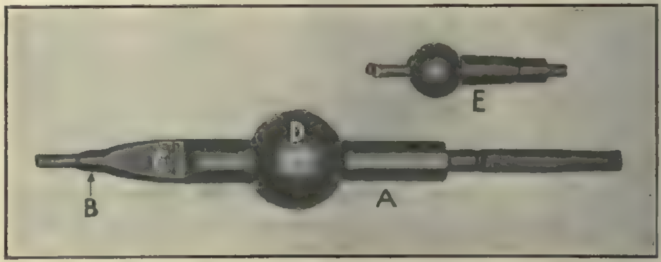


FIG. 1. THE FORGED PIECES

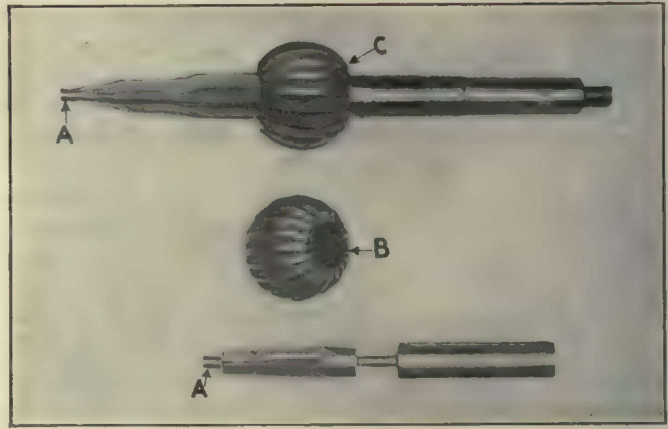


FIG. 2. SPECIAL DIE-SINKING CUTTERS

In the making of the dies there is nothing used but the ordinary die sinking equipment, horizontal milling machine, and the special shaped cutters shown in Fig. 2. These cutters are made to allow for shrinkage. In the smaller dies there are three impressions; one for roughing, and two for finishing, therefore, giving the production of two sets of dies in one. The only difference between the roughing and finishing impressions is that the corners of the rougher are more rounded as shown at *A*, Fig. 3.

First, the balls are sunk in each die with a ball-end mill. Then, in a horizontal machine, the sprues are milled in with a $\frac{9}{32}$-in. end mill. On this type of die there is a sprue on each end of the impression, which serves the double purpose of allowing the surplus stock to escape, and also for the supporting end of the cutter to sink into when feeding the die up against the cutter. These ends of the cutters, marked *A* in Fig. 2, are centered to run on the milling machine centers.

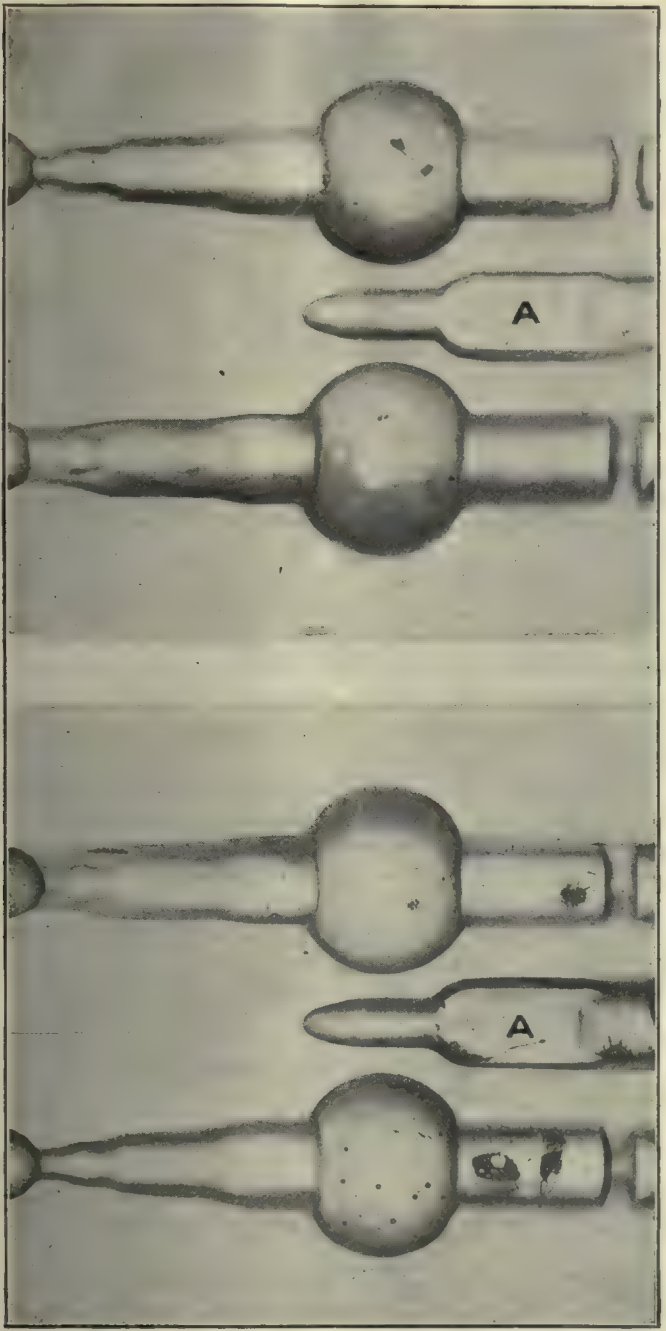


FIG. 4. DIES FOR GEAR SHIFT LEVER

On the larger dies, Fig. 4, it is impossible to sink the balls with a ball-end mill. It will be seen by looking at *D*, Fig. 1, that the ball is not a full ball, it having been cut away at opposite sides next to the shanks for clearance. To sink this impression it was necessary to make a ball cutter as shown in Fig. 2 at *B*, with a keyway in it to drive on the long cutter as shown at *C*. The ball part of the impression was first roughed out to make it easier on the cutter when feeding up.

It is well to sink the impressions about 0.005 in. deeper than finish depth to allow for surface grinding after hardening. It was found that a small flexible shaft grinder is a very handy part of the die sinking equipment, to grind out places that changed in hardening. These dies are being used in Bradley hammers of the upright helve type. When the hammerman places the bar in the rougher, and starts the hammer he immediately begins turning the bar with every stroke of the hammer, and keeps this up until the dies come together. Then he places the work in the finisher, always turning to make it perfectly round and finally brings it over on the cutoff *B*, Fig. 3, which is shown set into a slot in the dies. It is fastened with a $\frac{1}{4}$-in. pin. The large dies, Fig. 4, have an impression *A* in the center for producing the flat shown on the forging. They have no cutoffs, it being best either to hot-saw them or cut them off in a press as the dies are quite large, being 8 x 8 in. on the face. It is needless to say there is no flash to trim off on these forgings.

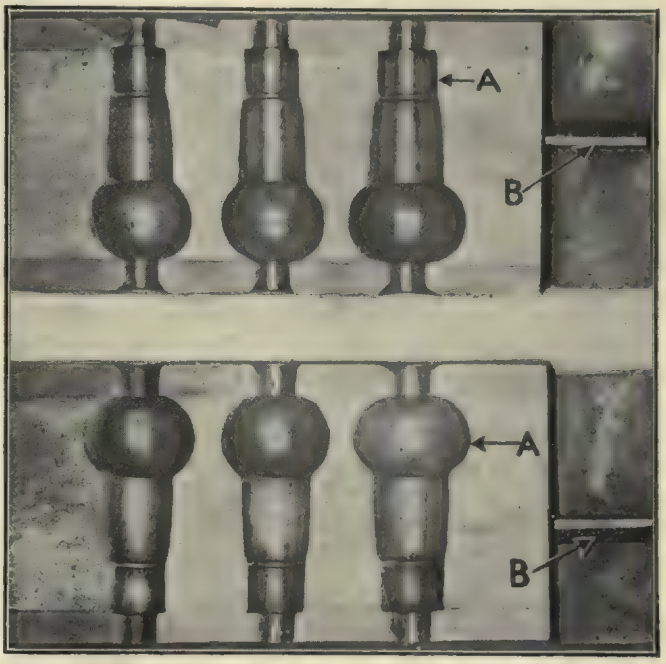


FIG. 3. DIES FOR STEERING CONNECTION BALLS

Price and the Man

BY A. SCHLEIMER

Two concerns manufacture the same article, but the uses of the product of each is different. It may be a finished article or a part. A's market may be such as to allow him a large profit, while the use to which B puts his product may demand close figuring. Naturally, the same operations are followed in both plants, but A can afford to pay better wages than B for the same work.

Now, one of the important factors in manufacturing is the cost of labor turnover. Briefly stated, turnover can be explained by the difference in cost of an operation when performed for a year by one man, and the cost of the same work done by 50 men, or a new man each week. This is an exaggerated condition, but explains the case. Once the value of this is understood, we realize the importance of keeping the man on the job.

Analyzing the situation we find that, in order to do any work in an efficient manner, a man's mind must be concentrated on that particular job, and in order to concentrate his mind, he must be interested in the work. Psychic law demands an incentive to produce interest. Lacking incentive, results are impossible in any line of endeavor.

Webster gives the following definition of incentive: "Encouraging, inciting, rousing to action, spur, motive, influence, love of money, and the desire for promotion."

Just what constitutes an incentive is not always clear in the minds of some. For instance, there are those who consider that a light, well equipped, sanitary workshop is an incentive. This is not so. Such a plant is congenial to the workman, and a credit to firm; but in reality it is nothing more or less than an investment. It can only be viewed in the light of an incentive when all other conditions are equal. The average man will take a job in a poorly lighted, ill-kept, unsanitary factory, where a high wage is an inducement, in preference to one in an up-to-the-minute plant, with a low wage scale. Of course, we know that this is not as it should be, but we must recognize the fact, and facts are what we have to contend with.

THE REAL INCENTIVES

The concensus of opinion of a number of executives is that there are only two real incentives, wages and promotion. But, if the increase of wage is taken out of promotion it will cease to be an incentive. Therefore, we have but one. Experience has proven this, and that is why the foreman receives a percentage in the bonus system as well as the workman.

Some years ago, when the piece-work system was evolved, it was looked upon as the greatest factor toward solving the wage question. It was conceded to be as near perfection as it was possible to get. It proved conclusively that it was possible to advance the interest of the employee and the employer at one and the same time, a thing heretofore considered unattainable. Yet it was not long afterward that the bonus system appeared, an unqualified improvement on the piece work plan. These however, are simply systems, nothing more or less, and will be satisfactory, or otherwise, according to how they are put in operation. The real question is this: What shall be the standard upon which an employee's wage is to be gaged? If we pay him the price he asks when he applies for a job it may be too little, for he may have mentioned less than he really wants to work for because he wants the job. If this is the case, he will be dissatisfied because he will always have the feeling that he ought to get more. Again, he may ask for more than he expects to get. In this case he is likely to feel that, as he got his price, he would have received still more had he asked for it. This naturally leads him to think that the job is worth more than he is getting.

Another way of getting a wage is to gage it according to standards used in other plants for the same class of work. The objection to this is that when two concerns pay the same rate the actual wage is lost sight of by the employee, and other conditions will influence him. In the other plant he will be nearer home, the other employees may be more congenial, the plant equipment may be a little better, and other things too numerous to mention.

The only logical way to set a wage rate is to base it upon what the profit will permit. This is simply an application of the law of the survival of the fittest. If A can afford to pay $2 for a certain piece of work, and B can only pay $1.75, it is proper that A should have the first call. B is at a disadvantage, and is working under a handicap. The moment that A refuses to pay more than B, he is placing in his own path the obstacles that B is up against. If employees can be paid a higher wage than they can get elsewhere for the same work, the percentage over and above the regular rate will be the most profitable investment that can be made.

No plan has been, or ever will be, devised to keep secret the wages in any organization. Employees know when they are getting more than they can get elsewhere, as well as they know when they are getting less. When they do get more they will be content and interested in their work, will be tractable and use every means to hold their job. It will be an easy matter to have them observe the necessary rules and regulations, which will tend to lessen accidents, to increase efficiency and output, and go far toward making a permanent organization by cutting down the turnover to a minimum.

In an organization working along these lines it might not be apparent that other workmen are acquainted with conditions, but let one of your men drop out suddenly and you will be surprised how quickly you will be flooded with applications to fill the opening. Whatever plan is used, whether the piece-work, bonus or any other system, it should always be borne in mind that it is simply a means to, and not a solution of the problem.

English Lead Screw and Metric Threads

By H. C. Card

The following may be of use at this time to those who want to cut metric threads on a lathe fitted with an English lead screw: This method requires a compound gear of 127 and 50 teeth. With this compound gear in use the gearing for any metric thread may be figured from the rule; threads per cm. = threads per inch; i. e., ascertain the number of threads per cm. to be cut and using the compound gear select gears for the same number of threads per inch.

For example: To cut 0.5 mm. pitch, which is 20 threads per cm., select the same gears as for 20 threads per in.; for 1 mm. pitch select the same gears as for 10 threads per in.; and for 1.25 mm. pitch select the same gears as for 8 threads per in. The compound gear is based on the equation 2.54 cm. = 1 in. (or 1.27 cm. = .50 in.)

The above method first came to my attention at the shops of the Taft-Peirce Mfg. Co., about 1908.

Cost of Health Supervision in the Metal Trades in 1916

Compiled for the Conference Board of Physicians in Industrial Practice, by Magnus W. Alexander

Plant Number	Average Number of Employees	Physicians Employed Full Time	Physicians Employed Part Time	Physicians Engaged for Call Service	Nurses Employed M—Male F—Female	Others Employed	Surgical Cases Treated	Medical Cases Treated	Redressings Made	Home Visits Made	Physical Examinations Made	Total Cases of all Kinds	Total Medical and Surgical Cost	Average Cost per Employee	Plant Number
1	400	0	0	1	0	1 first aider	240	240	80	0	0	560	$2,000	$5.00	1
2	500	0	0	2	0	1 attendant	1,451	506	654	....	......	2,611	692	1.38	2
3	720	0	0	1	0	0	300	0	....	....	0	300	2,651	3.68	3
4	762	0	1 4 hr. daily	0	1 F.	1 boy	2,032	895	1,399	17	1,715	6,057	3,112	4.08	4
5	776	0	1 5 hr. daily	1	1 M.	2 first aiders	7,543	255	6,117	36	40	13,991	5,744	7.40	5
6	875	0	0	1	1 F.	0	715	150	4,127	....	......	4,992	1,297	1.48	6
7	918	0	1 2 hr. daily	0	0	0	696	0	4,000	15	563	5,274	1,925	2.10	7
8	1,000	0	0	1	0	0	1,618	388	......	....	0	2,006	1,038	1.04	8
9	1,100	0	0	Yes	2 F.	0	959	0	678	204	1,500	3,341	3,160	2.87	9
10	1,157	0	1	7	2 F.	1 first aider	327	1,382	970	.....	......	2,679	5,878	5.08	10
11	1,244	0	1 daily	0	2 F.	0	7,984	2,400	......	200	40	10,624	4,040	3.25	11
12	1,561	0	0	1	1 F.	0	5,332	3,802	3,826	0	0	12,960	1,332	.85	12
13	1,730	0	1 2 hr. daily	0	1 M.	1 stenographer	2,660	......	4,872	144	2,782	10,458	3,485	2.01	13
14	1,928	0	1 1½ hr. daily	0	1 F.	Part-time clerk	2,628	572	6,416	716	......	10,332	4,939	2.56	14
15	2,000	0	0	0	1 M.	0	3,000	......	936	144	0	4,080	2,330	1.16	15
16	2,200	0	0	0	0	1 first aider	1,294	0	0	0	0	1,294	1,165	.53	16
17	2,400	0	0	0	1 M.	0	7,200	1,000	3,200	0	0	11,400	5,250	2.19	17
18	2,565	0	0	0	2 F.	0	6,657	......	11,163	....	0	17,820	4,074	1.58	18
19	2,600	1	0	0	1 F.	0	1,628	1,772	812	112	176	4,500	3,040	1.17	19
20	2,862	0	4 4 hr. daily	4	2 M.	1 stenographer	4,596	(1)	17,948	148	5,516	28,208	9,068	3.17	20
21	3,097	1	1 daily	0	0	1 clerk	3,098	220	4,350	20	0	7,688	4,491	1.45	21
22	3,250	1	0	Yes	1 M., 1 F.	0	1,648	990	13,844	.....	12,117	28,599	7,517	2.31	22
23	3,503	0	0	Yes	1 F.	0	318	0	0	0	0	318	3,550	1.01	23
24	3,794	1	0	0	2 M., 1 F.	1 clerk	25,782	(1)	32,688	.....	......	58,470	8,820	2.32	24
25	4,000	1	0	Yes	2 M.	0	1,280	(1)	24,000	380	8,000	33,660	10,980	2.74	25
26	4,534	0	2 2 hr. daily	0	2 M.	0	6,522	0	10,000	1,000	4,278	21,800	11,376	2.51	26
27	4,848	1	1 1 hr. daily	2	1 M., 3 F.	1 clerk	2,360	4,944	3,850	3,962	6,246	21,362	15,494	3.20	27
28	5,300	0	0	8	1 F.	4 first aiders	1,109	(1)	4,671	.....	0	5,780	5,157	.97	28
29	5,655	0	1 1 hr. daily	Yes	1 M.	1 clerk	3,968	4,843	4,433	0	1,000	14,244	5,728	1.01	29
30	5,809	3	0	0	1 F.	2 first aiders	15,992	......	15,188	0	7,864	39,044	8,272	1.42	30
31	6,000	1	1	0	2 F.	3 (3)	14,394	11,772	17,416	0	1,004	44,586	7,074	1.18	31
32	6,727	0	0	2	1 F.	0	10,580	......	14,000	.....	0	24,580	7,713	1.15	32
33	6,806	0	0	1	1 F.	1 steward	5,194	2,012	7,417	64	7,000	21,687	9,646	1.42	33
34	7,608	0	6 6 hr. daily	0	0	5 (4)	15,659	2,998	53,252	65	23,136	95,110	19,897	2.62	34
35	7,745	2	0	0	1 F.	3 (5)	3,164	848	5,349	584	1,970	11,915	9,002	1.16	35
36	7,922	1	1 3 hr. daily	0	5 F.	1 stenographer	8,122	18,644	7,254	406	6,388	40,814	14,997	1.89	36
37	8,000	4	0	0	5 M.	2 clerks	1,327	30,500	2,745	1,078	15,565	51,215	18,897	2.36	37
38	10,000	3	0	1	2 F.	1 stenographer	23,112	9,350	42,972	1,724	25,458	102,616	17,680	1.77	38
39	11,000	0	1 1 hr. daily	0	1 M., 4 F.	6 (6)	17,516	......	39,931	.....	......	57,447	17,267	1.57	39
40	12,786	2	0	0	1 M., 2 F.	0	11,177	1,526	24,502	1,719	17,318	56,242	13,641	1.07	40
41	14,500	5	0	0	9 F.	7 (7)	9,600	3,800	32,000	3,000	18,600	67,000	30,200	2.08	41
42	15,793	1	0	0	4 M., 2 F.	1 attendant	32,160	(1)	36,676	1,032	0	69,868	32,961	2.09	42
43	16,776	12	0	Yes	5 F.	(8)	53,006	54,273	62,891	(9)	16,000	186,170	28,749	1.71	43
44	16,880	5	0	0	1 M., 10 F.	0	29,626	......	71,914	.....	5,749	107,289	34,409	2.04	44
45	17,387	2	0	Yes	5 M., 1 F.	0	12,200	742	32,364	1,110	15,648	62,064	22,650	1.30	45
46	18,521	2	0	0	6 M., 5 F.	5 (10)	55,728	(1)	83,648	0	0	139,376	21,606	1.16	46
47	37,107	9	0	0	24 M.	(11)	86,611	133,036	202,095	3,643	41,175	466,560	87,717	2.36	47

[1] Included with surgical cases. [2] Included with redressings. [3] One attendant, one clerk, one stenographer. [4] Three clerks, one masseur, one janitor. [5] One clerk, one janitor, one messenger. [6] Five clerks, one janitress. [7] Three clerks, four cleaners. [8] Supt., 16 clerks, janitor, doorkeeper, and scrubwoman. [9] Included with other cases. [10] Two clerks, two drivers, one assistant. [11] Clerical force, dentist, hygienic laboratory, judicial and transfer departments.

Core Box Dowel Pins

By A. E. Holaday

We have five plants situated in different locations. Four of these plants are using taper dowel-pins in core boxes and claim that they are the best and most satisfactory.

I claim that a straight dowel pin is the only correct pin to use for core boxes and will produce a more perfect core. I back this up for the reason that our foundry has less imperfect castings returned to them due to imperfect cores than any of the other plants. If a straight dowel pin is used, any particle of sand in the hole will be pushed through by the pin and the box allowed to close tight. If a taper dowel pin is used, any particle of sand left in the taper hole will stay there and the core will not be perfect, owing to the fact that the core box will not come together. This also applies to iron core boxes where the pin is driven through one-half of the core box. I also claim that it takes more time to equip core boxes with taper dowel pins, consequently, they are more expensive.

Breakage of Roughing Tools

By Charles L. Yost

Considerable trouble had been experienced in having high-speed roughing tools break in two in the middle directly under the screw of the toolpost. Sometimes they would even break when a very light cut was being taken.

On first thought, I attributed the breakage to cracks caused by a flaw in the steel or improper heat treatment, but upon making a very careful examination of a number of these fractures I could discern no trace of a flaw or crack in the steel.

I reduced this trouble to a minimum by placing under each tool, after it was placed in the toolpost, a piece of ¼-in. flat iron the width of the tool and about 6 in. long. This, acting as a cushion, tended to overcome the unevenness of the bottom of the tool caused by redressing and treating.

I think this iron tended to neutralize the vibratory effect of heavy cutting, which in turn prevented crystallization of the tool.

IDEAS FROM PRACTICAL MEN

An Unusual Forming Die

By M. E. Hoag

The Wisconsin Metal Products Co., Racine, Wis., make a specialty of stamped and drawn metal parts and among the interesting dies used is the one for forming the flutes or corrugations in the curry-comb parts shown in Fig. 1. These parts are first punched out of sheet steel and then bent to form as shown at *A*. The corrugating is then done on the die shown in Fig. 2. The piece to be formed is slipped on the die block *A* and the end registered against the stop *B*. As the punch *C* descends the steel block *D* passes over the outer part of the piece to be corrugated and holds it against the die block *A* while the circular-forming punch *E* presses the metal into the die.

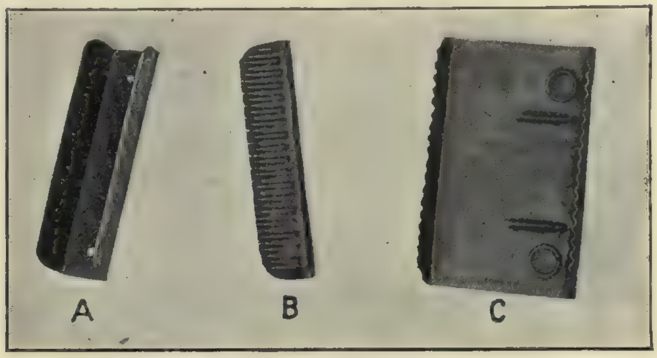


FIG. 1. CURRY-COMB PARTS

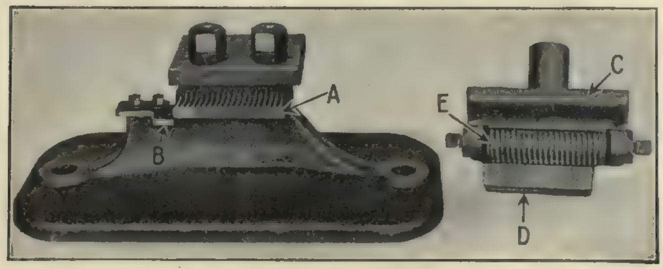


FIG. 2. AN UNUSUAL FORMING DIE

An interesting feature in connection with this punch and die is the circular forming punch *E*, which is in reality a screw with Whitworth form of thread. The setscrews seen at each end of the punch holder permit the punch to be turned when found necessary on account of wear.

In order to take the strain off the setscrews the punch is backed up by a soft steel wedge set in between the top of the punch and the holder.

Referring to Fig. 1, *B* is the central member of the comb after forming and corrugating. This piece is set and riveted to the piece *C* to form a four-bladed toothless curry comb.

Annealing Hard Spots in Oxyacetylene Repairs

By George H. Stauffer

I have read the article on page 500, in which Charles L. Brand disagrees with G. Handyside in the practice of using sulphur as an annealing agent of cast iron. Mr. Brand is right, when he says: "It would prove detrimental." Iron will absorb, up to 0.03 per cent. of sulphur, under ordinary conditions. An increase of from 0.04 to 0.08 per cent. of sulphur would render the mass hot short; that is, make it brittle while hot, and thus be productive of a poor weld.

Mr. Brand suggests buying welding rods from reputable concerns and thus avoid hard spots in the rods. There is wisdom in this suggestion, but since welding rods are usually very light castings, the welder may run across a hard spot once in a while, in spite of the fact, that a reputable concern made the rod.

The communication from Mr. Handyside, page 16, had for its subject, annealing the hard spot. However, these hard spots may be neutralized by the use of suitable fluxing. I know from experience, that borax used as a flux produces a good weld, thoroughly annealed, but when the same identical rod was used without borax, the weld could not be filed.

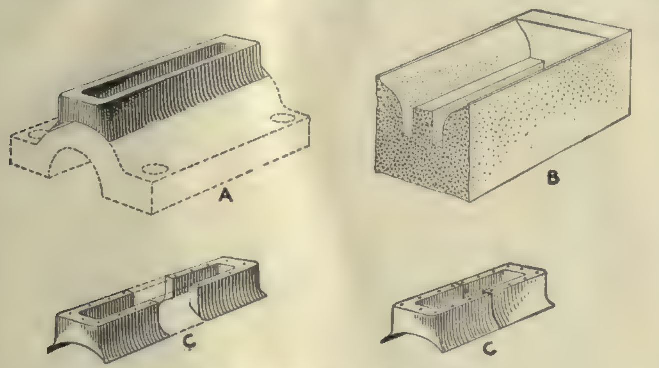
Patterns for Large Bearing Caps

By Arthur H. Dill

I was working for a large manufacturing company, who up to this time, had been providing lubrication for the large bearings, by drilling and countersinking the caps for the bearings. It was decided to provide oil pockets or wells on all of the various bearings, and as their product included many styles and sizes of machines, and many sizes of bearings, it appeared to be somewhat of an undertaking. However, the drawings were all changed, and orders sent to our patternmaker to change the pattern to provide for an oil pocket to be cast integral with the caps.

This is the way the patternmaker went about the job. He selected the largest cap and made a pattern *A* of wood of the oil pocket.

Then he made several molds, *B*, of plaster of paris and poured enough lead castings at one heat for the entire lot of patterns. The lead castings were fastened to the caps by brads, as shown at *C*; the lead bending to the contour of the wood pattern very readily. When he wished to provide for a shorter cap he would simply cut out the required amount from the center and join the ends, as shown at *C*. The lead was far more durable than wood, to say nothing of the saving of time and labor, if the usual method had been followed.

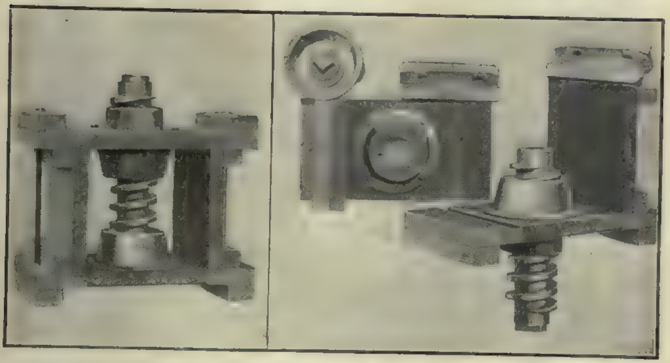


THE LEAD PATTERN AND ITS APPLICATION

Casting a Steel Worm

BY D. S. MANN

In the accompanying illustrations is shown a worm that was used in bottom-dumping coal cars. The worms were steel castings, approximately 4¾ in. in diameter and 9¼ in. long. They were made a loose fit for a square steel shaft by which they were turned when dumping the bottom of the car. As very little power was required, they could be made fairly light. They were cast entirely in dry sand cores, the boxes being constructed of hard wood, metal lined. The worm pattern was of cast iron, fitted with a babbitt nut at one end. The cone-shaped pieces, in the assembled view, Fig. 1, are prints, the core box for these being shown at the top in the disassembled view, Fig. 2. After being rammed, the worm was turned out and the box separated, being held together with two clamping bolts. Locating lugs were provided on the end and center cores so that they could be placed accurately in relation to one another.



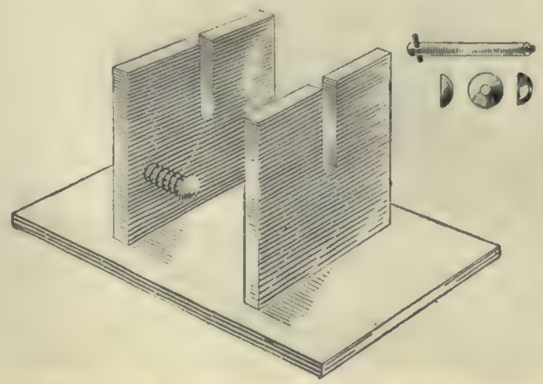
FIGS. 1 AND 2. ASSEMBLED AND DISASSEMBLED VIEWS OF WORM PATTERN

Brake for Wire Roller

BY GEORGE F. KUHNE

There is sometimes in the shop a demand for music wire cut to various lengths. As the wire comes in rolls, it is very annoying to the operator to be compelled to readjust the wire on the roller on account of its jumping over the flanges after it has been fed to the stop.

A good way to eliminate this trouble is to attach a spring and stud at the side of the roller stand, as in the sketch herewith. This creates a tension preventing the roller from continuing its rotary motion, except when the operator pulls the wire to the required stop and cuts it off.

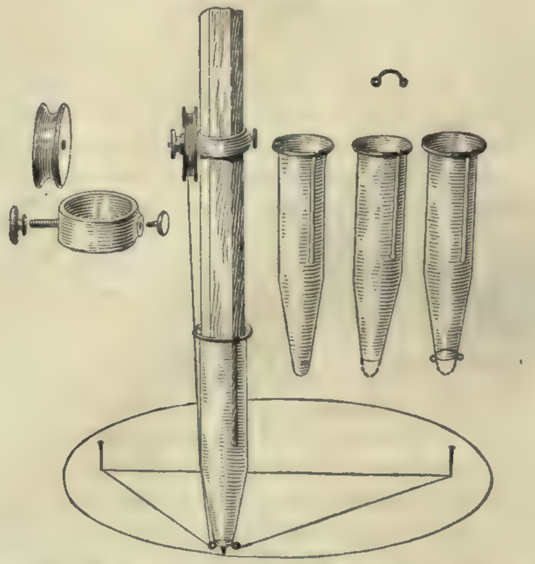


POSITION OF BRAKE FOR WIRE ROLLER

Simple Ellipsograph

BY J. A. LUCAS

The ellipsograph here shown will save you time, money and curses, when you try to lay out elliptical templets, dies or anything of the sort. It is so simply made that the illustration is self-explanatory. The pencil protector can be bought for 2c. A common pencil is always handy. A piece of catgut string (nonelastic), a ring and wheel and two setscrews complete the instrument.

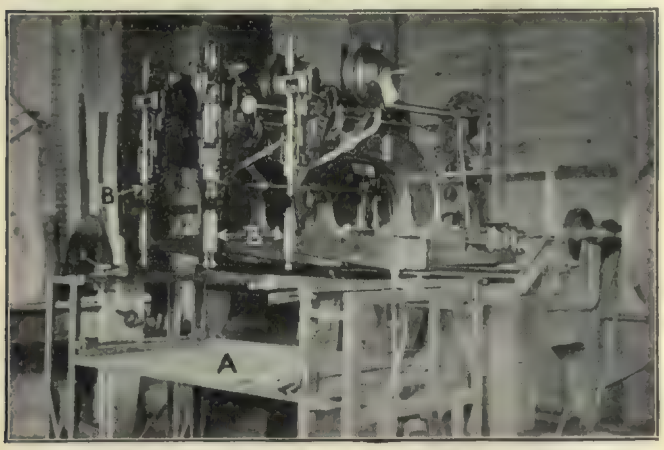


COMPONENT PARTS AND ASSEMBLED ELLIPSOGRAPH

An Automatic Rivet- and Tack-Driving Machine

By Jay M. Dosker

The accompanying illustration shows an automatic rivet- and tack-driving machine which is used in the trunk manufacturing establishment of the Grand Rapids Trunk Co., Grand Rapids, Mich. It drives rivets at an extremely high rate of speed. With this machine an average workman can operate it to drive over 400 rivets per min., while an experienced operator with the machine keyed to the highest pitch can drive at the rate of approximately 800 per min. Additional rivet or tack drivers may be added to increase production. In operation a trunk is placed in an automatic feeder *A*, and an entire side finished at one operation by the drivers *B*. The trunk is firmly clamped in place during the operation of the machine and is not handled by the workman in any way whatsoever.



AUTOMATIC RIVET- AND TACK-DRIVING MACHINE

Button-Setting Job

By Hugo F. Pusep

In reference to comments by Mr. Harris on page 602, regarding the merits of a button-setting job described by me in a previous article, I wish to add a few words of explanation regarding the job in question.

The disk-in-contact method described by Mr. Harris would certainly produce the results, provided the center disk, 6 spacing disks, and the outer ring were machined to the required degree of accuracy. But I do differ from Mr. Harris as regards the disk-in-contact method being quicker of the two, and for the following reasons: In order to attain accurate results the various disks must be kept to within less than half of the error allowed on the finished rings, which in this case would be less than 0.0001 in. in diameter and concentricity of holes with the perimeter of the disks. It would be practically impossible to use anything but hardened, ground and lapped disks for this purpose. I have yet to see a lathe hand who can work to so close a limit, and a conservative estimate of finishing these disks would give at least 20 hours' work, irrespective of the material cost which, including the large outer ring, would be a large item. All this work has to be done, and done absolutely right before the boring of the ¾-in. holes can be started.

There were altogether 6 rings of the given dimensions required for the construction of this special machine; and the total time taken by the toolmaker in machining the center piece, affixing the buttons, and boring all the holes in those 6 rings was about 24 hours, which would leave with the disk-in-contact method about 4 hours in which to locate, drill, bore and ream the 18 ¾-in. holes, a practical impossibility.

The reason for choosing a partial disk for the center piece was the fact that a piece of cold rolled steel ¾ x 1½ x 4¼ in. was found in the scrap box of the shop, therefore, there was no necessity of waiting until a suitable piece was cut off and machined to the required dimensions, thus increasing slightly the cost of the whole job. I admit that a full disk would not have any elements of uncertainty as to permanent accuracy of the center button, but we encountered no difficulties in this respect; moreover, the center button was tested with an indicator at every new setting of a ring on the faceplate of the lathe.

For the sake of argument, let us suppose that a set of disks had been made; the chances are a hundred to one that, as this was a special job, the disks would never be used again or would have to be altered altogether to suit a similar job of varied dimensions. Another thing that has to be taken into consideration, namely: Very few small shops building special machinery will tolerate the expense of making a set of disks if the job can be done cheaper by any other method.

On very close work the true setting-bar method described by Mr. Harris is a very uncertain way of locating holes accurately for the reason that unless the bar runs dead true in the milling machine spindle it is of little worth, and I have not yet seen a setting-bar which really runs dead true unless it has been ground to size in the milling machine. This procedure would bring the cost of boring the rings in question to a prohibitive figure.

Kind of Work for a Trade School Shop

By W. D. Forbes

Mr. Wesley McArdle, on page 907, Vol. 46, of the *American Machinist* makes some comments on my article concerning trade schools. I have never met the gentleman, but I have met a great many who have the same bent of mind and the same general set of expressions. We will take a word from Mr. McArdle, and class all these gentlemen as "elements." They would never submit to being called teachers, but would insist upon being called "pedagogues." I cannot say how it is in the case of Mr. McArdle, he may be an exception, but all the others that form this element, whom I have personally known, never served a real apprenticeship at any trade. The only value of a discussion is to broaden the views of those who listen to it, and it may not be worth while on the part of the *American Machinist* to lay before its readers what I now set down, yet the combination chuck is the one I would buy for a trade school if I had money enough to buy only one, because I could then show the students a chuck where the jaws could be made independent in their movements, or could be made to operate simultaneously. I could further show that when the circular rack is out of mesh with the pinions on the screws that the chuck is just as strong and rugged as any independent chuck of equal weight; more than this, I could show how little or no strain would be put on the circular rack when in mesh with the pinions and work was clamped by using the circular rack as it was intended to be used; that is, to bring the jaws to the work; also, that clamping should be done by tightening up on each screw lightly several times. So much for the chuck question in answer to Mr. McArdle.

Now as to not teaching how to harden a reamer, and to forge and harden a tool, I contend that a trade school should not attempt to produce a toolmaker, but a plain every-day machinist; and as making a reamer is the job of a toolmaker anyway, its hardening should not be attempted by a machinist's apprentice. Another reason is, it is much better to buy reamers than to try to make them, and in order to harden them better facilities would have to exist than is generally found at the ordinary blacksmith's forge. The element of hardening can just as well be taught by hardening an inexpensive lathe tool as by an expensive piece of work such as a reamer.

Now, the question is asked by Mr. McArdle if I want to turn out only plain machinists from a trade school? I certainly do; that is, at public expense. The majority of manufacturers will agree with me, I am certan, that what they want is machinists, not foremen or toolmakers. These are of course wanted, but they will be obtained from the ranks of the machinist, and no trade school in the world can turn them out any more than a college can turn out a bank president.

How Mr. McArdle arrives at the idea that the machinists' trade is applied mathematics, as far as the operator is concerned, is beyond me.

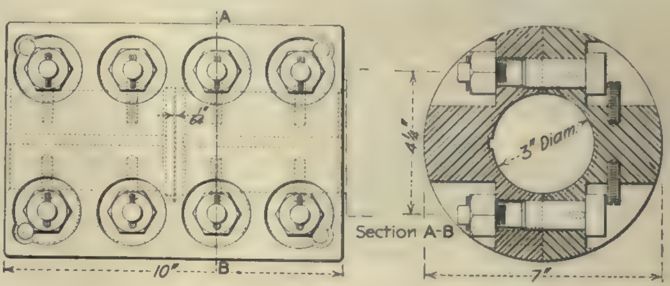
Mr. McArdle may be able to talk a great deal more convincingly than I, even be far more persuasive.

I will allow that he is 100 per cent. better in both than I am, but I will bet him a good cigar, if he smokes, that I could go around to twenty-five machine shops in a town and raise twice as much money in one day to open a trade school that would turn out "plain machinists" only, than he could in trying to raise money for a trade school to turn out foremen and toolmakers, and if I wanted to get the money from the ladies I would get ten times as much money subscribed by them to turn out plain cooks than he could to establish a school to turn out "demonstrating domestic economists." What the country needs is people who are ready to do actual work as directed, for when such work is well done the advance of the party is assured. The point I made, in the article criticized by Mr. McArdle, was that higher education in trade schools should not be undertaken at public expense (I have no objection to private funds being so used) and I think that manufacturers will back me up in my assertion that more machinists are wanted who can run lathes, shaping machines, and planing machines, and who can read drawings correctly and produce work within reasonable time limits, than they do men who understand plane geometry and trigonometry or can figure stresses and strains.

The Critical Speeds of Rotors Resting on Two Bearings

By Walter Rautenstrauch

In reply to the criticism made by Paul Hoffman to my article on "The Critical Speeds of Rotors Resting on Two Bearings," I will first quote in full what Mr. Hoffman gave in abstract: "The determination of the critical speed requires *first the determination of the load diagram of the shaft.* This load to include the weight of the shaft as well as the weights of all the attached parts. It will be found convenient to divide the length of the shaft into sections *A*, *B*, *C*, . . . *Q*, *R* as shown in Fig. 11, *for the purpose of conveniently estimating the weights* of the several parts of the rotor and distributing the load along the length of the shaft axis. Some judgment must be exercised *in making these computations in order that too much labor be not entered into* when the conditions of the problem to be considered do not justify the expenditure of a great deal of time.



COUPLING ASSEMBLY

"The sections *A*, *B*, *C* are assumed to be *equivalent to a 3-in. shaft for the reason that the additional weight of the coupling will probably be compensated for by the greater stiffness.* At least the situation is unknown since the stiffness will depend on the accuracy of the fit. Furthermore, *taken one way or the other the critical speeds resulting will not be noticeably different.*"

My argument was made entirely with reference to weights, although I can readily see how one referring only to the last few lines might interpret these as relating to stiffness. With the assumption of a solid block of metal 7 in. in diameter, the stiffness is very different from that of a 3-in. shaft. The deflection diagram clearly shows that the greatest deflection occurs over this section and, therefore, any stiffening of the shaft at this place will noticeably effect the critical speed.

But my opinion and that of other engineers to whom I had submitted this very point is that this particular form of coupling may admit of as much deflection as the solid 3-in. shaft, and my reasons for this conclusion are as follows: The design of the coupling is shown above. To my knowledge Mr. Hoffman has not seen this design in this instance. It is at once evident that this is not a "force fit," as Mr. Hoffman suggests, nor does it parallel the instance cited by Mr. Hoffman in his reference to Stodola. Again, it will be observed that, contrary to Mr. Hoffman's assumption, the moment of inertia is not constant throughout the length of the coupling, but is much less than he assumed for the major part of the length.

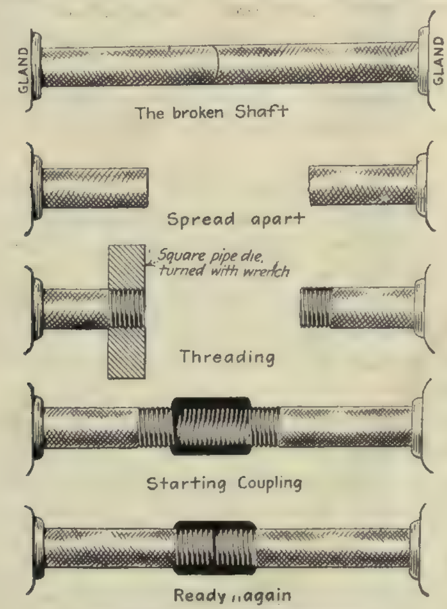
The gripping effect on the two shaft ends is had by the tightening of eight ⅞-in. bolts. The two halves of the couplings, being bored with a 0.005-in. liner between the halves, provide for a firm seating of the two halves on the shaft ends. With this provision it nevertheless remains that the frictional contact provided by tightening the bolts is probably a maximum on that surface of the shaft which is at right angles to the split in the coupling. In the line of the split there is no drawing together and, therefore, no grip of any consequence. When the split is vertical, it appears that the restraint offered is a frictional grip around the neutral axis and thus unfavorable to resist bending, but most favorable to resist longitudinal shear or the tendency to slip. At 90 deg. from this position when the split is horizontal, the grip is most favorable to resist bending, but least favorable to resist longitudinal shear. The coupling, moreover, is not ground internally, nor are the shaft ends fitting in the coupling ground; and, therefore, the nature of the surface contact is uncertain. The bolts are not provided with locknuts, but a cotter pin guards against a complete backing off of the nut. With these elements of flexibility present, I am inclined to believe that the coupling does not afford a much greater stiffness than the continuous shaft. I hope to obtain some experimental evidence in this matter, which I shall be pleased to publish.

Pump-Rod Repair

By J. A. Lucas

The shaft of a large feed pump snapped, as shown in Fig. 1. As we could not shut down the plant for repair and had no other means to feed the boilers, we came to the quick solution here shown.

In order to give us room for the square pipe die to cut the thread as shown, the broken shaft was forced half into the water end, the other half into the steam end. A suitable coupling was screwed on the two ends, and in a very short time the shaft was in commission again. The pump ran until a new shaft was made, this being installed when the plant was shut down in the regular course of events.



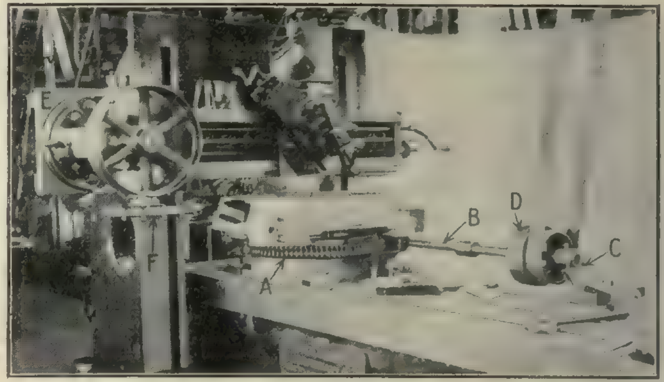
THE PISTON-ROD REPAIR

Turning and Boring Attachment

Special Correspondence

There are many shops that are sometimes called on to do boring and turning jobs that are too large for the lathes at hand. Where there is not enough of this work to warrant the investment in a boring mill, the attachment shown in the accompanying illustration will be found very handy for these odd jobs.

This fixture is of simple construction, similar to circular milling attachments in general use. Part of the table shown at *A* is a worm gear, and is driven by a worm on the end of the shaft *B*. This shaft is supported at the outer end by the bearing *C*, which is bolted to the planer table. Power is obtained through pulley *D*, which is driven from the lineshaft.



A TURNING AND BORING ATTACHMENT FOR A PLANER

The planer shown in the illustration is also equipped with a milling attachment *E* and *F* which is manufactured by the Adams Co., of Dubuque, Iowa. The two attachments make the planer a very useful tool for the small shop.

Grinding Snap Gages

By Allen Knapp

In an article appearing on page 472 entitled "Grinding Snap Gages," a set-up was shown using a thin spacing collar between two saucer wheels, the whole mounted on a wheel arbor, thereby grinding both faces of a gage without removing the wheel and reversing it as is done in some shops.

I have found this method good, but I prefer using a plain wheel of the desired grain and grade dressed to the shape of a T-wheel. It is only necessary to remove a very slight amount of the sides of the wheel in order to secure the proper cutting edges, and the wheel will last for a surprisingly long period. One of the advantages to the credit of the single T-shaped wheel over the former double-saucer type, is that it can be used in a much smaller gage.

The loss of time caused by the reversing of the wheel, together with the loss of wheel's use, made necessary by the subsequent truing certainly prohibits the use of one saucer wheel in grinding snap gages where there is any amount of this work to be done.

I heartily agree with the writer of the article in that there is much needless waste of wheel and time through the careless forming and truing of wheels in many grinding departments.

Utilizing Discarded Geometric Chasers

By W. F. Hirschmann

The three illustrations show how discarded "Geometric" chasers can be utilized, the chamfering tool being exceptionally rigid and in addition saving much time. The whole face can be used, as it is only necessary to loosen the screw and push the blade backward or forward until the complete cutting edge has become dull.

The chaser holder was made to overcome a difficulty that undoubtedly exists in other shops besides my own. Very often, within the past few years, Whitworth, International and millimeter pitch threads have been called for. Toolrooms have been rushed, and the makers of chasers have been unable to furnish their product. Consequently, much of this work has been made on lathes with feed-screw or chasing-bar attachments. In many instances I found that I had the chasers in the diameter specified, but either in U.S.S. or V-thread. I therefore used these chasers, leaving the diameter a trifle large, and then used a chaser of the specified thread (but not the diameter) inserted in the handle to cut the work to the desired form of thread.

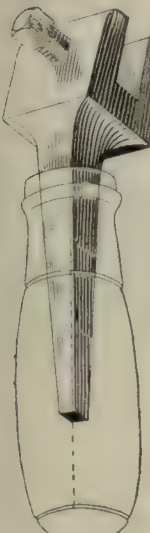


FIG. 1

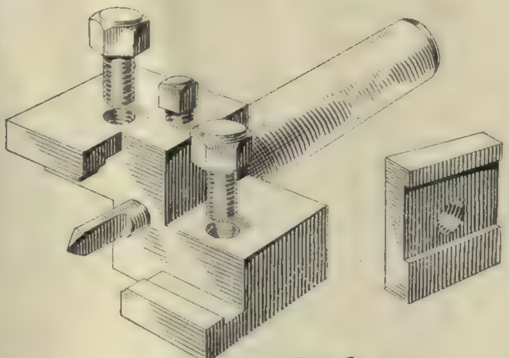


FIG. 2

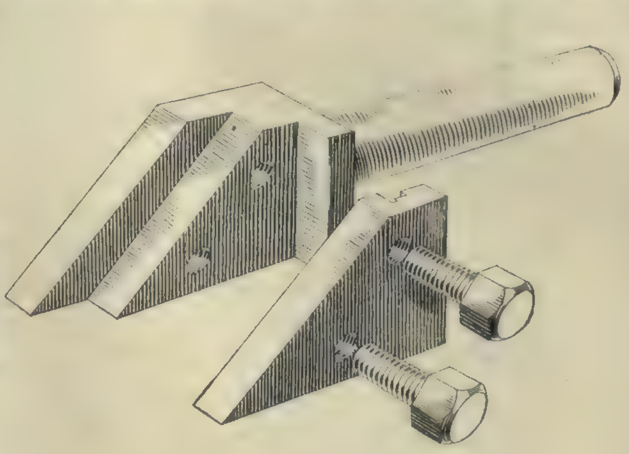


FIG. 3

FIGS. 1 TO 3. HOLDER FOR GEOMETRIC CHASERS, FACING AND CENTERING TOOL AND CHAMFERING TOOL

Grinding Cutters

By A. K. Schwarz

Some weeks ago a man walked up to me asking for a job. He claimed to be an expert tool grinder, and as I needed such a man, I hired him. Among the firms he named as his former employers were some large Eastern concerns. Whether his statement was true or not I do not know; he did not last long enough to make an investigation worth while.

I gave him a special counterbore to grind and specified 3 deg. clearance for the outside and 5 deg. for the end. I soon discovered that the fellow did not know a thing about clearances. Upon being asked how he ground tools before, he answered, "Well, we just ground them until they looked like they had plenty of clearance and let them go."

It is an astonishing fact that some otherwise up-to-date shops permit such primitive methods to exist in their cutter-grinding department. They seem to be satisfied with simply bringing the cutter or tool to a sharp cutting edge, regardless of clearance, land and the number of high teeth. Disk wheel grinding wherever possible is common practice, although it has been proved that the cup wheel is the proper wheel to use. Tools ground in such manner stand up much longer.

Some authority claims to have improved the output of a milling machine 60 per cent. by correcting faulty cutter grinding. I have seen expensive solid side-milling cutters ground on common lathe mandrels. We all know mandrels are taper, which causes the cutter to be out of true sidewise. Let us assume that 0.010 in. of steel must be removed to sharpen the cutter. If the cutter runs 0.005 in. out of true, which is really not the worst case I have seen, then 0.015 in. must be ground away in order to true it up; and if the cutter has to be ground on both sides, or 0.030 in., it is too much ground to waste. Do this about 10 times, then good-by cutter.

Gear cutters and formed cutters seldom receive sufficient care in grinding. A machine-tool builder of Cincinnati, in whose tool-grinding department I was employed about nine years ago, permitted a variation of only 0.001 in. in the height of teeth on those types of cutters.

A thorough inspection of tools that have been ground is necessary to obtain best results and would prevent occurrences like the one I wish to mention. Some time ago, while I was working on the bench, I obtained an end mill from a tool-supply room to rough out a punch. It was my intention to come within about 0.020 in. of the line, and I assumed that any cutter would be ground good enough for the job; but after taking a few cuts, I found out differently. I examined the end mill and found it 0.025 in. taper in about 1½ in. of length, it being small toward the shank. Someone evidently had it ground for a special job, I thought, and obtained another end mill, which was 0.015 in. taper, small at the end.

A good deal of wrong tool grinding is also due to the fact that most so-called universal tool and cutter grinders make frequent changes extremely difficult.

Put the Drafted Mechanics Where They Belong

THE first consideration of every problem must be its relation to the general good and not its effect on any one industry. It is with this in mind that we urge the careful and speedy consideration of the best service which can be rendered by the thousands of mechanics who are in the National Army. Such consideration can result but one way. Mechanics in the army should be detailed to the work for which they are best fitted and in which they can render the greatest service.

□ □

We appreciate the desire to avoid all discrimination, to be absolutely fair to all; but there is nothing fair in leaving to chance the service men are to render!

□ □

The chance drawing of a number by which men happen to be designated to service is not an efficient way to determine the best service they can render.

□ □

We never pick our men for any business blindfolded, even though we do not discriminate for or against any class of men. We realize that some are most valuable in one kind of work, while others excel in an entirely different line. And, if we are to work along modern lines, we must conserve our men even more than we do our other resources.

□ □

Our first draft, with the best of intentions, was selective in name only. But instead of omitting its errors and correcting them in the light of the experience of England and France, the Provost Marshall's department has clung to its first ruling.

□ □

The Ordnance division has been sadly handicapped by a lack of draftsmen and has appealed to the Adjutant General to detail some of the hundreds of draftsmen now in camp, to the very necessary work of designing artillery and ammunition, but in vain; because of this, manufacturers, who had already lost good men in the draft, were requested to release a portion of their remaining staff for this work.

□ □

The same condition now exists with regard to mechanics for the shops at the army bases, somewhere in France. These bases require several thousands of good mechanics, and efforts are being made to secure them from the machine shops of the country, already short-handed in most cases. And at the same time in the various camps there are thousands of good mechanics being drilled for infantry duty who, according to the Adjutant General, cannot be detailed to the work in which they would be of much greater value than they can possibly be in the trenches.

□ □

If the Government demands that the various machine shops give up some of their men, it will be done. But those who feel that they have the best interests of the country at heart, know that it would be a terrible and costly mistake; the same kind of a mistake which both England and France so bitterly regretted when it was too late.

□ □

The shops are already short of good men needed to carry on the huge machine-building program necessary to do our share in the making of guns and of airplanes in large quantities. And without these and other weapons, no army can hope to succeed, no matter how large nor how well drilled it may be.

□ □

Every good mechanic taken from the shop which is building munitions or machinery with which these munitions are made, means a lessening in the output of that shop. It takes away not only one man, but all the knowledge and skill which training and experience have given him. And this training is most difficult to replace at this time.

□ □

New workers, whether men or women, must be trained, and this training can only be done by those who already know the work. With the great demands which are to be made on all our shops when the present program gets fairly started, the necessary dilution of skilled labor by unskilled men and women will tax all our resources. And if the army can take away the men who can teach and train the new hands, our shops are doubly crippled at a most inopportune and dangerous moment.

□ □

The main excuse given for holding these skilled mechanics is that the army needs just this kind of intelligent men for corporals and sergeants. The compliment is appreciated, but the machine-building industry can hardly claim a monopoly of the brains of the country. There are thousands of equally capable men in industries which are less essential at this time, industries which do not and cannot supply the munitions for our boys in France.

□ □

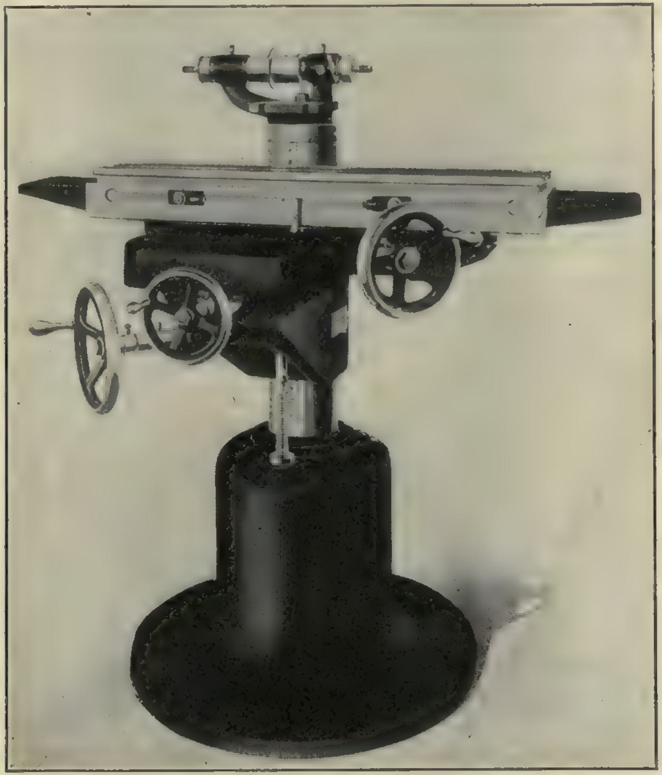
It is not a question of exemption from service, either for the benefit of the man or the shop. We are asking only that such mechanics as are needed for military service be assigned to the duty in which they can be of greatest service to the country; and this is a consideration which has already been too long ignored. Immediate action is needed to prevent further disorganization of industry. The machine industry is at the service of the country. Its only desire is to preserve its capacity—to increase its capacity for service.

SHOP EQUIPMENT NEWS

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Woods Universal Tool and Cutter-Grinding Machine

The Woods Engineering Co., Alliance, Ohio, has recently made a number of improvements on its No. 2 universal tool and cutter-grinding machine which is illustrated. The machine is furnished either for belt drive as shown, or with a self-contained motor drive.



TOOL AND CUTTER-GRINDING MACHINE

Longitudinal travel, 22 in.; cross travel, 7½ in.; vertical travel, 10 in.; maximum distance between centers, 22 in.; swing of center, 9 in.; opening between vise jaws, 2⅜ in.; weight, 1000 lb.

The knee is of the box-section type and entirely encircles the column, sliding on a V-key adjustable for wear. Both the elevating and cross-feed screws have micrometer dials. The saddle slides on one V- and one flat-way; the bearing surfaces of which are never exposed at any position of the table. The head may be swiveled through 180 deg. and is provided with a ⅝-in. clamping nut and graduated column. The spindle is of tool steel, runs in phosphor-bronze bearings and is equipped for two speeds. Both horizontal and vertical swivels are incorporated in the headstock, which is provided with a No. 12 Brown & Sharpe taper collet. An internal grinding attachment is supplied, as well as a universal vise and countershaft.

"Samson" Hand and Bench Punches

The "Samson" hand and bench punches are now being manufactured by the Machine Appliance Corp., 351 Jay St., Brooklyn, N. Y. The illustrations show two punches which are applicable for machine-shop work. Fig. 2 shows the No. 1 hand punch which is made in sizes from $\frac{1}{16}$ to ¼ in. in diameter with an opening between the dies of ¼ in. The throat is 1⅜ in. deep, and the capacity of the punch in sheet iron or soft steel is up to 20 gage. Paper, cardboard, leather, etc., up to ¼ in. thick may be handled. If desired, the punch may be furnished with interchangeable dies for various sized holes within the limits specified.

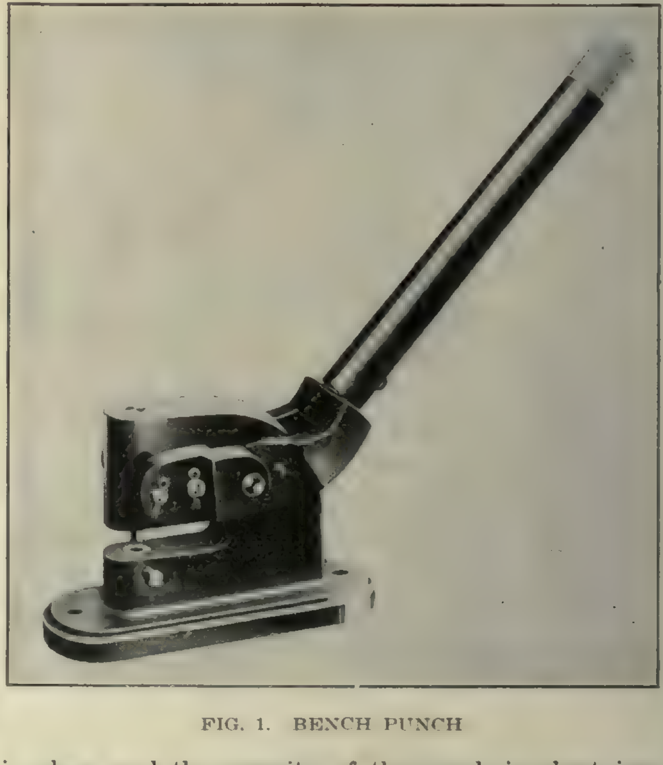


FIG. 1. BENCH PUNCH

Fig. 2 shows the No. 3 bench punch. This is fitted with a compound lever and is of heavy construction, being adapted for sheet iron and steel up to $\frac{1}{8}$ in. thick. Punches and dies are furnished from $\frac{3}{16}$ to $\frac{1}{2}$ in. in diameter, the opening between them being $\frac{5}{8}$ in.

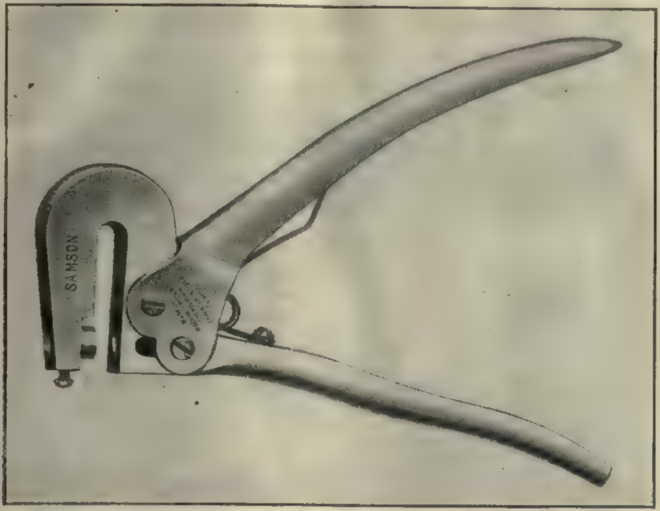


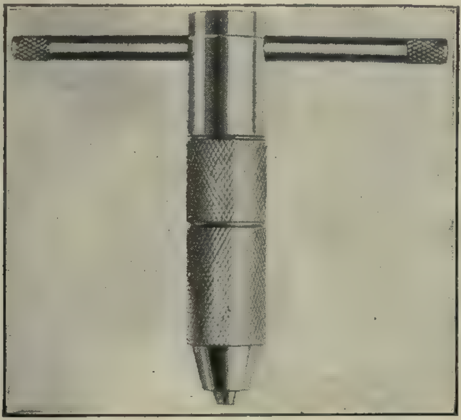
FIG. 2. SAMSON HAND PUNCH

The depth of throat is 3 in. Extra dies may be furnished in sizes from $\frac{3}{16}$ to $\frac{1}{2}$ in. in steps of $\frac{1}{16}$ in. These may be quickly interchanged when holes of the various sizes are desired.

This concern manufactures a various line of hand punches, stamps, etc., which are made in a variety of styles and sizes.

Moss-Ochs Ratchet-Tap Wrench

The ratchet-tap wrench illustrated, is now being marketed by the Moss-Ochs Co., 3387 East 116th St., Cleveland, Ohio. It is made in two sizes: No. 1, with a capacity of $\frac{1}{4}$ in.; No. 2, with a capacity from $\frac{1}{4}$ to $\frac{1}{2}$ in. The T-handle is made sliding to permit operation in corners, but may be held in the center by means of a dog which automatically fits on a flat-milled surface on the handle. The ratchet adjustment for right- or left-hand motion is accomplished by turning the knurled sleeve. The chuck and ratchet are hardened to prevent wear, and the knurling on the chuck sleeve insures a firm hold for tightening or loosening.



MOSS-OCHS RATCHET-TAP WRENCH

"Presto" Blueprint and Drawing Holder

The National Co., 273-279 Congress St., Boston, Mass., is placing on the market a holder for blueprints, records, charts, drawings or newspapers. Fig. 1 shows the top strip of the binder removed for adding new material. The top strip is removed by means of catches shown in detail in Fig. 2. The device is locked by pressing the lever *B* and released by pressing lever *A*. The hardened-steel stud *C* is fastened to the lower strip *E*, and the lever *B* is fastened to the upper strip *D*. The holder may be suspended by means of the hooks shown at the top, and will hold from 1 to 60 prints or papers. It will be noticed that three catches are used, this feature allowing narrow prints to be held firmly. The holders are made in three sizes, 30, 36 and 42 in.

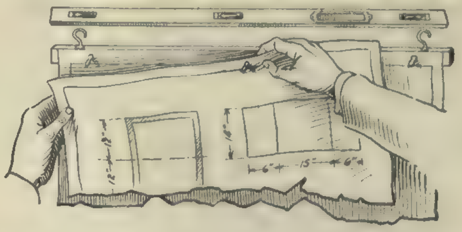


FIG. 1. HOW THE PAPERS ARE INSERTED OR REMOVED

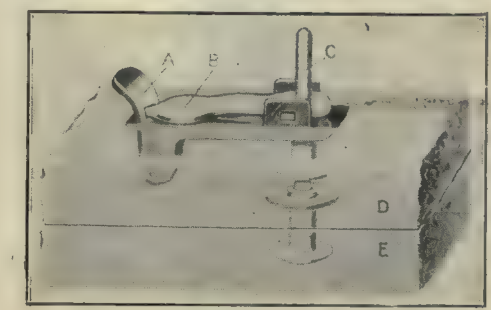


FIG. 2. DETAIL OF THE CATCH

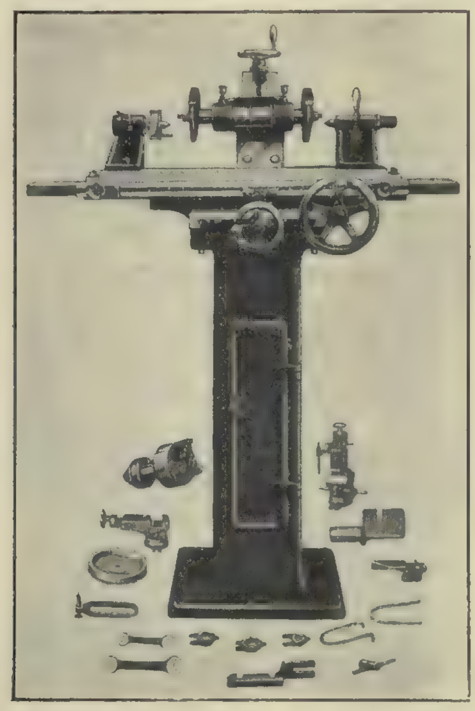
Critchley Improved Expanding Reamers

The illustration shows one of the improved Critchley expanding reamers which have recently made their appearance on the market. These reamers are fitted with six adjustable blades which enables the use of a micrometer for setting to size. The adjustment is made by means of the nuts at the ends of the blades which slide in inclined slots. Each reamer will expand from 0.010 in. to 0.015 in. over its maximum listed size, which permits considerable grinding before new blades are necessary. The adjustment is such that a set of 17 reamers will ream all sizes of holes from $\frac{15}{32}$ to $4\frac{1}{16}$ in. These tools are the products of the Cutter & Wood Supply Co., 68-70 Pearl St., Boston, Mass.

CRITCHLEY IMPROVED EXPANDING REAMERS

Draper & Hall Universal Grinding Machine

One of the latest universal grinding machines to make its appearance on the market is illustrated. It is the product of the Draper & Hall Co., Middletown, Conn. It is adapted to grinding cutters, reamers, counterbores, taps, end mills, arbors, gages, etc., as well as to internal and surface grinding. The table has no overhang, being supported its entire length by the longitudinal slide, which in turn, rests its entire length upon the main column. One end of the table is graduated to allow settings for taper per foot, while the other end is graduated in degrees. The spindle is of 60-point carbon steel, $1\frac{7}{16}$ in. in diameter, and is equipped with taper white bronze bearings protected from dust by means of felt washers. The headstock is universal, and a hand-table, chuck and special milling-cutter grinding attachment may be attached to it. One of the special features of the machine are the attachments, which it is claimed make the machine quickly adaptable to various types of work. The standard equipment includes universal vise, 3-in. chuck, V-combination attachment, internal grinding attachment, hand-table, adjustable tooth rest, tooth-rest holder for spiral cutter, three dogs and two wrenches. A magnetic chuck can be furnished as an extra.



D. & H. UNIVERSAL GRINDING MACHINE

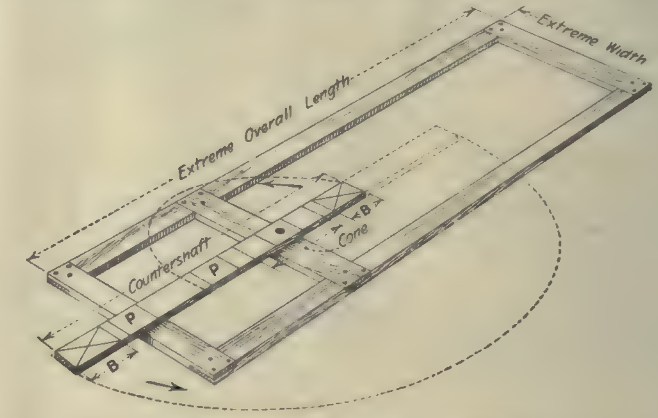
Swing, 8 in.; longitudinal feed, 18 in.; distance between centers, 17 in.; cross-feed, 7 in.; vertical adjustment, 7 in.; top of platen. 26 x 4 in.; grinds cutters on combination, 12 in. in diameter; diameter of wheels, 6 in.; weight complete with attachments and countershaft, 700 lb.

Moving Machinery

By Oscar E. Koehler

When it is necessary to move machinery from one room to another, it is of course desirable to have the machines running again as soon as possible. Quite frequently there is a delay, due to the fact that the draftsman overlooked an obstruction that prevented setting some machine as planned. Then the rest of the machine layout is generally upset.

The writer had occasion not long ago to transfer a large number of lathes from one room to another. The lathes were of various makes and sizes; in fact, no two were alike. The room into which they were going contained some machinery, somewhat scattered, and suspended from the ceiling were rails with a beam trolley that sustained a Triplex block for lifting. To arrange the lathes so as not to interfere with the machinery already in place and yet locate the countershafts so that the belts would not interfere with the trolley-rail hangers would have presented a difficult job to any draftsman. The obstructions and interferences seemed innumerable. To overcome the difficulty, the writer had a carpenter make frames or dummies of wood, as shown, to represent the maximum width and length of the outermost portion of each lathe. On a single board the exact length of the countershaft were marked the bearings *B*, friction pulleys *P* and cone in their respective positions. A crosspiece was fastened on the frame at the center of the headstock-cone location. A spike driven through the center of the countershaft and headstock cones made the countershaft, friction pulleys and hangers (bearings) movable to either side of the cone, as any particular condition might necessitate.



SAMPLE OF MACHINE DUMMY

When all the frames were made, each one was put on the floor, and location sighted for its countershaft. The dummies were moved around in various combinations until a favorable layout was established. There they were left until the actual machines were brought in, and one by one the lathes were set up and started. This plan worked very successfully and was much cheaper than having a draftsman lay out the shop plan and miniature machine diagrams on the drawing board. When the transfer of machines was completed, the frames were dismantled and the boards were used for boxing.

"Hartford" Diamond-Tool Holder—Erratum

In the description of the diamond-tool holder, manufactured by the National Machine Co., 111-135 Shelton St., Hartford, Conn., on page 783, and in the Condensed Clipping-Index card on page 835, the size of tools held should be from $\frac{5}{16}$ to $\frac{17}{32}$ in., instead of from $\frac{5}{16}$ to $\frac{7}{32}$ in., as printed.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Dec. 8, 1917—The very important question of transportation affects the machine shop so vitally that any information in regard to it is of particular interest at this time.

In addition to the movement which is on foot to increase the use of motor-truck transportation, particularly by urging the improvement of existing highways, it is interesting to note what is being done by the Railroads' War Board and to see what can be accomplished by complete coöperation in the matter of a public utility such as transportation. The delays in securing rail shipments are not only exasperating but they delay the production of munitions of various kinds; and to the man whose form of service involves travel from place to place, the habitual lateness of the trains, particularly in and out of Washington, is causing considerable loss of time.

It is not fair, however, indiscriminately to condemn the railways, because more than ever before, they are earnestly striving to carry out their part of the war program. Duplicating trains are being eliminated from competing roads, trains *de luxe* are being withdrawn, and so far as possible the work of transportation is being handled as fully and rapidly as the equipment permits.

MOVE FREIGHT WITHOUT INCREASED EQUIPMENT

In spite of embargoes and the limitation of shipments on some classes of goods, the freight tonnage has increased 16 per cent. over the corresponding period of last year. Some idea of the increase during the past 10 years may be had from the fact that for the six months ending in September the railways handled more freight traffic than in any entire year prior to 1907. In coal alone there were moved 150,000 more carloads of anthracite than within the same six months for 1916, making an increase of 18 per cent. Curiously enough there was the same increase in the hauling of bituminous and lignite coals, only in this case it meant the hauling of 751,000 more carloads than in the same period of last year.

In addition to this, a total of 116,000 carloads of freight have been hauled to the National Army and National Guard camps; there were also more than 17,000 carloads of freight handled for the Civic Board. The advantages of the coöperation which is now being secured, and which means the elimination of competition in railway transportation, is indicated by the fact that all this additional haulage has been done with practically the same equipment and facilities as before.

One of the most gratifying features of the whole situation is the way in which the troops have been handled in addition to an increased passenger traffic—which by the way has been the largest ever known. Between Aug. 1 and Nov. 12, 1 200,000 soldiers were transported to training camps, cantonments, and points of embarkation. This troop movement involved the use of approximately 2750 special trains. This large passenger traffic and troop movement have complicated matters and increased the difficulty of the freight traffic which included the moving to training camps and cantonments about 75,000 carloads of supplies per month.

SLEEPING CARS FOR SOLDIERS

One interesting feature in connection with the movement of troops is the fact that, with very few if any exceptions, troops which had to be in transit during the night have been provided with either tourist or regular Pullman sleepers. Such a method of moving troops has never been employed by any other country, and it will be remembered that the German military officials pointed to our use of sleeping cars for troops as an evidence of our lack of military fitness. They are in a fair way to change their minds in a few months.

On one of the long hauls 8000 men were moved from a training camp on the Pacific Coast to a point on the Eastern Coast, a distance of 3700 miles in less than a week. This contingent traveled in 16 sections each consisting of 12 tourist cars and 2 baggage cars. In order to do this the Pullman company changed the supervision of the supply and movement of these cars, from their headquarters in Chicago to Washington. Here they have stationed an assistant to the superintendent, with headquarters in the office of the Railroads' War Board, where he is in daily touch with the office of the Quartermaster General.

SECURING SLEEPING CARS

On receipt of requests from military authorities for sleeping-car equipment, the latter is immediately secured by wire and rushed to the point needed. As a result of this coöperation, half a million of our soldiers have been spared the discomforts of making long train trips in day coaches. It is also gratifying to note that there have been practically no casualties in transportation. The railroads have adopted an average speed of 25 miles an hour for all troop trains, except where freight cars needed for the transportation of equipment are incorporated in the trains. In such case the speed is reduced to 20 miles per hour.

While the machine-building industry has been subjected to more or less delay in transportation, it is particularly fortunate in not having any of its supplies placed under the ban as has happened in a number of other instances. All told, there are over 500 commodities which cannot secure transportation as long as there is other material to be hauled. The embargoed list is made up of products which it is believed the public can forego without any considerable inconvenience. This curtailment has become compulsory because unless the unnecessary commodities are eliminated, it is impossible to handle the necessities.

Priority of shipment is naturally given to those things which are most needed such as fuel, the minerals, machinery of various kinds, and munitions of war; together with foodstuff, necessary clothing, and similar products. The increase of freight traffic handled, is considered equivalent to the addition to 5000 locomotives and nearly 400,000 cars to the number formerly in service; and it is difficult to secure additional equipment for railroads because it is thought by the majority of those in authority that the national welfare demands that the output of iron and steel mills and railway equipment concerns is more needed in other quarters. Add to this the loss in skilled men taken by the draft, the fact that it has not been possible to secure a sufficient number of men in many departments, and other problems which have confronted the railways, and it will be seen they have been doing extremely well with the equipment and facilities at their command.

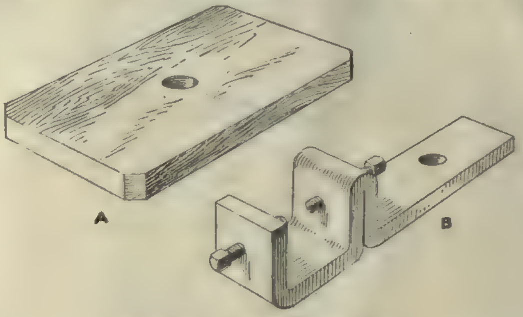
Truing Light Rings

By Martin H. Ball

The accompanying illustrations show fixtures for truing and holding, while turning, rings of light section which would be liable to spring if ordinary chucking methods were used.

Four hardwood blocks like *A* are bolted to the faceplate at such a point that either their inside or outside ends will not quite allow the ring to pass through them or outside of them, as the case may be.

The corners of the blocks should be chamfered off as shown, to prevent slivering off when turning; and they should be placed so that the end of the grain will bear against the work. Then with a keen cutting tool they are turned or bored to a size that fits the work closely, but not hard enough to spring it, thus locating the work very accurately, which can then be clamped directly to the faceplate.



RING-HOLDING DEVICES

A simple clamping device that can often be used to advantage is shown at *B*. It is made of flat iron, bent as shown, with a hole for a clamping bolt and two setscrews to clamp the work to it. The setscrews should be set tight against the work before clamping the fixture to the faceplate.

For finishing cuts on extremely light rings, enough blocks are sometimes used to make nearly a complete circle. The fitting is done so closely that the work will crowd over rather hard, and no further clamping is required, the friction between the blocks and the work being enough to sustain a light cut.

Personals

L. B. Moses has accepted a position as second vice president in charge of the rail department of the Walter A. Zelnicker Supply Co., St. Louis, Mo.

J. W. Hook was recently elected president of the Amalgamated Machinery Company of America, with headquarters at 120 Broadway, New York City.

J. H. Schneider, assistant superintendent in charge of special organizations and engineering work at the Gurney Electric Elevator Co., Honesdale, Penn., has accepted a position as head of the efficiency department of the American Tool Works Co., Cincinnati, Ohio.

Business Items

Goddard & Goddard Co. is the new name of the Gorham & Goddard Co., 39-45 Congress St., West Detroit, Mich., L. C. Gorham having retired from the firm.

The Wagner Electric Manufacturing Co., St. Louis, Mo., announces the opening of a sales office at 129 Church St., New Haven, Conn. The office will be in charge of C. M. French, formerly representative at Springfield, Mass.

The Ideal Machine & Tool Co., Cincinnati, Ohio, has purchased the machinery and tools formerly belonging to the New World Manufacturing Co. and have also installed considerable new machinery. Their capacity for special machinery tools, dies, gages, lathes and grinders has been doubled.

Trade Catalogs

Surface Grinding Machine. Abrasive Machine Tool Co., East Providence, R. I. Circular. Illustrated.

Connecticut Universal Grinding Machine. Middlesex Machine Co., Inc., Middletown, Conn. Circular. Illustrated.

Recuperative Gas Oven Furnaces. Tate-Jones & Co., Inc., Pittsburgh, Penn. Bulletin No. 160. Pp. 12; 8 x 11 in.; illustrated.

Hall Universal Counterbore, End-Mill, Hollow-Mill or Boring Tool. The Hall Manufacturing Co., Abington, Mass. Circular. Illustrated.

Beaver Die Stocks, Pipe Cutters, etc. The Borden Co., Warren, Ohio. Catalog No. 13. Pp. 32; 6 x 9 in.; illustrated. This is a very attractive catalog and shows several new tools.

Toolholders, Expanding Mandrels, Vises, Shop Furniture, Lathe Dogs, etc. Western Tool & Mfg. Co., Springfield, Ohio. Catalog No. 18. Pp. 96; 4½ x 7½ in.; illustrated.

Saws. Sammy Showme Saw is the title of a pamphlet issued by the Simonds Mfg. Co., Fitchburg, Mass., which tells in an interesting way of the visits of a representative of the company to different shops using Simonds saws.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Feb. 7, 8 and 9. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

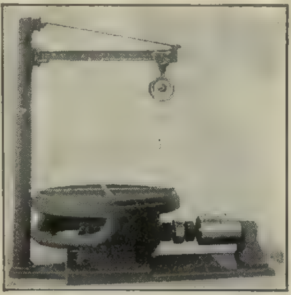
Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Grinding Machine, Disk, Vertical Spindle

Gardner Machine Co., Beloit, Wis.

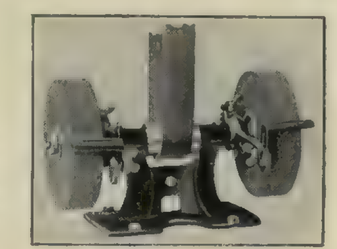
"American Machinist," Nov. 29, 1917



This machine is provided with a jib crane for loading, and can be furnished for either belt or motor drive. Where the latter drive is used the motor is mounted directly on the base in place of the outbored bearing. Diameter of disk wheel, 53 in.; diameter of spindle, 3⅝ in.; cast-iron flange supporting spindle, 20 in. in diameter by 1⅜ in. thick; diameter of balls in thrust bearing, 1⅛ in.; spindle runs on self-aligning ball bearings; spindle speed, 500 r.p.m.; ratio of bevel driving gears, 2.4 to 1; weight, 4600 lb.

Grinding Stand, No. 306

Luther Grinder Manufacturing Co., 285-289 S. Water St., Milwaukee, Wis.



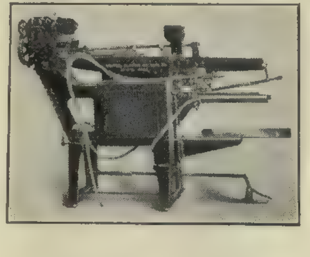
"American Machinist," Nov. 22, 1917

The wheels used are 6 in. in diameter and 1⅜ in. thick, coarse and fine wheels being regularly furnished. The machine is claimed to have extra large bearings. It is intended to be fastened to a bench or heavy table and weighs 15 lb.

Seam-Welding Machine

Thompson Electric Welding Co., Lynn, Mass.

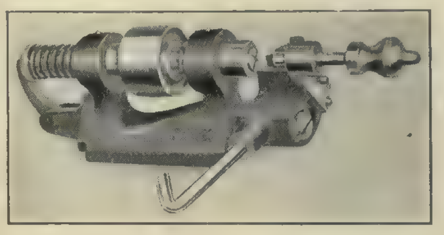
"American Machinist," Nov. 22, 1917



Made in four sizes for seam-welding material not exceeding 16-gage thickness. Machines are known as Nos. 306, 312, 318 and 324, and handle work up to 6, 12, 18 and 24 in. in length respectively. Floor space of 6-in. machine, 96 x 32 in.; weight, 2750 lb. Floor space of 12-in. machine, 78 x 24 in.; weight, 3500 lb. Floor space of 18-in. machine, 84 x 24 in.; weight, 3150 lb. Floor space of 24 in. machine, 90 x 36 in.; weight, 3500 lb.

Shell Trimmer

De Mant Tool and Machine Co., 79 East 130th St., New York City



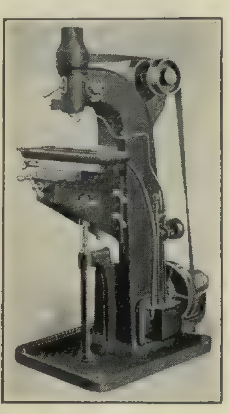
"American Machinist," Nov. 22, 1917

This shell trimmer is semi-automatic and adjustable for trimming shells from ¼ to 2 in. long, and from $\frac{1}{16}$ to ½ in. in diameter. Shells may be fed without stopping the machine. It may also be modified for use in filing and polishing pins and other small articles. Bench space, 6 x 15 in.; weight, 23½ lb.

Milling Machine, High-Speed

Taylor & Fenn Co., Hartford, Conn.

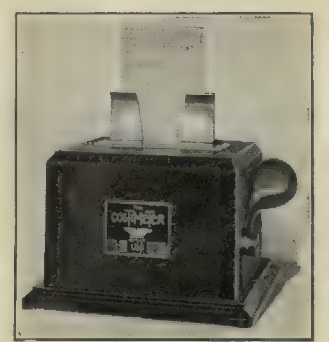
"American Machinist," Nov. 22, 1917



Intended for the lighter classes of vertical milling with high spindle speeds, and is also adaptable for light profiling operations. Longitudinal movement, 11 in.; cross movement, 6 in.; vertical movement of knee, 9½ in.; spindle movement, 2 in.; maximum distance from end of spindle to top of table, 11½ in.; center of spindle to column, 10 in.; size of table, 9 x 21 in.; working surface of table, 6 x 8 in., with ⅝-in. T-slot; size of hole through spindle, $\frac{13}{32}$ in.; taper in spindle, No. 7 B. & S.; number of speeds, eight, 246 to 4000 r.p.m.; floor space, 50 x 30 in.; net weight, 1050 lb.

Time Stamp, "Costimeter"

Costimeter Company, Detroit, Mich.

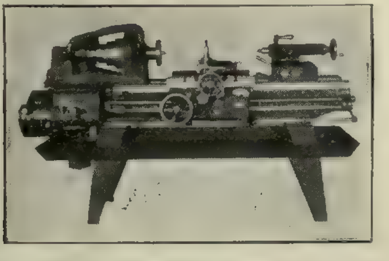


"American Machinist," Nov. 29, 1917

The costimeter is applicable in any case where a job or operation ticket or a daily time card is used, and together with a special wage chart forms a method of ascertaining the time consumption for any job or operation and the wages to be paid for this time. The stamp is rugged in construction and so arranged that the card cannot be inserted in any but the correct position. A program clock is used, which may be arranged for intervals of any desired frequency from one minute up

Lathe, Toolroom

Joseph Crawford, Jr. Company, Erie, Penn.



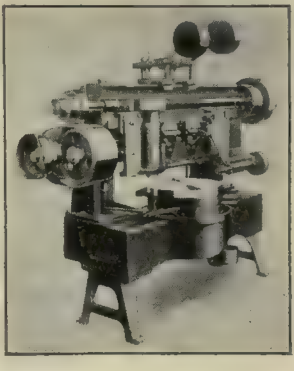
"American Machinist," Nov. 29, 1917

Swing over ways, 16½ in.; swing over carriage, 9½ in.; distance between centers, 34 in.; diameters of cone pulley, 4, 5½, 7, and 8½ in.; width of belt, 2¼ in.; hole through spindle, 1¼ in.; front bearing, 2⅝ x 4½ in.; rear bearing, 2¼ x 3¼ in.; diameter of tail spindle, 1⅞ in.; ratio of back gears, 8½ to 1; centers, Morse No. 3; center spindle sleeve, Morse No. 5; net weight, 1900 lb.

Milling and Drilling Machine

Moline Machinery Co., Moline, Ill.

"American Machinist," Nov. 29, 1917



Designed to accomplish both milling and drilling operations at one setting of the work. The table is of the continuous-operation, six-station type. Number of spindles, 1 milling and 3 drilling; diameter of work table, 22 in.; horsepower required, 5½; floor space, 96 x 36 in.; maximum height, 6 ft.; distance from floor to top of table, 36 in.; shipping weight, 5900 lb.

Patent Applied For

WEEKLY PRICE GUIDE O

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Dec. 7, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$33.00	$23.00
No. 2 Southern Foundry, Chicago	33.00	33.00	30.00
*Bessemer, Pittsburgh	37.25	36.30	35.95
*Basic, Pittsburgh	33.00	33.00	30.95
No. 2X, Philadelphia	33.75	33.75	29.50
*No. 2, Valley	33.00	33.00	31.00
No. 2, Southern Cincinnati	35.90	35.00	25.90
Basic, Eastern Pennsylvania	33.75	30.00	30.00

*Delivered Pittsburgh; f.o.b. Vallley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Dec. 7, 1917	One Month Ago	One Year Ago	Dec. 7, 1917	One Year Ago	Dec. 7, 1917	One Year Ago
Structural shapes	$4.20	$5.25	$3.75	$4–4.04	$3.85	$4.20	$3.70
Soft steel bars	4.10	5.00	3.75	4–4.04	3.85	4.10	3.60
Soft steel bar shapes	4.10	5.00	3.75	4.14	3.85	4.10	3.60
Plates, ¼ to 1 in. thick	4.45	10.00	4.75	4.39	4.50	4.45	3.60

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Dec. 7, 1917	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York	4.25	3.75
Warehouse, Cleveland	3.95	3.70
Warehouse, Chicago	4.10	3.65

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Dec. 7, 1917	One Month Ago	One Year Ago	Dec. 7, 1917	One Year Ago	Dec. 7, 1917	One Year Ago
*No. 28 black	5.00	6.445	9.00	5.25	6.45	4.75	6.445	4.75
*No. 26 black	4.90	6.345	8.90	5.15	6.35	4.65	6.345	4.65
*Nos. 22 and 24 black	4.85	6.295	8.85	5.10	6.30	4.60	6.295	4.60
Nos. 18 and 20 black	4.80	6.245	8.80	5.05	6.25	4.55	6.245	4.50
No. 16 blue annealed	4.45	5.645	8.20	4.85	5.65	4.45	5.645	4.50
No. 14 blue annealed	4.35	5.545	8.10	4.75	5.55	4.35	5.545	4.40
No. 12 blue annealed	4.30	5.495	8.05	4.70	5.50	4.30	5.495	4.30
No. 10 blue annealed	4.25	5.445	8.00	4.65	5.45	4.25	5.445	4.25
*No. 28 galvanized	6.25	7.695	10.50	7.25	7.70	6.50	7.695	6.75
*No. 26 galvanized	5.95	7.395	10.20	6.95	7.40	6.20	7.395	6.45
No. 24 galvanized	5.80	7.245	10.05	6.80	7.25	6.05	7.245	6.30

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Dec. 7, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Dec. 7, 1917	One Year Ago
New York	$15.00	$7.50
Cleveland	15.30	7.50
Chicago	15.00	5.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*	
3/8, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

* Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Dec. 7, 1917	Cleveland Dec. 7, 1917	Chicago Dec. 7, 1917
Tire	5.00	5.00	4.04
Toe calk	5.70	5.50	4.35
Openhearth spring steel	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Coppered bessemer rods	9.00	....	....

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Dec. 7, 1917	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	36.00
Tin, in 5-ton lots	80.00	74.00	43.00
Lead	6.50	7.25	8.00
Spelter	8.00	7.88	11.75

*Government price.

ST. LOUIS

	Dec. 7, 1917	One Month Ago	One Year Ago
Lead	6.37½	7.13	7.80
Spelter	7.75	7.63	11.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Dec. 7, 1917	One Month Ago	One Year Ago	Dec. 7, 1917	One Year Ago	Dec. 7, 1917	One Year Ago
Copper sheets, base	35.00–37.00	35–37	41.00	35.00	45.00	35–36	42.00
Copper wire (carload lots)	36.00	36.00	36.00	31.00	44.00	33.50	36.50
Brass pipe, base	38.50	38.50	47.50	46.50	52.00	41.00	46.50
Brass sheets	35.75	35.75	45.50	34.00	47.00	35.00	44.00
Solder ½ and ½ (case lots)	40.50	40.50	27.50	43.25	28.25	41.00	28.25

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Dec. 7, 1917	One Year Ago
Mill	$29.00	$42.00
New York	30.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

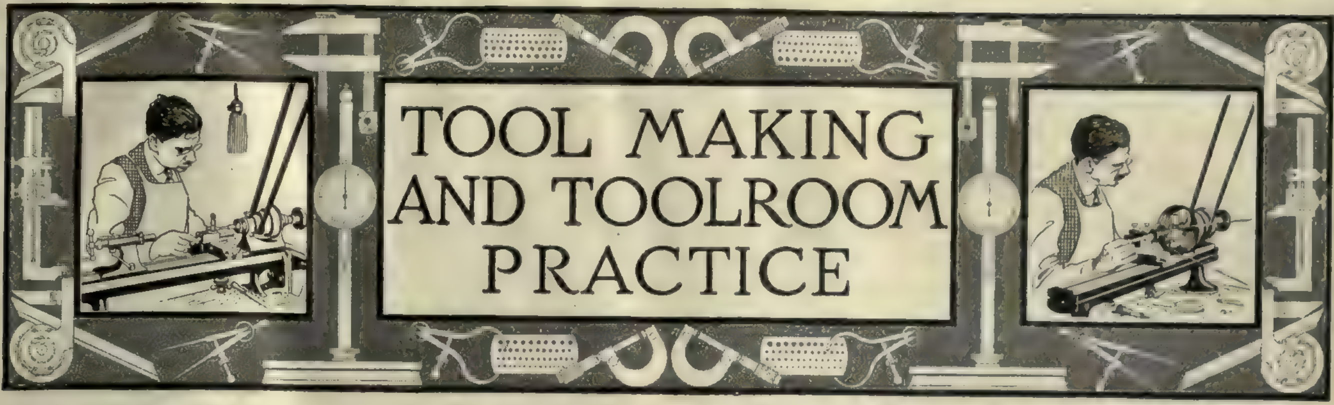
ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Dec. 7, 1917	One Year Ago	Dec. 7, 1917	One Year Ago
Cleveland	21.00	23.00	21.25	23.25
New York	20.00	22.00	20.50	23.00
Chicago	21.00	22.75	21.50	23.25

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Dec. 7, 1917	One Year Ago
New York	15.00	14.75
Cleveland	17.00	16.00
Chicago	16.00	15.00



The Inspection of Screw Gages for Munitions of War

By H. J. BINGHAM POWELL
M. Am. Soc. C. E., M. Inst. C. E., M. I. Mech. E.
Inspector in Charge, Department of Gages and Standards, British Ministry of Munitions of War in United States.

This is published to assist screw-gage manufacturers in their work of making gages for munitions of war, which have to be accurate within very low tolerances. The necessary accuracy can only be attained by the manufacturer possessing certain essential instruments for the inspection of his product, and this article describes such equipment, and desirable methods of inspection.

IN THIS article the terms employed for the ruling diameters of a screw will be those adopted by the Engineering Standards Committee of Great Britain in its report entitled "Report on British Standard Systems for Limit Gages for Screw Threads," and now used by the Gage Department of the Bureau of Standards, Washington, D. C., as follows: "Full" (or major) diameter; "effective" (or mean) diameter; "core" (or minor) diameter, corresponding respectively to the terms "outside," "pitch" and "root" diameters usual in the United States.

For both ring and plug-screw gages, the core diameter is the smallest diameter and the full diameter is the largest diameter of the screw.

Also, on the same authority, the word "pitch" is employed for the distance from thread to thread.

The Measurement of the Pitch

Until recently, the matter of the accuracy of pitch of screw gages has been almost entirely neglected, attention in the inspection of such gages being given only to the correctness of the ruling diameters of the thread—that is, to the core, effective and full diameters.

The reason for this disregard of the pitch has been the want of an instrument which can measure it from thread to thread, in a rapid and exact manner, without bringing into the result the "personal equation" of the operator. The measurement must be made with great exactness, since any error in the pitch of a plug screw requires that the pitch diameter be reduced by about twice the amount, in order that the gage may function in an identical way to a similar gage with the proper pitch. In a ring-screw gage the pitch diameter must be increased in a corresponding manner.

Within the last two years, however, the question of pitch has forced itself to the front because of the accuracy required in the screw gages used on munitions work, where the allowances for incorrectness of workmanship of the product are very small, being a matter of only a few thousandths of an inch, as a rule—especially in fuse work. For example, a very important gage used on the British shell is that which checks the screw in the nose, into which the fuse is fixed. This is a "go" or "low" plug gage, and the tolerances for the accuracy of the gage are as follows:

$$\text{Tolerance} \begin{matrix} +\,0.0003\text{ in.} \\ -\,0.0006\text{ in.} \end{matrix} \Big\} \begin{matrix} \text{Range} \\ 0.0009\text{ in.} \end{matrix}$$

$$\text{If the error in the pitch} = 0 \left\{ \begin{array}{l} \text{Normal effective diameter: } 1.9513\text{ in.} \\ \text{Maximum effective diameter: } 1.9516\text{ in.} \\ \text{Minimum effective diameter: } 1.9507\text{ in.} \end{array} \right.$$

If the Error in the Pitch Is In.	Limits of Effective Diameter	
	High, In.	Low, In.
±0.0001	1.9514	1.9507
±0.0002	1.9512	1.9507
±0.0003	1.9510	1.9507
±0.0004	1.9508	1.9507
±0.00045	1.9507	1.9507

Thus, for each 0.0001 in. error in the pitch of the plug gage, the gage maker reduces his "high" limit of the tolerance for the pitch diameter by 0.0002 in.; and finally, if the error amounts to 0.00045 in., he has no tolerance left on the pitch diameter, but must make it to the low limit. In practice, an error in the pitch of more than 0.0002 in. ought not to be exceeded, in order to leave sufficient margin (0.0005 in.) of tolerance for the effective diameter, to meet workshop requirements.

Errors in the pitch are of two kinds:

1. "Variable" error; that where the distance from thread to thread varies in an erratic manner. This is generally due to distortion after hardening (through want of proper seasoning, to permit the molecular structure of the steel to come to a stable form. The great demand for gages during the war has prevented sufficient time being given to seasoning, and the distortion that arises affects not only the pitch but also

the "roundness" of the screw), or to faulty adjustment of the thrust bearing of the lead screw of the lathe or grinding machine. This is the most common defect in pitch found in the United States.

2. "Progressive," or gradually increasing, error is due to a bad lead screw or else to the lap used for finishing the gage not having an identical pitch to that of the lead screw on the machine in which the gage was made.

The latter cause of bad pitch shows the necessity of making both the lap and gage on the same lathe or grinding machine.

In practice, both kinds of error in pitch usually occur in combination; thus a variable error is the resultant, since the positive progressive error is reduced or increased in places by variable errors of the opposite or same sign.

The maximum error in pitch between thread and thread, or over a number of threads, is the ruling error in determining the reduction to be made in the effective diameter, and is the weakest link in the chain which determines the fate of the gage in that respect. Until recently, it was a common practice to stipulate the maximum error in pitch permissible over a given length of thread, such as ½ in. or 1 in. This is a very incorrect manner of specifying the correctness of the pitch, since thereby an assumption is made that the error is of the progressive type, whereas, as already indicated it is usually not so. In fact, with the common form of variable error in pitch, cases may happen where a positive error between a thread or two is annulled a little further on by a similar negative error, and over ½ in. or 1 in. the resultant error would measure as zero.

Devices for Measuring Pitch

There exist a number of devices to measure the pitch, based on the idea of measuring over a given number of threads. For example, sometimes two blocks, similar to Johansson blocks, are used with their ends ground to a triangular form of the same included angle as that of the screw to be checked; between these are placed Johansson blocks to give the correct distance corresponding to the number of threads over which the measurement is to be made. The piece is then inserted into the screw and the bearing of the points on the slopes of the screw observed under a magnifying glass; if the bearing is not satisfactory, the Johansson blocks are changed for others differing by the number of tenths of a thousandth of an inch considered convenient to give the desired bearing. The objection to this method of measuring the pitch is the personal equation brought in by the observer having to watch by eye for the proper bearing of the points in the thread, and further the fact that the points cannot be brought near enough together to measure between adjacent threads, because the blocks have to be of a certain minimum thickness.

Another instrument has two V-pointed pieces, one of which is fixed and the other movable, parallel to the first. The movable point is connected to a long lever arm which moves over a scale graduated to give readings in thouandths of an inch. The screw is inserted between centers and gradually raised to the V-point, being turned on its axis, meanwhile, until both of the V-points bear evenly in the thread. The bearing is observed under a magnifying glass, assisted by a light fixed behind the screw. This instrument does not give readings reliable to more than 0.0002 or 0.0003 in., and further the pitch is measured on the fixed distance of ½ in.

The Taylor gage presented to the Engineering Standards Committee by the designer is based on two fixed V-points at a given distance apart and is used by watching the bearing of the points in the screw.

There are numerous other devices of a similar nature, which all suffer from the fundamental defects noted in the instruments described.

Pitch from Thread to Thread

There are a few machines to measure the pitch from thread to thread, but have the defect that the accuracy of the operation depends on the care taken by the user. Such instruments have the general form of a V-point attached to a bar, at right angles, in such a way that the point can freely fall in the proper direction into the screw, the latter being held in a position parallel to the bar by centers. The bar is attached to a micrometer head, and thus the V-point can be advanced along the screw until its adjustment between the slopes of the thread is satisfactory, as seen under a magnifying glass, aided by a light placed behind the screw. This device is certainly better than any yet described, but two sources of inaccuracy are apparent; first, there is no absolute certainty that the V-point is bearing equally on both slopes of the thread, as it must to obtain the true pitch; and secondly, the V-point may have a little side play, due to its not being rigidly attached to the bar connected with the micrometer head, and so falsify the reading of the latter.

In England a very ingenious manner of overcoming these troubles has been found by Mr. Vidal and used in his patented pitch-measuring machine. For the V-point is substituted a ball, so that it can bear evenly in the thread whatever the inclination of the spindle to which it is fixed, and the ball is split, with a lamina of mica interposed to insulate the two portions. Electric circuits are made between the halves of the ball and the screw, and will only close when the ball is touching the slope of the thread on both sides. The spindle with the ball is connected to a longitudinal carrier of a triangular truss form with a spring arranged to press it toward the screw, and so keep the ball in continual light contact with the thread. The adjustment given by the spring is so delicate that the carrier can be blown away from contact by the breath. The carrier is attached to a micrometer head. This instrument has certainly overcome the defects mentioned as inherent to the other pitch-measuring devices described. Also, to obtain a perfect contact with the screw, the latter and the ball must be quite clean and free from all grease, since otherwise the electric circuit will not close. This incidental condition of working gives a further guarantee of accuracy, because the operator of the instrument always knows that he is obtaining a true contact on the thread, without a film of oil intervening.

A very good pitch-measuring machine, Fig. 1, is used in England by the National Physical Laboratory, the Department of the British Government in charge of the inspection of gages. The following description is from an article published in *Engineering* on Sept. 15, 1916.

by Sir R. T. Glazebrook, director of the laboratory: "The screw is mounted on centers of a stiff bed which carries a saddle sliding parallel to the line of centers. The feeler carried by the saddle takes the form of a small spherical ball at the end of a bent lever. The ball is held pressed into the threads of the screw by a light spring, and as the saddle is traversed along the ball moves to and fro, always remaining in contact with the screw. The ball is too large in diameter to reach the bottom of the thread. In its motion it slides down one flank of the thread until it is arrested by contact with the opposite flank, when it immediately begins to move up this flank; this change of motion is very sharply defined. By noting on the micrometer screw the positions of the slider at which these changes of motion take place, we clearly have a means of measuring the pitch of the screw. To effect this, a mirror is attached to the arm carrying the small sphere and rotates backward and forward as the arm moves. A spot of light reflected from the mirror on to a scale moves in one direction then stops and moves back; after a time its motion is again reversed and so on. The sharp reversals caused by the point of contact of the sphere passing from one flank of the screw to the opposite flank are clearly defined, and by their means an accurate measure of the pitch is obtained."

By a suitable arrangement of the feeler, the pitch of ring-screw gages can be measured, the gages being fixed on a faceplate at the end of the instrument.

An instrument of this design has been made by the Bureau of Standards and installed in the new laboratory for testing gages. The working drawings from which the machine was made were lent to the Bureau by the National Physical Laboratory. This is an accurate instrument and interesting to watch working; the way in which the ball feeler goes down the side of the thread across to the other slope and then over the crest being very beautiful in action.

The writer of this article has been studying the problem of measuring the pitch of the screw gages for some time. All the instruments described were carefully considered for use in the gage laboratory of the Inspection Department of the British Ministry of Munitions of War in the United States with the view to adopting one of them, or possibly improving the design of one of the types. A machine of the design with two V-points, one of which is connected to a lever moving over a scale, came into his hands. The machine originally carried the screw gage on a V-block, which was pushed against the points, along inclined ways. This manner of supporting the gage is clearly not satisfactory, as the V-block had to be raised by hand and the motion was not sufficiently under control to bring the screw gradually against the points, as is desirable, to get satisfactory results. Also the screw was not restrained from horizontal movement in the block. The latter was therefore removed and a carrier with centers, raised by a screw, substituted. As modified, the instrument gave fair satisfaction in obtaining the pitch over ½ in. of thread, but for the reasons already noted, the readings so obtained were not of great value.

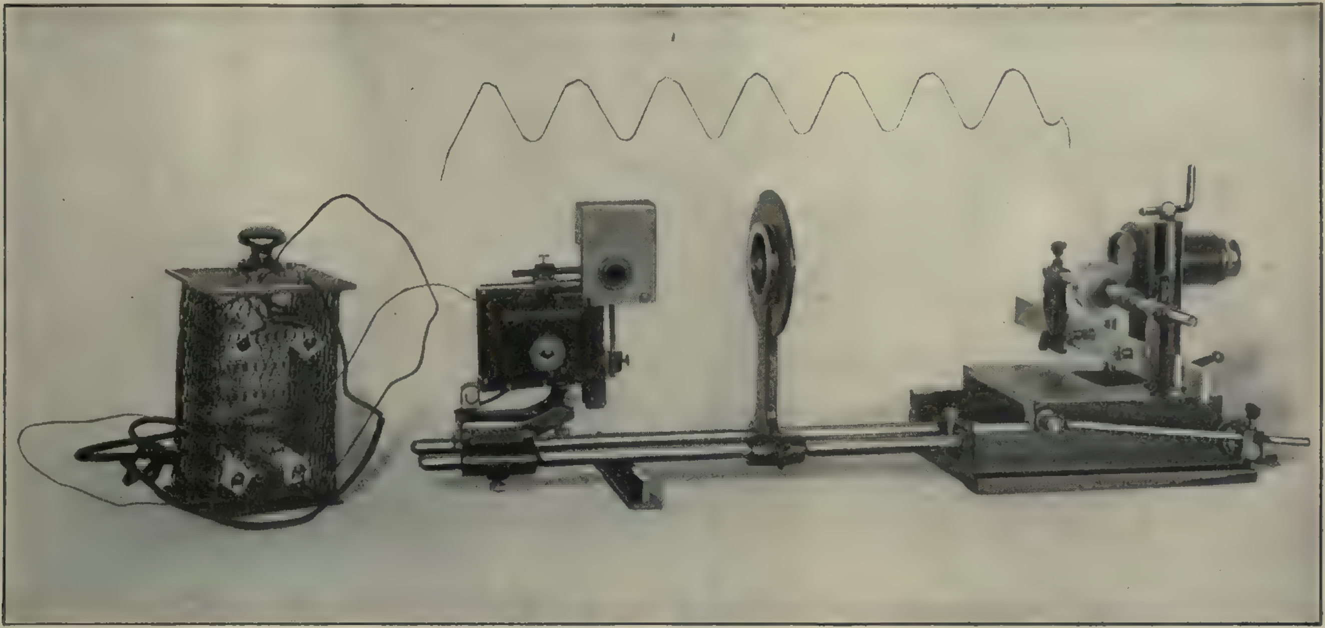


FIG. 1. NATIONAL PHYSICAL LABORATORY PROJECTION MACHINE

Meanwhile, the need for a pitch machine to measure from thread to thread became a pressing one, especially for inspecting the gages being purchased in this country for export to England, for which the specification is very definite in the requirement of an error in the pitch being compensated by the limits of the pitch diameter being reduced. A machine was promised from England to the design of the National Physical Laboratory, but there was great delay in sending it, owing to the pressure at which all departments are working to meet the demands of the war. Thus the writer decided to design a machine of his own, which will now be described somewhat in detail.

The principal matter that impressed him in all the existing designs was the various devices for assuring that the V-points or ball-pointed spindle resting in the screw bore equally on both sides of the thread; in all cases this depended on visual inspection, electric contact, or reflection from a mirror on the scale. The writer believes that a more convenient way to design the bearing on the thread is to arrange that this is fundamentally so, without having to rely on electrical, optical or other devices to prove it.

Now if a suitably sized ball is dropped into a screw. that ball must naturally assume an equal bearing on both slopes. If it were possible to have such a ball placed between guides, so its center was always over the axis of the screw, and then to arrange a microscope moved by a micrometer head or similar measuring system, to read down on to a point on the ball or else on to an engraved line on the flat surface of a hemisphere instead of the complete ball, the solution would be complete.

But practically, there is no satisfactory way of knowing that the engraved line on the half ball is exactly in the same vertical plane as that bisecting the thread in the direction of the helix, and that, of course, must be the condition to obtain a working instrument.

If for the simple ball or half ball is substituted a ball-ended spindle, that freely bears vertically, or nearly vertically, into the screw and is suitably guided along the axis from thread to thread, its movement being measured by a micrometer head, a satisfactory basis for designing the machine is found. This is the principle adopted. The spindle is very light, so the machine may be also used to check the pitch of casts of screw ring gages. An apparatus in which casts can be made and afterward serve to carry the cast in the correct position on the machine, will be described later.

The details of the machine as made and now in use in the gage department of the British Ministry in the United States can now be briefly described. A patent in the United States has been applied for, so the machine can only be made after obtaining a license to manufacture. A simpler form of the instrument has been drawn out, which, although identical in principle and general arrangement, has been simplified in design to reduce the cost to one-half that of the original model and thereby bring it within the reach of the smaller manufacturers and users of gages.

The machine consists of a base *A*, Fig. 2, in form of a surface plate supported at the corners by screwed legs *B* for leveling purposes. At the back of the base are two cast-iron brackets *C* with double V-ways of hard steel, to carry balls. On the bracket runs a carriage *E* made in the form of a long narrow plate of suitable thickness for stiffness, and with the ends carrying V-ways, corresponding to those on the brackets. The carriage is pushed to and fro by a micrometer head *G* bearing on a round-ended spindle *H* screwed into the carriage, the spindle being maintained in contact with the micrometer spindle by a light weight *I* on cords passing over hooks. The micrometer head carries a large aluminum disk *L* divided into 250 indisions on the periphery, each spacing being $\frac{1}{10}$ in. long, so it is easy to read to tenths of a thousandth of an inch and even to a fifth of that amount, if a good micrometer is acquired and its accuracy checked on a Pratt & Whitney measuring machine, the readings being calibrated accordingly.

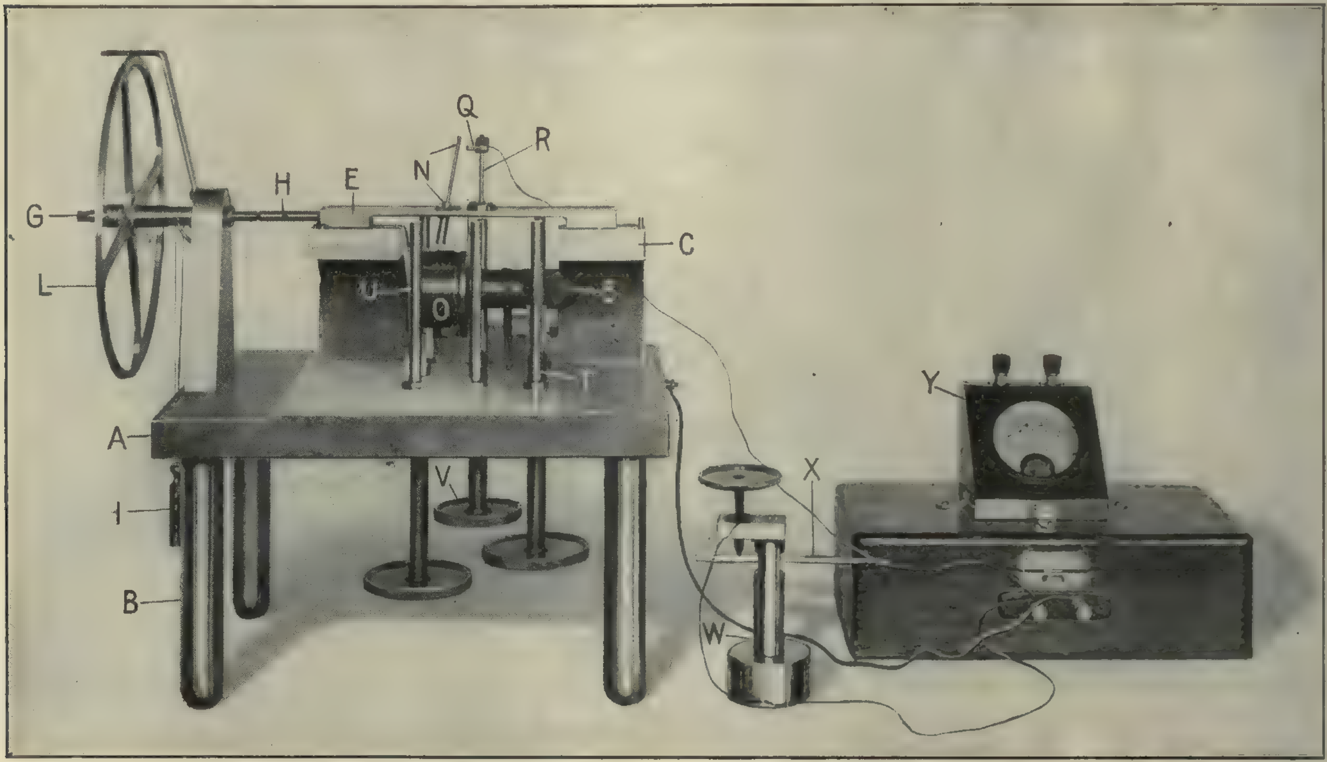


FIG. 2. BINGHAM POWELL PITCH MACHINE.

On the axis of the carriage is a V-opening, against which the ball-ended spindle *N* rests (at a point about two-fifths of its length from the ball), in a slightly inclined position (about 7 deg. with the vertical). The lower end of the spindle is restrained from side movement by parallel guides *O* ground in the foot of an L-piece fastened to the underside of the carriage. The opening in the guides is only about 0.00015 in. wider than the diameter of the spindle; thus, although the latter has entire freedom of movement in the vertical plane containing the axis of the carriage and the screw gage, it has none in a plane at right angles. The spindle is of smaller diameter in the portion projecting above the carriage and at the top can be brought to bear, by moving the carriage to and fro, into contact with a knife-edged electric contact *Q* carried on a small post *R* fixed into the carriage.

The screw gage *S* is carried on V-blocks and held from longitudinal movement by a stout rubber band passing through hooks in the base of the machine *T*. The blocks have ways at the sides, to slide on carefully adjusted posts *U* fixed in the base of the machine, so that the axis of the gage, carriage and ball-ended spindle are always in the same vertical plane. The V-blocks can be slowly raised or lowered by fine screw motions *V*. It is most important that the top of the threads of the gage should be truly horizontal; this is obtained by using an electric level *W* in the form of an adjustable arm *X* carried on a post whose base rests on the surface plate or base of the machine.

Leveling Operations

The level is brought over one end of the screw gage and the latter then slowly raised by screwing up the V-block until the arm of the level just lowers at the back from contact with its adjustment screw; this is shown by an electric circuit being broken through a galvanometer *Y*. Then the level is moved along to the other end of the screw, which is similarly raised to the proper height by the V-block at that end. The ball-ended spindle is afterward placed in the first thread of the screw, and the carriage slowly moved to the left or right until the top of the spindle (which swings about and slides through the V-support), just touches the knife edge, as shown by the electric circuit being completed through the galvanometer. The reading of the micrometer is noted. The spindle is raised and inserted into the second thread and the carriage again moved until electric contact with the knife edge is obtained. The difference of readings of the micrometer will give the pitch between the first and second threads; and so on, for the succeeding threads.

The ball point and gage must be free from oil or dirt, to obtain an electric circuit, and thus an additional factor in favor of accuracy is obtained, as noted in describing Mr. Vidal's instrument.

Ring Screw Gages

To take the pitch of ring screw gages, a special appliance has been designated in which the mold is made and afterward placed in the V-blocks of the machine and treated as a plug-screw gage. This appliance has centers so that it may be also used to carry the casts in the projection apparatus for throwing an enlarged (50 times) image of the thread on to a screen, to see that the angle of the slopes is correct and the rounding at the crest and root is such as is used at the laboratory of the British Ministry of Munitions of War in the United States (see Fig. 1).

It is useless taking a cast filling up the ring, as it is usually spoiled in being withdrawn; and further, as the cast has to be unscrewed to do this, the material, if plastic, will take the form and pitch of the last thread, and so be worthless.

Thus only a small segment of the thread should be molded. In the ordinary way it is a troublesome and messy business to do this; also, as usually obtained, the cast has no centers or reference axis parallel to the thread for setting up in a pitch or other measuring machine. As the gage is made against a faceplate, the cast should be carried in an apparatus with its axis exactly at right angles to the face of the gage in order to be able to use it in a pitch machine.

The apparatus, Fig. 3, is simple, and consists of a small square base of plate steel with the surfaces ground true. Into the plate is screwed exactly at right angles a spindle with an inclined wedged-shape slot at the bottom. The gage is placed on the plate and held against the slot of the spindle by a clamp. The sleeve on the spindle is brought down, so that the slot is not open more than the proper length where the screw bears. A melted composition of 7 per cent. graphite and 93 per cent. sulphur is poured into the slot. When set, the clamp is removed and the gage carefully drawn away from the spindle, over the base plate. A perfect cast of the thread remains in the spindle, and it cannot fall out as the smaller opening of the wedge is below when the spindle is placed in the pitch machine.

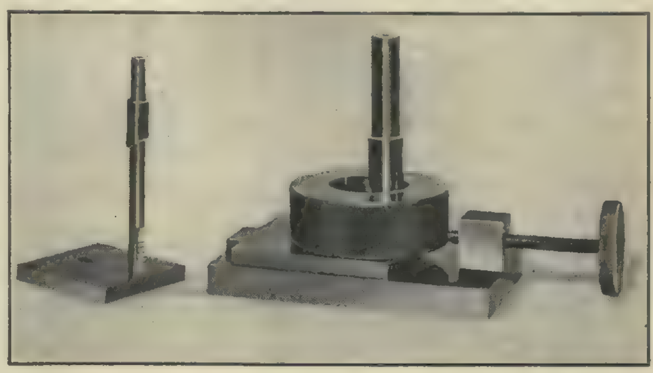


FIG. 3. APPARATUS FOR TAKING TRUE CASTS OF RING SCREW GAGES

The cast of the thread as taken is absolutely parallel to the spindle and at right angles to the baseplate and so is in the correct condition for measurement.

Plug-Screw Gages

The usual way of measuring the full diameter is by an ordinary micrometer. This is sufficient since a machine such as described below for checking the other diameters is not suitable, for the reason that the micrometer spindle face may not be absolutely parallel to the face of the screw, and so give a false reading; whereas for the effective and core diameters, a slight want of squareness of the micrometer face will not appreciably alter the result, because the bearing is on a wire or triangular piece and is therefore self-adjusting.

However, in measuring the full diameter, care must be taken to see that this is done on several diameters at right angles to each other, to note distortion, and also at different points along the screw for taper. Any gage inaccurate beyond the tolerance permitted, because of these defects, can be rejected, without troubling to proceed to the checking of the other diameters.

Before measuring the effective diameter, the gage inspector, should have before him the table of errors in the pitch from thread to thread, as measured on a suitable machine. It is useless to check the effective diameter without information about the error in the pitch, since the tolerance for the former must be reduced by an amount equal to twice the maximum value of the latter (see measurement of the pitch) and once the real tolerance for the effective diameter has been so calculated, the inspector knows what the gage is required to meet in this respect.

The effective diameter is measured by either thread micrometers or wires or, preferably, by both; as any difference observed by the two methods shows that the thread is of either bad form or else is staggered (inclined to one side along the axis of the screw); but these defects are better seen in a projection apparatus. The thread micrometer should never be used alone, because it bears only on protruding points on the slopes of the thread. Also the point of a micrometer wears rapidly, and it is difficult to accurately check it, the V-pieces supplied by makers being generally not very reliable.

Even when new, thread-micrometer points are rarely exact in angle. For laboratory work the micrometer should be disassembled, all the pieces thoroughly cleaned in gasoline, and the point carefully examined under a magnifying glass in a correct check piece, especially made for the purpose.

The writer believes that thread micrometers should only be used as a check on the results obtained by wires, and then only to assist in finding out the reason for any peculiarity observed in the results given by the latter when using two sizes of wire.

THE THREAD-MICROMETER PRINCIPLE

Screw-measuring machines have been devised where the thread-micrometer principle is used. One of these has a true surface as a base, and suspended above, a micrometer head with the spindle ground at the point to the angle of the thread (55 deg. for the Whitworth thread, 60 deg. for the International, or Metric, and U. S. S. thread, and 47½ deg. for the British Association thread). On the base rest little blocks, with the tops ground to a V-edge, of the same angle. The screw is seated on two of these blocks, placed as near together as possible, and then the micrometer point brought down to bear; the feel being obtained by moving the screw to and fro on the blocks.

The objection to this instrument is that the bearing on the blocks must be at a number of threads apart, because of the thickness of the blocks, and so the result obtained is only the mean effective diameter along the screw between that number of threads, which is an inaccurate condition if the gage is at all tapered. Also the blocks have a certain amount of friction resting on the base of the machine and possibly, therefore, do not move freely enough to take up a true seating when the screw is placed on them. Thus, although a better feel is obtained, this machine offers no advantages over an ordinary thread micrometer, and probably is not even so accurate.

The wire system of measuring the effective diameter is the most satisfactory, but only when properly carried out. In the first instance, the diameters of the wires must be the correct sizes for the particular pitch of thread being inspected, and calculated systematically. The system used by the writer is to have two diameters of wires for each pitch of the thread; one to give the wire a bearing just on the theoretical effective diameter of a correct screw, and the other such that the wire rests in the screw just near its crest, but avoiding the rounding of the crest in the case of the Whitworth thread. The wires resting on the true pitch diameter of a correct screw are known as "best" diameter wires and their sizes are:

No. of Threads Per In.	"Best" Diameter Wire	
	Whitworth Thread, In.	U. S. S. Thread, In.
12	0.0470	0.0481
14	0.0403	0.0412
20	0.0282	0.0289
24	0.0235	0.0241
32	0.0176	0.0180
36	0.0156	0.0160
40	0.0141	0.0144

These diameters are calculated from the simple formula:

Best diameter of wire $= D$

$$\textit{Pitch of thread} = \frac{1}{\textit{number of threads per inch}} = P$$

Included angle of the thread $= A$

then

$$D = \frac{P}{2} \textit{ multiplied by secant } \frac{A}{2}$$

For the different types of threads, we thus have

Whitworth: $D = 0.5637\,P$.
U. S. S.: $D = 0.5774\,P$.
British Association: $D = 0.5463\,P$.

The wire that bears near the crest of the thread is known as the "maximum" diameter wire, and for both the Whitworth and U. S. S. threads the size can be taken as 1½ times the best diameter wire for the same pitch.

Therefore, the maximum diameter wires for the several pitches will be:

No. of Threads Per In.	"Maximum" Diameter Wire	
	Whitworth Thread, In.	U. S. S. Thread, In.
12	0.0705	0.0721
14	0.0605	0.0618
20	0.0423	0.0434
24	0.0353	0.0362
32	0.0264	0.0270
36	0.0234	0.0240
40	0.0212	0.0216

The maximum diameter (D) wires are calculated from the formula:

Whitworth: $D = 0.8456\,P$.
U. S. S.: $D = 0.8661\,P$.
British Association: $D = 0.8195\,P$.

There is not much employing wires of smaller size than the best diameter, as they would get too far down into the thread and give no free bearing on top for the micrometer. The thread micrometer, used in conjunction with the two sizes of wire recommended, will generally show anything wrong in the thread below the point where the best diameter wire bears, if the screw is correct in form.

The wires must be accurately ground to size and be round; also, the exact size of the wire must be taken in a measuring machine to a hundred-thousandth part of an inch. These conditions are most essential, because any difference in the diameter of the wire is multiplied by three or more (see formula for K following), in the reading of the effective diameter. A convenient specification for wires is as follows:

1. Each wire must be round and to the diameter given; the combined error in roundness and diameter not to exceed 0.00005 in.

2. Each wire must be measured on a measuring machine to 0.00001 in. and the mean diameter given on a label attached to the wire.

3. Each wire will be 2 in. long (this is an average size, for very large screws the length will be in pro-

portion). Only the center $\frac{1}{2}$ in. will be of the exact dimensions specified; the remaining portions of the wires can be blackened, and should be approximately 0.001 in. to 0.002 in. less in diameter than the central portion.

4. The wires are to be of hardened steel, and one end softened, and bored or turned over to make a loop, to fasten the thread of the label to.

To use these wires a constant K must be calculated. Let

D = Mean diameter of the two or three wires used.
A = Included angle of the thread.
P = Pitch of the thread.

then

$$K = D\left(1 + cosecant\,\frac{A}{2}\right) - \left(\frac{P}{2}\,cotangent\,\frac{A}{2}\right)$$

Thus, for the several types of thread we have:

Whitworth: $K = 3.1657D - 0.9605P$.
U. S. S.: $K = 3.0000D - 0.8660P$.
British Association: $K = 3.4829D - 1.1363P$.

Given K, the micrometer reading over the wires minus K = pitch diameter of the screw.

In use, the diameters of the wires should be checked from time to time for wear, and if necessary the constant K recalculated.

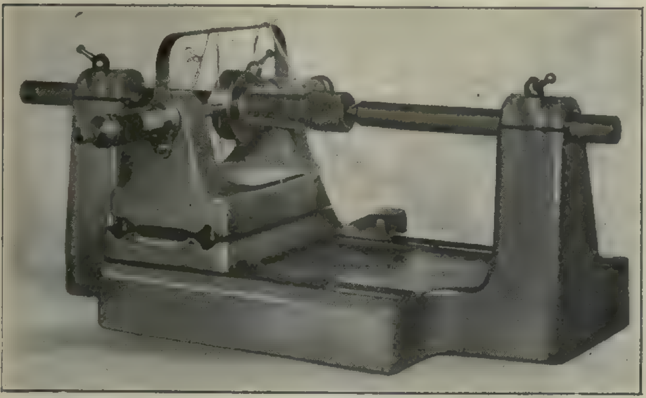


FIG. 4. NATIONAL PHYSICAL LABORATORY SCREW MEASURING MACHINE

The common way to use the wires in workshops is to employ three in number, two in adjacent threads on one side of the screw and one in an intermediate position in the corresponding thread on the other side. The wires are usually held down into the screw by elastic bands. If the wires are sufficiently large in size not to bend under the pull of the bands there is no objection, but often this is not so, and should the wires bend a false reading is obtained.

A better method is to use Johansson blocks in the holder provided with the set, and to arrange the distance between the jaws equal to the measurement over the wires corresponding to the correct effective diameter. The caliper so made is placed over the screw and the needles pushed into the thread; if the feel is not satisfactory, the distance between the blocks is varied by 0.0001 in., until it is. But the best system of measuring the effective diameter is to have a special machine for the purpose. There are one or two types of such machines, but none are nearly as quick and accurate in action as the model designed by the National Physical Laboratory of England, Fig. 4. The machine in question consists of a light carriage moving on balls in V-ways, across a platform, or base, underneath. On each side of the carriage are brackets, one of which carries a micrometer anvil which can be clamped in the bracket at any position along its length, and the other has a fixed micrometer head. By adjusting the position of the anvil, the "gap" of the micrometer can be arranged to suit the diameter of the gage being inspected; the zero of the reading being fixed by Johansson blocks.

The carriage can be moved along the platform laterally to bring the micrometer opposite any thread of the screw; this motion is over small cylinders resting in V-ways in the platform and the underside of the carriage. Cylinders are used to permit an easy motion; but at the same time with sufficient friction to keep the carriage in any given position. The screw gage is carried in adjustable centers in brackets on the ends of the platform.

One Wire Better

Across the carriage is a light steel support, with a narrow groove to allow the thread of the wires to pass—carrying the wires. An attachment for the Pratt & Whitney measuring machine has been made from designs by the writer, based on the principle of the screw-measuring machine just described. This is shown in Fig. 5. With this attachment, master plug screw gages can be checked to a fraction of 0.0001 in. It is not necessary to put pressure on the wires used in the attachment sufficient to make the small plug of the measuring machine fall from the horizontal to the vertical position, but only just enough to make it begin to move. From experiments with the particular machine in the laboratory of the British Ministry, the difference between the jaws just touching and enough pressure being put on to make the plug fall vertical, is only 0.00002 in.

With these screw-measuring instruments it is better to use one wire only, at either side of the screw, of diameters as nearly equal as possible.

The wires are suspended in the thread, opposite one another, and the micrometer head screwed in, until it touches them. The feel is almost perfect, because of the frictionless movement of the carriage.

To check the core diameter of plug-screw gages, small triangular pieces are employed, ground to an included angle of a few degrees less than that of the screw; the edge of the piece that bears on the thread being slightly rounded. These pieces are suspended in a similar way to the wires. The width across each triangular piece being known, the subtraction of the sum of the widths of the two pieces from the micrometer reading gives the core diameter of the screw.

Also to check the core diameter, an ordinary micrometer with the spindle ground to a convenient angle and the sharp point removed, may be used, or an ordinary micrometer may be employed in conjunction with triangular pieces, such as those described above for the machine.

Once the three ruling diameters of a screw have been checked, in planes at right angles to each other, at different points along the thread, the concentricity of these diameters should be measured over a few places. This is an important proceeding if separate laps are used for bringing the gage to size on the core, effective and full diameters respectively, since as this is thus done in three distinct operations, the diameters may not be concentric. Alterations in the structure of the steel after hardening would also cause the same defect. The same reasoning would apply to screws ground to size, when employing different wheels for correcting the three diameters.

The eccentricity is readily found by using one wire or one triangular piece, in the diameter-measuring machine previously referred to, and measuring the full diameter. Observations are made on the variation in reading the full diameter obtained during one revolution of the gage, keeping on the same thread. Eccentricity of core and effective diameters can be similarly found by using the triangular piece and wire, respectively, on opposite sides of the gage.

Before leaving the subject of the measurement of the three diameters of plug-screw gages, attention may be drawn to the difficulty of obtaining the core diameter correct within the low limit, where the gage is ground to size. Also there are two other important objections to grinding to size:

1. The surface of the thread always has grinding marks, which bring about more friction when using the gage in the product, and so increased wear.

2. The rough surface of the thread may cause seizing of the gage in the product in the cases of a tight fit.

Thus, the writer believes it is generally advisable to lap threads after grinding.

The checking of this class of gage is very little understood, as at present usually practiced. The common method is to employ a single screw plug of normal dimensions on the core, effective and full diameters; or else on the effective and full diameters only and with a low core diameter, so that a plain plug has to be used to check the latter element of the thread of the ring gage. If such checks go into the gage, the test is considered satisfactory. But, of course, it is not so, for the plug may give a good fit if it bears on one diameter only, and the other diameters of the ring gage could be large, beyond the tolerance.

Logically, if in the case of a plug-screw gage each diameter is checked separately, the same procedure should be observed in the case of a ring-screw gage, but this is very rarely done.

Of course, it is practically impossible to so check a ring-screw gage by direct measurements, but it can be carried out quite easily by indirect methods. For instance, if for a ring-screw gage the following set of plug checks is provided, each diameter is duly taken care of. The checks are:

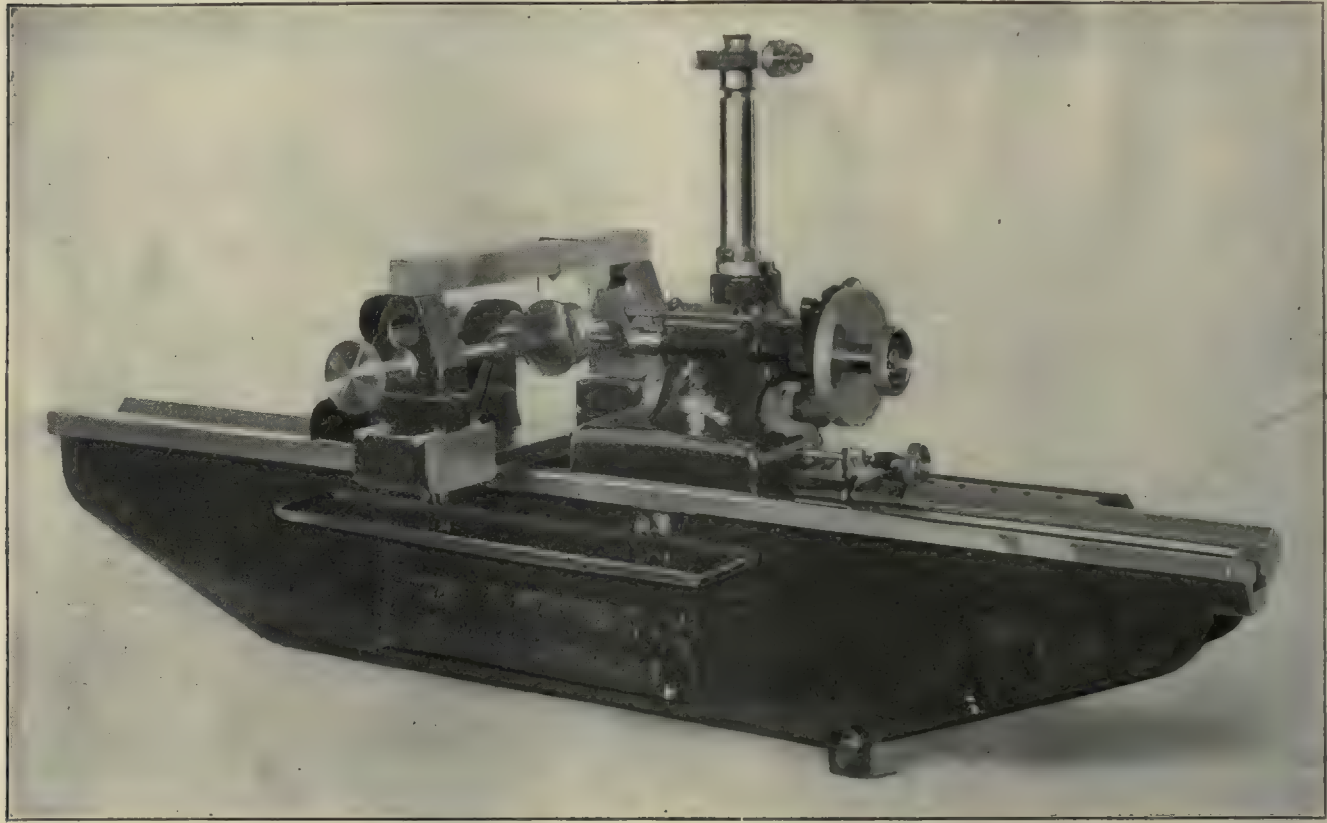


FIG. 5. ATTACHMENT PLACED IN PRATT & WHITNEY MEASURING MACHINE

1. A "no go full diameter check." This is a screw check of a full diameter equal to that of the ring-screw gage, on the high limit. The angle between the slopes of the thread at the crest is made a couple of degrees less than the included angle of the normal thread. The rounding at the top of the thread is of sharp radius, and the core diameter that corresponding to a V-root. Such a check can only bear on the full diameter. Not more than a couple of threads are advisable, to minimize the effect of errors on the pitch entering into the result.

2. A "no go effective diameter check." This has the effective diameter equal to the high limit of that element of the ring-screw gage. The crest of the thread is made flat, and the root of the thread carried down to a V. Two threads are enough. This check can only bear on the effective diameter of the screw-ring gage.

3. A "go effective diameter check." This is similar to (2), only the effective diameter is made to the low limit of the effective diameter of the screw-ring gage.

4. A "full form go check." This should have the dimensions of the low limits of the ring-screw gage on the full, effective and core diameters, and contain the same number of threads. The rounding at the crest and root must be correct. Such a check tests the three diameters on the low limit, the roundness at the crest and root; and also proves that the pitch is correct, if it screws right home into the gage.

5. "Go," and (6). "No go, core diameter checks." These can be in the form of a double-ended plain plug, with the two diameters the same as the high and low limits, respectively, of the core diameter of the ring-screw gage.

TOLERANCE ALLOWED

The ruling diameters of each of these checks should not have a greater tolerance in any case, than +0.0001 in. for the no go checks and —0.0001 in. for the go checks. The error in the pitch should not be beyond ±0.0001 in.

With a set of checks on this system the manufacturer knows at every stage of the finishing of the ring-screw gage how the work is proceeding, and a great number of spoiled gages will be avoided by their use. For inspection purposes, a set of checks as above is also desirable but not essential since a ring-screw gage can be satisfactorily inspected if only those under Nos. (1), (2), (3) and (4), are used; that is: A no go full diameter plug, no go effective diameter plug, no go core diameter plug and go full form diameter plug.

The form of the thread of a ring-screw gage is checked by No. (4), but as an additional measure it can be observed by taking a cast of the thread; employing such an apparatus as that used with the pitch machine, previously described. The cast should be placed in a projection apparatus, so that an exact image, enlarged fifty times, can be thrown on a screen and compared with a carefully drawn-out enlargement of the thread made on cardboard and adjusted on the image. If no projection apparatus is available (but every maker of screw gages should possess one), the cast can be compared with a correct screw plug under a glass.

In concluding this brief account of accurate methods of checking screw gages, a recapitulation of the essential equipment may be made. This should consist of:

1. A pitch-measuring machine to read from thread to thread, to at least 0.0001 in.
2. An appliance to take casts of ring-screw gages, so arranged that the cast may be accurately set up in the pitch machine or projection apparatus.
3. A screw-measuring machine to check the governing diameters of a plug-screw gage with accuracy to 0.0001 in. An equipment of best diameter and maximum diameter wires, and triangular pieces for the same.
4. Thread micrometers, checked for accuracy, to use in conjunction with the screw-measuring machine.
5. Ordinary micrometers, to measure full diameters, with Johansson blocks to keep them accurate.
6. Complete sets of check plugs for the several diameters, pitch and form of thread of ring-screw gages.

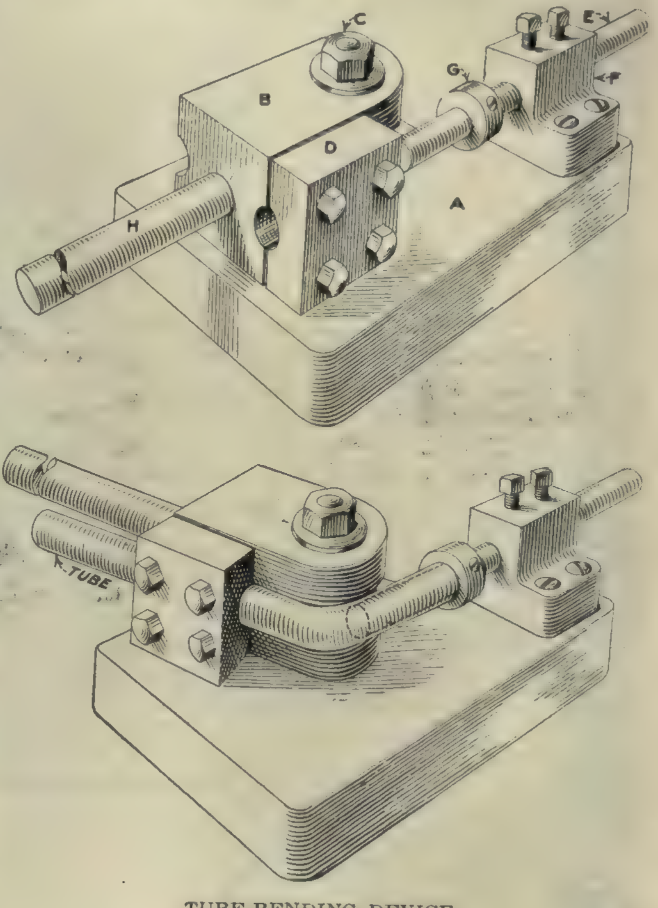
Finally, the equipment would be complete with a projection apparatus for observing the angle between the slopes of the thread, and the form of the entire thread.

Possessing an inspection laboratory with these instruments, a gage maker is in a position to produce the very accurate screw gages employed in munitions work, and to meet all the requirements of the inspection departments of the several governments.

Tube-Bending Device

By A. Ryden

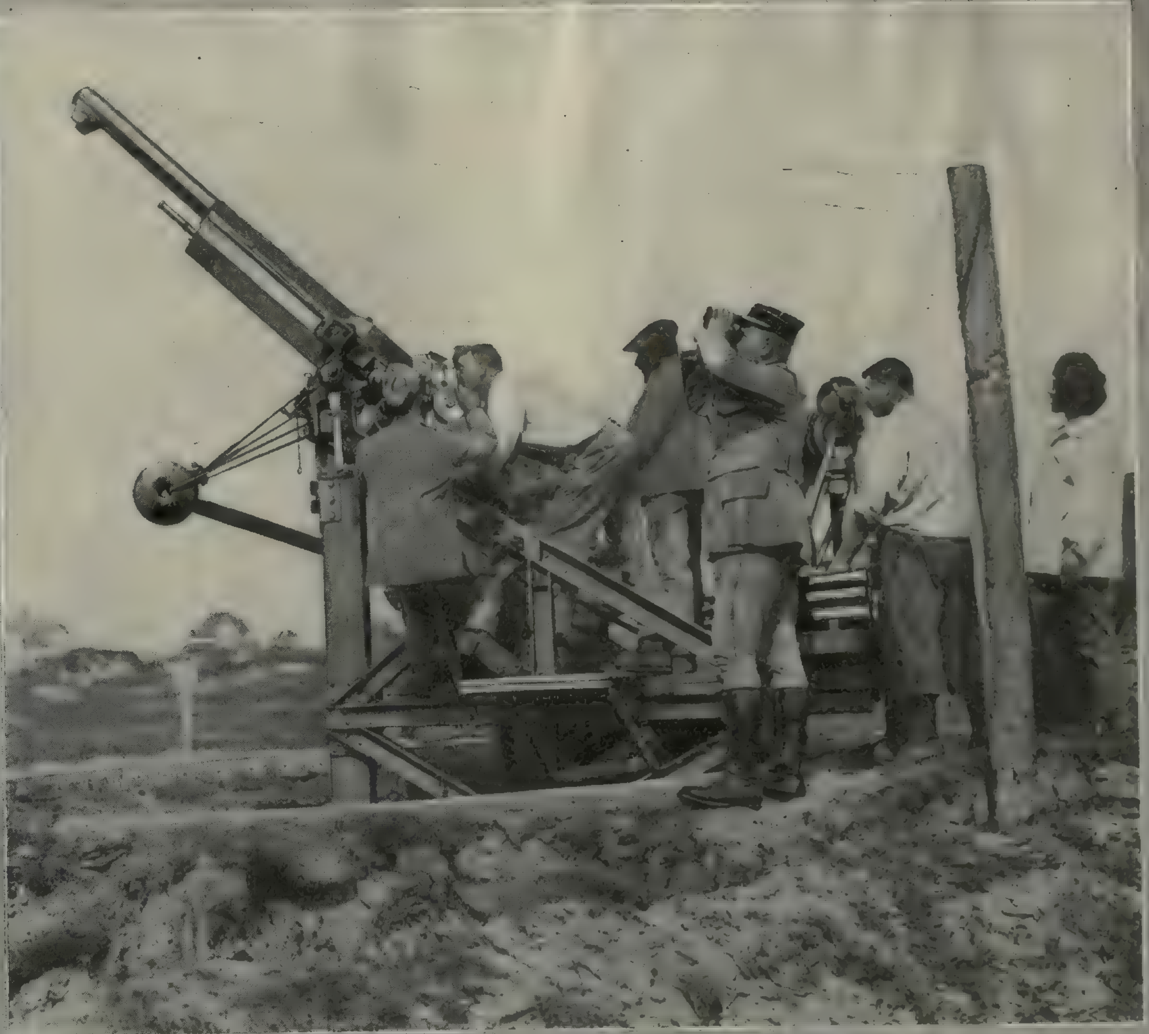
This bending device may help Mr. Terry on his job. At *A* is a cast-iron base; *B*, the forming block, pivoted on the stud *C*, has a groove milled around its three sides, the radius of the tube to be bent. A clamp block *D* has a groove milled to correspond, but $\frac{1}{16}$ in. less in depth to allow for clamping. A block *F* holds in position the mandrel *E*, which is made of steel, slightly rounded on its front edge and hardened. It is to be a sliding fit in the tube. The block *B* is turned by the handle *H*. A collar *G* can be set to adjust the length of the bend.



TUBE-BENDING DEVICE

In operating this device, open the clamp block *D*, slide the tubing into the opening between *B* and *D*, on the mandrel *E*, against the set collar *G*, and tighten the clamp block *D*. In grasping the handle *H*, bringing the forming block *B* around a half turn, it will be plainly seen that the tube is pulled off the mandrel without kinking or injuring the tubing in the least. The writer has tried this device on various diameters of brass tubing, and it works out perfectly.

75-mm. Anti-Aircraft Gun



The illustration shows one of the late types of French 75-mm. anti-aircraft guns and crew in action somewhere in Belgium. The graduated circular track around which the gun may be swung, is plainly visible. The post from which the wireless antennae are strung is also shown, and the operator with his receivers clamped to his ears may be seen in back of the group.

Metal Frames and Fittings for Airplanes

BY FRED H. COLVIN

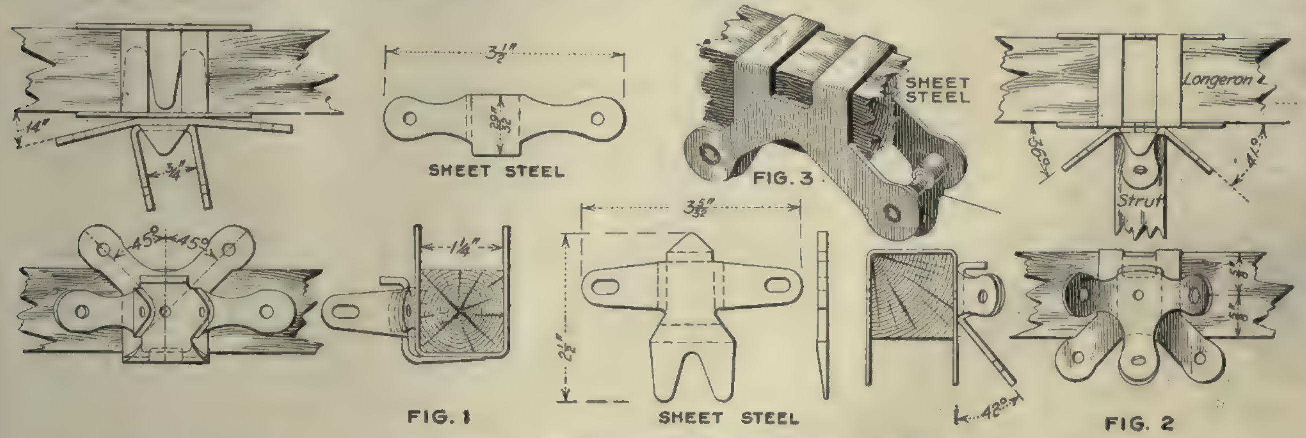
The construction of airplanes is becoming more of a metal-working problem than in the earlier days and the ways in which metal is supplanting wood is of general interest.

THE use of metal in airplane construction is increasing in many factories and some of the fittings used involve interesting problems.

In Fig. 1 may be seen a type of fuselage fitting that is built up from two pieces of 0.10-in. sheet steel. These pieces are blanked and bent in a punch press and then spot welded as shown in the assembly drawing. Another somewhat similar fitting is presented in Fig. 2. It is also composed of two pieces bent and spot welded, the outline showing the fitting in position on the longeron with the strut in position.

Fig. 3 illustrates another form of fuselage fitting which is almost universal in its use and which has several advantages. It is made from a single stamping, is easily bent to go around the longeron and has the advantage that it can readily be put in place at any point instead of having to be threaded over the longeron, as is the case with some fittings adopted for this purpose. This one has the further advantage of having the turnbuckle and truss-wire connections so that they form a universal joint instead of requiring them to be bent to the exact angle as with some fittings used for this purpose. Fig. 3 shows how this fitting goes on the longeron and the way in which the clevis is held in the fitting, so as to adjust itself to the exact angle of the truss wire. This, together with the connections on either the turnbuckle or the truss wire itself, makes a universal joint at each fitting.

The tail skid, which supports the tail end of the airplane in landing and when at rest on the ground, contains an interesting piece of machine work in addition to the skid itself. The whole assembly is illustrated in Fig. 4, and the construction of the hinge connection to the fuselage in Fig. 5. This consists primarily of a trunnion *A* made from a 1-in. steel tube with the end swaged down, as shown. This fits through a plate *B* after the plate has been properly bent, as shown at *C*. The plate is then welded to the tube, while the piece *D* is also welded in position, as shown at *E*, after the two ears have been bent so as to fit against the tube *A*, the whole piece being welded together into a solid whole.



FIGS. 1 TO 3. SHEET-METAL AIRPLANE FITTINGS

Fig. 1—Built-up fuselage fittings. Fig. 2—Another of similar design. Fig. 3—Universal fuselage fitting

The trunnion fits into suitable openings in the lower longeron and allows the skid to turn on them when the lower end strikes the ground, under control of the heavy rubber spring shown at the upper end. The skid itself is held in a yoke formed of sheet steel and spot welded, this yoke allowing the tail skid to swing on a pivot that connects it with the first fitting shown.

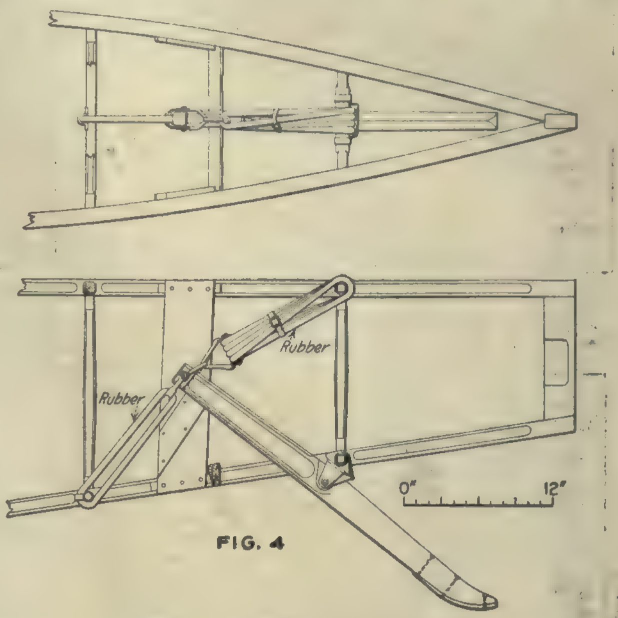
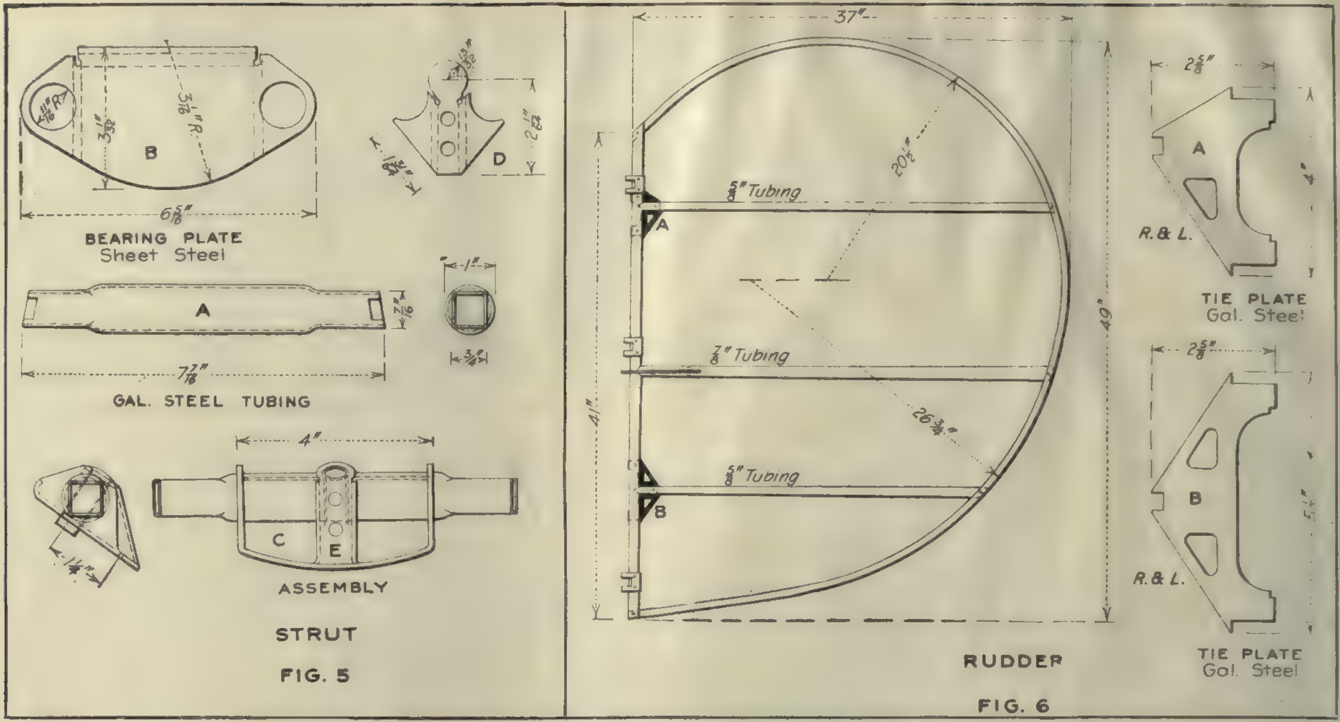
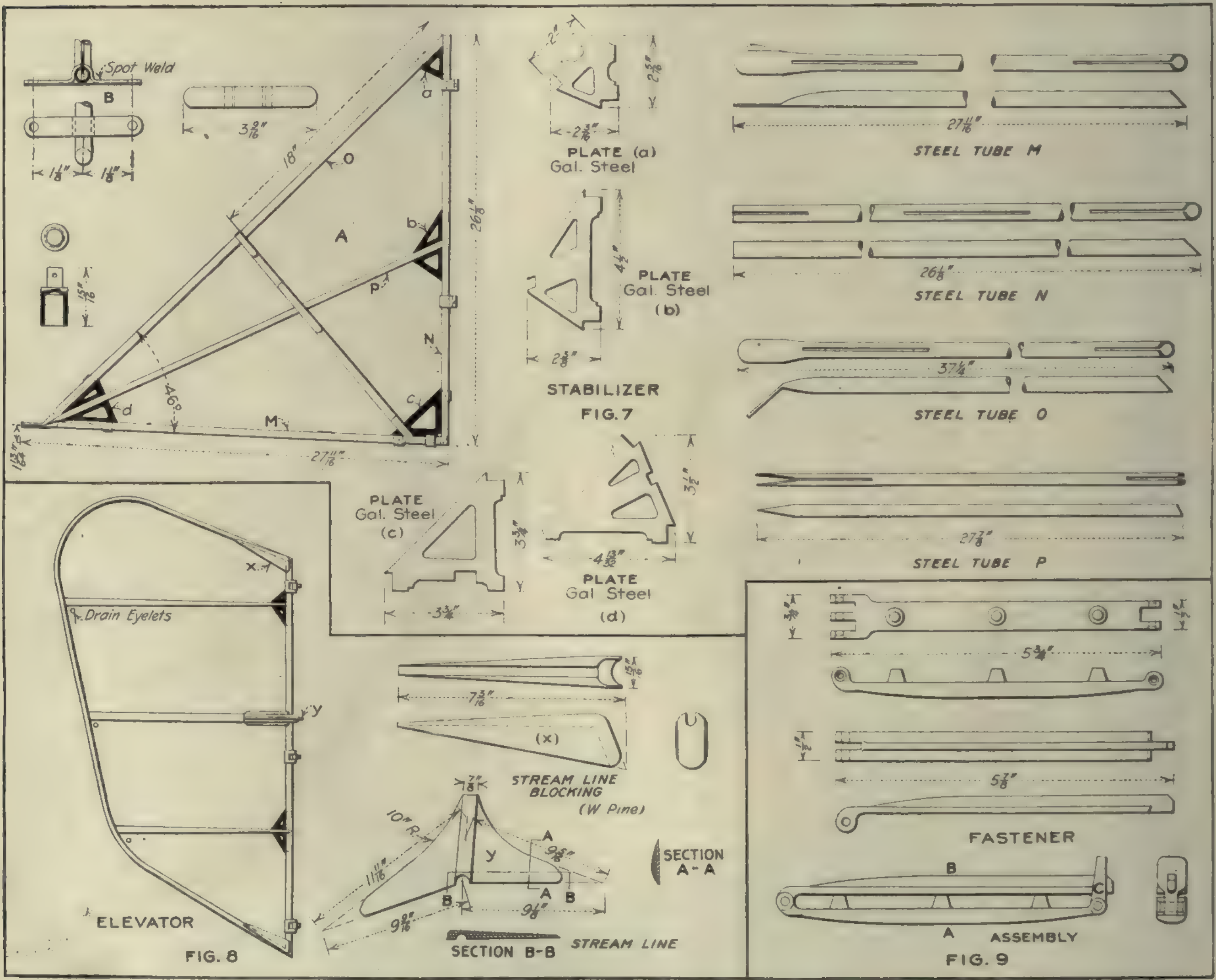


FIG. 4. THE TAIL SKID

The use of metal, however, is not confined to such small fittings and connections as have already been mentioned, but is being extended to the framework of the various parts. Among these is the rudder, illustrated in Fig. 6, which also shows the reinforcements *A* and *B* on a larger scale. This entire framework is built up from steel tubing, although on some of the later models the long outer frame is made from a special U-shaped section, the exact section being designed with



FIGS. 5 AND 6. TAIL SKID AND RUDDER DETAILS
Fig. 5—Tail-skid hinge. Fig. 6—Steel rudder frame



FIGS. 7 TO 9. DETAILS OF CONTROL APPARATUS
Fig. 7—Steel vertical stabilizer. Fig. 8—Steel frame elevator. Fig. 9—Safety-belt clasp

due regard to reducing wind resistance. The three rudder hinges are seen in place on the rudder post, as well as the three braces between the post and the curved outer portion of the frame.

It is particularly interesting to notice the form of reinforcements used. They are the result of considerable study, as the question of shrinkage or contraction of the pieces after being subjected to the heat of the oxyacetylene flame is one that can only be solved by long experience. It will be observed that these reinforcements go through both walls of the rudder post and that the other end is notched so as to locate the position of the crossbrace. This requires very careful welding in order neither to burn the metal nor to cause undue contraction if they are heated more than is absolutly necessary.

The reinforcements are firmly welded into place at all points of contact and then very carefully inspected after cooling, to make sure that the contraction has not caused either cracks or distortion. In the early days of this method, cracks were very frequently found in the reinforcing piece, and these cracks had to be welded before the frames could be used.

In many cases of this kind where the piece does not require heat-treating, there is a tendency to return to the brazing process on account of its not requiring such a high heat as the welding.

THE VERTICAL STABILIZER

Another interesting example of this sort of construction is illustrated in Fig. 7, which shows how the vertical stabilizer at the tail of the machine is constructed. Complete details are given of the way in which the various tubes are slotted and bent to receive the reinforcing pieces, the shape of the reinforcing pieces themselves and the way in which the final assembly is worked out. This is particularly interesting owing to the use of the crossbraces at *A*, as shown in the details at *B*. In this case both spot welding and oxyacetylene welding are used, the former being for packing the pieces together in order to hold them firmly in place for the final welding.

In Fig. 8 are shown the assembly and the necessary details of the framework for one of the elevators at the rear of the machine. This illustration hardly requires explanation in view of what has gone before, but gives an extremely good idea of the construction, which is proving successful in machines of this type.

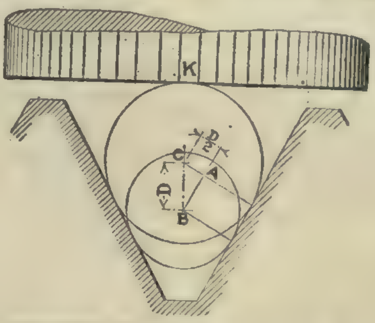
Another interesting metal detail is seen in Fig. 9. It is the quick-release buckle, or holder, for the safety belt by which the aviator fastens himself into his machine. There are three parts, one end of the belt being fastened around the lower bar *A* with the three pins projecting through it. The aviator takes his seat, puts the belt around him and pulls the other end, which is supplied with several sets of three eyelets each, over the three pins shown, and swings the bar *B* so as to hold the two portions of the belt firmly together. Then the catch *C* is swung over the upper end of the bar *B*, and the belt is firmly locked in place. In case it is necessary or desirable to release himself quickly, he simply swings up the catch *C*, and a very slight pressure instantly frees him from the confines of the belt and leaves him at liberty to jump, climb or swim, as the case may be.

Errors in Measuring Thread Pitch Diameters With Wires

BY J. HARLAND BILLINGS

Why should the pitch diameter of threads measured by wires so often differ from measurements taken with pitch micrometers? This is a question often asked by thread gage makers and inspectors, and is the basis of many a heated dispute as to the relative merits of the two methods.

With micrometers reading correctly there are four factors, any or all of which may cause the wires to give a different result. The first and most important is the size assumed for the wires themselves. Many seem to think that if the wires are known to be correct to 0.0001 in. the resulting pitch diameter will have like accuracy. A consideration of the illustration will show this assumption 200 per cent. in error. Let the large circle represent the actual size of the wire, and the small circle the size assumed. If $\frac{D}{2}$ represents the difference in the radii then the error made in measuring the wire diameter was D in. For a 60 deg. thread it will be seen from the right triangle *ABC* that the assumed wire has its center a distance *D* nearer the thread axis than the center of the actual wire. The point of contact *K* between the micrometer and the actual wire has to advance, in order to get to a similar point on the assumed wire, this distance *D* plus the shortening of the radius $\frac{D}{2}$, or a total distance $\frac{3}{2}D$. That is, the plain micrometer reading, on one wire, will be in error $1\frac{1}{2}$ times as much as the measurement of the diameter of the single wire is in error. If the two wires on the other side of the thread have the same error as the single wire, the micrometer measurement has three times the error of the wire measurement. For Whitworth threads the figure becomes 3.17. This means that wires measured with the common micrometer cannot be depended upon to give pitch diameter results closer than say 0.0002 in. Wherever possible wires should be measured in a precision machine such as Pratt & Whitney or at least checked with Johansson blocks.



HOW THE ERROR IS MULTIPLIED

Given wires of known diameter it is still necessary to handle them much as soap bubbles would be treated in order to prevent further error. Whereas pitch micrometers make line contacts on the threads, wires make theoretical point contacts and very little pressure will wedge them down into the threads sufficiently to distort the surface at the contact points. A good way to demonstrate this difference is to carefully measure two wires, and compare the sum of their diameters with what is obtained by crossing the two, and measuring overall.

A third factor arises from the nature of the surface on the sides of a lapped thread. Thread lapping is about the only kind of lapping where the cutting lines cannot be crossed. The motion of the cutting abrasive of the lap is always in helices concentric with the thread axis. The result is furrows and ridges which will be large or small according to the size of the abrasive grain but they are always there. If they are large the reading of pitch diameter is considerably affected by whether the wires make contact on the tops of ridges or lie in the furrows. Hence, checking the thread angle with sets of wires of different size can only be done accurately when the sides are quite smooth. It need only be mentioned that if the thread angle differs from the angle of the pitch micrometer spindle or anvil, medium-sized wires will give a lower reading than the micrometer on that account.

This may look like a clear case against wires, but when there is discrepancy between the results they give, and the pitch micrometer reading it is poor policy to convict the former without first cross-questioning the latter. The pitch micrometer has plenty of faults. If, for instance, thread gages are being measured, which are nearly uniform in pitch diameter, flat spots will develop on the sides of the spindle in a surprisingly short time. This is particularly so where the thread angle is wider than the spindle angle. In any case where pitch micrometers are used on a number of the same sized gages it is good policy to check frequently on a master of the same size set apart for this purpose.

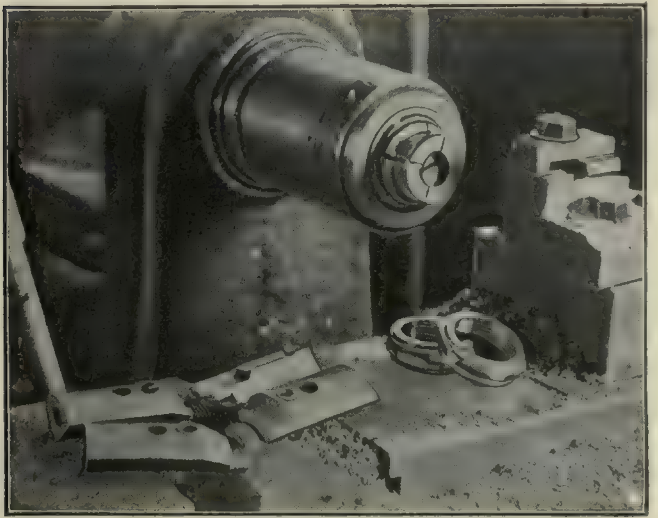
From the above considerations there is no magic required to explain why the wires so often differ from the micrometer. In general the wires will be found to give a lower, rather than a higher reading.

Expanding Air Chuck

By E. Shaff

The chuck shown in the illustration was designed to hold brass nuts during forming, but it will hold any similar work internally. It is operated by compressed air, the cylinder being at the other end of the spindle.

This chuck consists of a sleeve threaded on one end to fit the spindle and bored any convenient size, in this case 2 in., with a wall between having a ½-in. hole to guide the bolt that opens the jaws. The bolt is ½ in., with a ¾-in. head, and it has a 60-deg. taper on the under side to fit the taper in the jaws. A 60-deg. taper is about right for a 6-in. air cylinder and 75 lb. air pressure.



EXPANDING AIR CHUCK

Four holes in the sleeve are tapped for headless screws that extend through and fit loosely in the holes in the jaws, to keep them from coming out or turning. The jaws carry springs to make them close when released by the bolt. They are easy to make.

For work smaller than the hole in the sleeve, a piece of shafting the size of the hole can be cut off, faced on one end, then inserted in the sleeve, and the sleeve used as a jig to drill the holes in the jaws. One or two screws are put in to hold the jaw blank, and the whole fixture is screwed on the lathe spindle.

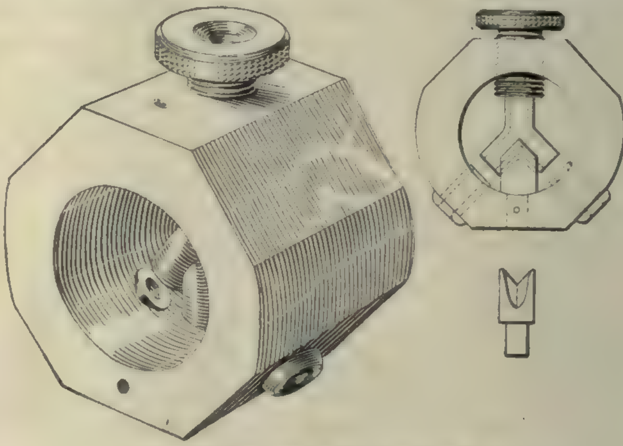
The projecting end is turned or threaded the required size, and the hole for the bolt is bored enough larger than the bolt to allow the jaws to close. The jaws are then numbered, taken out and sawed apart. Holes are drilled for springs, which are inserted.

When locked, the chuck is like a solid mandrel, and the nut or other work can be screwed on easily. When the operation is completed, the air is turned off, the jaws collapse, and the work comes off without stopping the machine.

Drill Jig for Y Connections

By H. E. McCray

In the illustration is shown a simple and very effective drill jig for small Y-shaped castings. These castings, which are made of brass, are used in considerable quantities as soldered unions in oil pipes, gas lines, etc. The holes are drilled for ¼-in. tubing.



DETAILS OF DRILLING JIG

The body of the jig is of steel, about 1¼ in. thick, originally a round piece about 4 in. in diameter. The central hole is bored, and the piece is given six flats, as it is drilled from three directions.

The knurled screw bushing in the top is bell mouthed to center the casting, and forces it down into the double V-block milled from a round pin. A side view of the V-block is given; it has 90-deg. notches milled in 45 deg. each way from the center line.

The thread on the screw bushing is cut eight to the inch and ¾ in. in diameter. Two turns of this screw release the casting completely. As may be imagined, it is quite rapid in operation, the rate being about 175 to 200 pieces per hour per operator.

Ball Bearings for Electric Motors

BY GEORGE ANDRUS

This article discusses the use of ball bearings for electric motors from the standpoint of the user. As the user is the person who must be satisfied, the opinion of one who has had experience is of considerable interest.

THE use of ball bearings on electric motors of all classes has been urged very diligently and aptly by the manufacturers of ball bearings, who are directly interested in their use. But little or nothing has appeared in the technical press to state the case of the user, whose interest may not always coincide with that of the maker. To dispel a wrong impression it should not be considered the purpose of this article to bring out the negative of the argument, that is, why ball bearings should not be used on such motors. As a matter of fact they have been used successfully in actual service for many years. But to attain such success, certain conditions must be met, a clear statement of which, on the basis of practical experience, should be of interest to the user and should only be welcome to the ball bearing manufacturer. Also, if we gain a clear conception of the actual advantages of ball bearings and the conditions under which gains in service may actually be secured from such advantages, we will prevent misapplication, thoughtless use of ball bearings and thereby will insure permanently satisfied customers. This is the aim of the maker of ball bearings as well as of the maker of motors. An enthusiastic buyer turned into a disillusioned user is a poor asset to the supplier.

BALL-BEARING MOTORS ON MACHINE TOOLS

The writer is personally familiar with motors equipped with ball bearings installed on machine tools some twelve years ago and these motors are still giving excellent service with the same set of bearings. The service in this case has not been particularly severe; on the other hand, the ball bearings have received practically no attention other than very infrequent cleaning and refilling with grease. Ball bearings have also been used extensively in applications related to electric motors such as mining locomotives, automobiles, etc. At the same time, and in spite of years of experience and of perfecting the product to a high degree, the fact remains that broadly the old sleeve bearing has not been superseded by ball bearings for general-purpose motors. We may consider this as a sort of verdict of history, more so as it bears out individual experience. What are the reasons for this condition, and what may be expected in the future? These questions are perhaps best answered by analyzing in an impartial manner and supported by facts the claims which can be made for ball bearings in electric motors as to their merits. The advantages as usually stated are: Reduced friction losses with a correspondingly higher efficiency, less attention required, smaller air gap possible with resulting saving in material or gain in performance, and, finally shortening of the length of the motor.

In regard to the first item, reduced friction losses and increased efficiency, it should be remembered that the thing uppermost in the operator's mind is uninterrupted service. The point of motor efficiency is often capitalized to excess by motor salesmen. The efficiency of electric motors is relatively high in all cases and to the operator a further slight gain of a fraction of a per cent. in the efficiency, that is in power consumption, is of no importance as compared with general serviceability. It will easily be seen that a single shutdown would offset any saving in power. Therefore, ruggedness, foolproof qualities of motors and their bearings are the prime requisite. In this connection, it must be remembered that (as stated by every ball bearing manufacturer) a modern ball bearing is a highly refined product, and manufacturing accuracies of a few ten thousandths of an inch on the ball bearing are of no avail, unless a proportionate degree of care is given to correct mounting and maintenance of the bearing.

QUESTION OF WORKMANSHIP

As far as the motor manufacturer is concerned this demand presents no unsurmountable difficulty, inasmuch as accuracy and skilled workmanship is required in many of the operations involved in the manufacture of electric motors, although the correct machining for and mounting of ball bearings in the manufacture of motors means training of a suitable crew and special attention on the part of the inspectors. This is the first condition, neglect of which precludes success with ball bearings from the start. The additional expense inherent to increased demands for accuracy and the scarcity of high-class mechanics are, therefore, the first handicap to the extensive use of ball bearings on motors intended for general power purposes.

The question of correct mounting and of workmanship becomes more serious when we consider that the term, general-purpose motors, means installations of all kinds, mill service and farm work; even an individual motor in a bakery or shoe repair shop. It will be admitted that in many instances of this sort sufficiently skilled help is not available to dismantle and properly reassemble a ball bearing motor.

In remote installations we cannot count on mechanical knowledge commensurate with the highly refined product as a ball bearing is and must be. Hammering to get a pulley on or off, binding of races or retainers in tightening some bolts, grease containing impurities, any one of these and similar factors is sufficient to cause failure of a ball bearing. The old style sleeve bearing requires a certain amount of care, but it is vastly more foolproof, and its simple functions are more readily grasped. The principal difficulty with ball bearings, therefore, comes in, when motors are dismantled in the field. Such work should be undertaken only by help equally skilled as the original assemblers. The writer has had cases where a number of motors, after successful service of several months have given trouble when dismantled for cleaning or roughly handled in connection with a change in the method of driving. It is largely in view of the difficulty in obtaining skilled labor for proper maintenance that ball bearings have up to the present not been applied as broadly as they might be to motors for general power purposes. The cases of trouble have been few by comparison, but sufficient to turn users against the ball bearings, and to cause motor manufacturers to avoid possible trouble for which they are held responsible even though the case may be one entirely out of their control, caused by dismantling and improper reassembling, or by faulty lubrication.

We have purposely put this consideration of service here in the first place, since the "service efficiency" is far more important, than efficiency in input-output of the motor. As for the latter it is true that ball bearings have appreciably lower friction than sleeve bearings. On the other hand, the losses due to friction in bearings of up-to-date motors are only a very small part of the total losses in the motor and, therefore, affect the motor efficiency only to that extent. Comparisons made between motors having well-designed sleeve bearings, and the same motors equipped with ball bearings have shown the average gain in over-all efficiency to be only a fraction of one per cent. This amount, of course, depends on the type and construction of the sleeve bearing, but in all cases tested, the margin was so small that it was at times completely lost by such details as the felt washers used for retaining the lubricant gripping the shaft too closely.

Lubrication and Oil Leakage

In regard to attention to the bearings in service, lubrication and oil leakage, it has been the writer's definite experience that attention at regular and not too long intervals is desirable, and in fact necessary with ball bearings. Oil leakage, largely overcome with well-designed solid sleeve bearings is unfortunately not unknown on ball bearings. However, the ball bearing offers advantages in this respect for certain applications. In special cases, for instance, motor-driven pumps along a railroad line, far away from any station, assuming a repair shop with skilled help to be available, or on motors in textile installations, which are as a rule mounted on the ceiling, the point of somewhat reduced attention may become of value and the additional expense for a special motor with ball bearings may be justified. Ball bearings are inherently more sensitive to the quality of lubricant supplied. Any acid or grit in the lubricant is likely to destroy the bearing. A babbitted sleeve bearing is capable of withstanding a greater amount of abuse and adverse conditions.

The air gap, that is, the clearance between revolving and stationary parts of a motor, has an important influence on the performance of the motor, or on the amount of material required in the motor to secure a certain performance. If it is possible, therefore, to reduce the air gap, in view of the fact that there is practically no wear in ball bearings, a gain may be made which would in part offset the additional cost of the ball bearing. This consideration applies only to alternating-current motors as in direct-current motors the gap depends on commutation and other electrical considerations and not on the possible wear of the bearing. With the large and well-designed sleeve bearings used on modern motors the air gap has been reduced to nearly the limit, which is drawn by manufacturing variations such as possible eccentricities and irregularities in the component parts, such as the rotor and stator punchings, bearing brackets, etc. For example. the air gap customary on motors of approximately 5 hp. amounts to only 0.0023 in.; a figure which cannot be reduced very much even if the feature of bearing wear is entirely left out of consideration. On the other hand, ball bearings reduce the risk of damage to the machines, which occurs when the wear in a babbitted sleeve bearing is permitted to go on, until the rotor rubs on the stator, and perhaps destroys the insulation of the windings by the heat produced. This is an unusual condition, because with liberal bearing area and good material, the wear is normally very slow, and the motor is, or should be, given an occasional inspection. but ball bearings further reduce the liability of trouble from this source. At the same time they do not entirely eliminate it. In the writer's experience there were two cases where the outer race of the ball bearing was worn to such an extent that the rotor struck the stator. This is unusual, due either to softness of the race or to faulty lubrication, but it proves that the possibility exists.

How Much Can a Motor Be Shortened?

The amount by which a motor may be shortened by the use of ball bearings is subject to wide fluctuations depending on the construction of the motor. The difference is somewhat greater on direct-current motors than on alternating-current types. For a certain line of standard alternating-current motors the writer found the actual reduction in overall length due to the use of ball bearings to vary between about 2 in. on a 2 hp. motor to 6 or 8 in. on motors of 35 to 50 hp. capacity. This shortening is an undoubted advantage of ball bearings in all those cases where space limitations make this feature essential. In mining locomotives ball bearings have come to be generally used for this reason, and on motors for use on board ships the same condition exists at times. For general-purpose motors it is not a decisive point.

From all this it seems, in the writer's opinion, to be fair to draw the following conclusions: There may be enthusiasts and pessimists on ball bearings, but the fact is that ball bearings properly selected as to size and quality give excellent service, provided they are correctly mounted and carefully maintained. But the absence of any of these four conditions may mean failure.

The correct mounting involves proper fits for inner and outer race, lateral supports for the inner race by nuts or collars and shoulders on the shaft, proper relation of lugs or flanges on the retaining housing of the outer race, clearance between such housings and the shaft, proper means for preventing escape of lubricant, etc. All these points do not present unsurmountable difficulties to the motor manufacturer, but as stated, require care and skill with proportionate increase in manufacturing costs. For motors to be repaired in the field this condition becomes much more serious, and has so far presented perhaps the most formidable obstacle to a more general use of ball bearings for all conditions of service. The manufacture of motors in quantities for stock, without either a definite destination or application, is a disadvantage in this respect.

But on specific application where the service is known and the operator familiar with the peculiarities of ball bearings, there is no objection from a service standpoint to their use.

The broader application of ball bearings in the general field of electric motors will come in proportion as the understanding of their requirements broadens. There is, therefore, a field for most useful educational work on the part of the ball-bearing manufacturer in issuing short clear-cut instructions on mounting and maintenance of ball bearings, giving all the manufacturing allowances and clearances recommended for a certain class of motors, giving also the points to be watched in dismantling and assembling, instructions in regard to lubricant to be used, draining and refilling, etc. In the absence of such knowledge even the best ball bearing is bound to give occasional trouble, and the annoyed user is then inclined to go to the other extreme of condemning ball bearings as such. The safe procedure for all concerned, motor manufacturer and user, as well as for the ball-bearing manufacturer, is therefore, to prepare the ground by spreading a thorough understanding of the conditions under which ball bearings give successful service before any broad application of them is made to general-purpose motors.

Muscle and Brain

By W. Thomas

I was at a shop recently where, owing to the country's needs, everything was apparently being forced to the highest speed. At least, this was the report that outsiders got, and all outsiders are in a position to know that just now the highest speed is none too high.

What impressed me most was the high speed of muscle and the slower speed of brain, and I thought I saw this exemplified very plainly on punching holes in plates. A punching machine in good condition, a product of one of our best manufacturers, was at work on plates about ½ in. thick, I should say, and roughly 6 ft. wide and about 12 ft. long. The plate was therefore quite flexible. It was supported from two trolleys running on bridges of small I-beam overhead cranes with tracks extending both sides of the machine. Owing to the bend in the plate, the height of the hooks had to be changed as they approached or receded from the punch, and the whole plate had to be dropped and new grips taken when the hooks reached the punching-machine frame.

The traverse of bridges and of trolleys to properly locate the plate under the punch was attended to by a man at each end. The plate was supported high enough to be against the punch when the latter was in its highest position and at rest. A man at the machine, with the help of the two men at the ends, would work the plate about until the pricked or other marked point was under the punch. The man at the machine would then nod or shout to a fourth man, who had been watching the other three, and this fourth man would put his foot on a pedal, the clutch would snap in, the punching-machine head would go down, carrying the punch and plate until it struck the die below, and the hole would be punched. Punching a hole seemed to be quite a feat.

The foregoing is not an exaggeration, for I have seen and venture to state that I can find many places even in shipyards, where today slowness is worse than criminality, in which not only four but five men will be found nursing a large husky punching machine and feeding it as if it was an invalid.

I know something of punching machines; and from what experience I have had, I feel safe in stating that with an underneath support for the plate in place of an overhead support, two, if not three, of the four men could be dispensed with. And the output, in place of being decreased, would be increased. The cost of installing an underneath support in place of cranes might be more, although I do not know; but I doubt if it would be much, if any. The wages of two men, however, could hardly be less than $5 a day, or $1500 a year. This is 10 per cent. on $15,000, and no under support I have ever seen would cost that, unless it was some special spacing device good only for much duplicate work.

Gag vs. Clutch Control

Of course, the under support means a gag control of the punch in place of a clutch control; but the helper could throw in a gag more easily than he could release a clutch, and I question if the upkeep cost is as great for gag control as for clutch control.

I have heard it suggested, and it sounds reasonable to me, that if the punching machine was fitted with a variable-speed motor it would also help increase the output. The idea is that the speed on any job would be so made that the operator would just have time to nicely locate his work to get a hole every other stroke. For instance, if the machine was running 30 strokes per minute and the operator found he could not quite get his work properly located in one idle stroke, it would mean he had to take three strokes per hole, or 10 holes per minute. If he could slow his machine to 25 strokes, he would get 12½ holes per minute. It seems worth considering. The speed range required should not be great.

While I have only mentioned punching machines, I do not doubt that there are operations in many shops that could be speeded up materially by the use of more brain and less muscle. Every manager should see that his foremen are constantly on the lookout for any chance to improve the output by other means than simply working the men faster or putting more muscle on the job. Output does not depend on muscle, unless muscle is properly directed and applied.

Repairing Old Planing Machines

By Vilas H. Jackson

I was given a free-hand in overhauling a dozen old planing machines which had been in service from ten to thirty years and made by various manufacturers. They ranged from 20 in. to 36 in., in size. I found the T-slots and stop-pin holes badly worn and after measuring both on all the machines, I decided to make them uniform in order to interchange stops, studs, bolts, angle, squaring plates, etc. Securely clamping an electric end milling attachment to the rail head having the largest T-slots I procured a cutter that would just clean up the bottom, top and sides of the lower portion of the T-slots, leaving the sides of the upper portion to be planed later. I then threaded a 1-in. rod a little longer than the longest table, drilled and tapped the front end of each table to a tight fit for the feed screw, and then bushed and tapped an old 12-in. flanged pulley to fit the screw. I clamped a big angle plate on the floor, far enough ahead to clear, with a hole in line with feed screw. I next mounted a 6-in. pulley on an electric portable drilling machine spindle, and clamped the drilling machine to the floor with the pulley in line. I rigged up a wooden horse to support the screw when extended. With the planing machine drive and reverse belts off, and after a few trials with different feeds and by regulating the speed of the portable drilling machine, I milled the T-slots on each planing machine rapidly and accurately.

Drilling and Reaming

The table of each machine was then placed right side up under a radial drilling machine, and new holes were drilled where needed, and old and new holes reamed. Large holes were drilled in the chip boxes to facilitate cleaning. I then inverted the tables and counterbored each hole twice its diameter, and 1½ times its diameter in depth. Round nuts were made of cold-rolled steel with a shoulder turned to clear one-half of the pin-key drill and tap. The nuts were twice the stop-hole diameter deep on their threaded portion with a shoulder flush with the under side of the machine table. After pressing in the nuts I drilled and tapped half-and-half for ⅜-in. pin-keys, which were a tight fit, and were made of long rods cut off in 12-in. sections, forced in by a stud nut, sawed off and upset.

Planing the Ways

The ways of each planing machine base were then trued on a large new planing machine, and the table ways planed to fit, relieving the rack if necessary. I then planed the head slides, rebushed the bearings, and attended to all other needed repairs. Tables were scraped in and run for a week on rough work, after which I planed the sides and surface, also the sides of the grooves. I then planed T-nuts in long bars, $\frac{1}{32}$ in. below table surface, and a loose sliding fit in T-slots. T-nuts were then drilled in a simple sliding jig, spacing holes three times a bolt's diameter. I tapped them in long bar lengths in a small drilling machine, using one roughing and one finishing tap. The nut bars were then sawed off, making about two dozen for each planing machine. I next drilled, tapped and turned, then sawed off a large number of ordinary square head stops with a heavy-cuffed screw, making stops of various heights up to 4 in. I tapped these in the same way I did the T-slot nuts, except that the drilling machine table was tilted to place the setscrews in the stops on an angle. I also made a number of heavy high combination multi-parallels, stops and planing machine centers, using 2 x 6 in.; 2 x 8 in., and 2 x 12 in. steel slabs, cutting them at an angle on the cold-saw, drilling and marking them in pairs for the setscrews or stop centers. I held them to the planing machine table by a stud fitting stop-pinhole and a nut at the bottom of the stop-pinhole. These stops may be used in either direction, also as angle plates and parallels, and are cheap if rightly made. I drilled and slotted them for hexagonal nuts. I made a number of standard angle plates, and in making these I drilled them for stops as well as bolts, and made the backs support a standard angle, which I machined. I then made one long multiface angle plate full length of our longest small planing machine table. With keyway bolt slots, stop-pin holes, squaring lines, etc.

The studs next occupied my attention and I made them in large quantities scrapping all the miscellaneous hexagonal and square nuts, and making a large number of double length hexagonal nuts with wrenches to fit. Nuts were kept on the studs with the length stamped on the end of each stud, while the stud dropped through a large plate near the planing machine.

Increasing the Labor Supply

By Entropy

In spite of the immense number of men engaged in war, the attendant activities and the demand of other industries, expressed in terms of high-wage rates, our park benches, saloons and poolrooms appear to have suffered little in patronage.

Of course nobody wants them, because they are bench warmers, and do not know what work is. Nevertheless, they are slackers in an industrial sense and should be made to secure employment of some kind. They, very probably, have not sufficient physique to stand up under army life, and they are quite often limited in mental caliber. From an employer's standpoint they are infinitely inferior to women and children, but from a community standpoint they do not deserve to eat, because they do not work. Most of them have some slight connection, though indirect, with a pay envelope. They are usually partially supported by some member of the family, who has not the heart to see them actually starve. They are therefore undernourished and incapable of real work.

Once fed and brought up to a stage of physical soundness, they should be made to work at something so disagreeable, though necessary, that they would revolt, and volunteer to do something more useful, thereby saving themselves and their friends much worry and concern.

We say a great deal about rebuilding men, maimed and wounded in the war, and in industrial accidents, but here is a field, wonderfully fertile, right at our doors that has been waiting many years for attention.

Often what these people need is not altogether physical. Some of them have simply lost their grip. They are following the line of least resistance. Having tasted the joys of living without effort, they find it easier to stop wanting things than to go out and earn the money with which to buy them.

Men who have lost their grip are objects of derision, when they should be objects of study. They sometimes come back. Those that have come under my observation have come back through being successful at some very simple, almost childlike, occupation. They seem to have suffered something similar to mental paralysis, which necessitates the complete training of new mental powers. A nagging wife, or derisive companions makes the disease worse until the point is reached, where rebuke is expected and received in sullen silence, or passed off with a shrug.

What is really required is an educational process in which gentle and constructive leading is sandwiched in between a couple of stiff kicks.

Repairing a Cracked Irregular Hub

BY J. V. HUNTER

A successful method of repairing broken hubs of irregular shape is here given. The same scheme is also shown to be applicable to other work of a similar nature.

MANY a cast-iron wheel or pulley has shown a cracked hub after it has been in service for some time, due often to driving in a taper key too tight or some similar fault of the assembler. Usually, these cracks are discovered after the machine has been in the shop so long that there seems to be little chance for a "come-back" at the manufacturer. In such instances it is a common method of repair to forge up a good heavy steel ring and shrink it on either one side or both sides of the hub; these rings take up all the strain that usually comes upon the hub. I have known of such pulleys being in use for many years after such a repair, and have yet to come across one that has failed. However, when such a cracked hub is not a true circle, nor even an ellipse, but a very irregular outline full of clutch parts, then the proposition of forging a band ring and shrinking it into place is out of the question, because for one thing a shrinking ring tends to pull into circular form, and that must undoubtedly create a distortion of the hub at its weak parts.

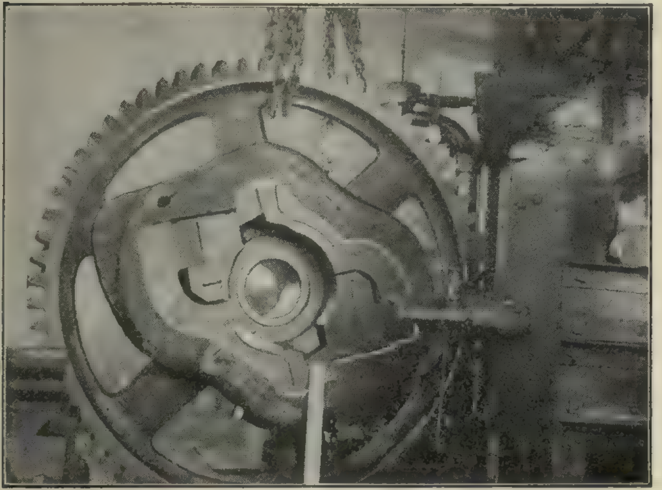


FIG. 1. THE REPAIRED HUB

We have recently had the unfortunate experience of a cracked hub and clutch-container portion of the large drive gear on a 4-in. forging machine. This gear was of cast steel, weighed the best part of a ton, and the price quoted to us for a new one for replacement came to nearly a thousand dollars. Consequently, if a good and permanent repair could be made within a cost of a couple of hundred, the saving would be well worth a little effort.

The illustration, Fig. 1, shows this gear wheel after a great irregular cast-steel band had been put in place for repair. The main body of the clutch hub lies inside the white line that is the mark of the zinc filling. It will be noticed that this hub is in many ways a poor design, in that light and heavy sections are closely joined and can hardly avoid causing shrinkage strains that might be expected eventually to cause trouble. At the same time these thin sections are in a position that undergoes a great strain from the backlash of the machine, which in this particular case probably caused them to tear loose from the heavy parts and spokes.

The damage to this hub was so severe that pieces were actually broken out, and this damage was first repaired by a thermit weld. Following the outline of the hub and sufficiently oversize so that there would be ¼-in. play all around after casting, a pattern was made up for casting the steel band shown. This was given a uniform heavy section and shaped to come down around about half the thickness of the spokes. The section of this band was something over 5 in. square; naturally, so heavy a section must be cast carefully with heavy risers to insure a sound casting. After receiving the casting, it was chipped and fitted down into place over the hub, then drilled for a heavy bolt to pass through the center of each spoke as an additional precaution.

THE FILLER

The main problem now was to provide a solid and permanent filler for that space between the band and the hub. For this problem we had previous experience to guide us gained by setting the cast manganese-steel centers in street railway-track special work. Such steel cannot be machined or provided with any of the common forms of machinery fastenings. Consequently, it is usually set in place in the main steel casting, held in place to as great an extent as is practicable by means of wedges, and all space that is then left where lateral motion might occur is filled with molten zinc.

The molten-zinc filling method was resorted to to fill every particle of the space between the hub of the gear and the strengthening band. To accomplish this properly, the gear was laid in a bed of molding sand with the band side uppermost. The sand was carefully rammed about every crevice visible on the under side, through which the molten metal might escape while being poured. A small funnel gate was provided at one point of the space on the upper side to aid in guiding the metal into the narrow space to be filled. This funnel was made of soft clay.

It has been our experience that if the steel is too cold when attempting to pour the molten zinc, the rapid chilling action of a large body of metal may cause the metal to set long before it has traveled far enough to fill up more than half the space. Likewise, pouring upon cold metal runs the risk of striking damp spots that cause the molten metal to fly and spatter. To avoid any troubles of such a nature, a large oil torch was procured, such as is now found in nearly every shop, and the whole casting was heated with this until its temperature was probably more than 300 deg. C.

The zinc, which had meanwhile been melting in graphite crucibles in a blacksmith's forge fire near-by, was then rapidly poured into the space provided. As it cooled and shrank down, a little more was added to keep the space full. After cooling, the gear was removed from the sand, and the surplus fins of zinc metal were neatly trimmed off.

The result was approximately as shown in Fig. 2, where *A* represents the cast-steel band, *B* the zinc filler, *C* the main hub and gear body, while *D* is the clutch portion of the mainshaft.

The amount of steel in the cast band is amply sufficient to insure against future breakage. By this method of securing it upon such a hub of so irregular shape, there is no possibility of causing a distortion of the hub, as might have occurred had an attempt been made to shrink it on by the usual well-known methods.

As for judging the success of this repair from the standpoint of service, the machine has since been in almost constant use for nearly a year, on all classes of work, some of it the heaviest that the machine itself will handle, and it today shows not the slightest signs of weakening.

A similar use of this same process for manufacturing purposes of a kind that does not seem to be so generally known, is illustrated in Fig. 3. This particular method was used some years ago in making up the hubs of large traction-engine wheels that we were then building. The center spindle *X* was to be made of different material from the large hub casting *Y*. The regular machinists' method for handling such a proposition would be to bore out the hub and turn the outside of the spindle so that one would be a press fit into the other.

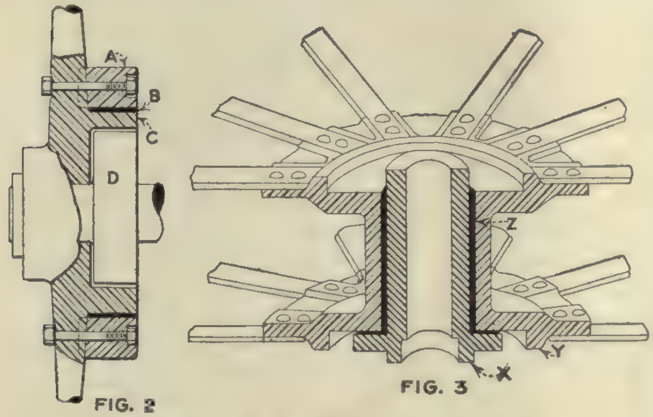


FIG. 2

FIG. 3

FIGS. 2 AND 3. SECTIONAL VIEWS

Unfortunately, there was no lathe or boring mill available large enough to swing these big hubs. The illustrated method of setting the hubs was then developed and gave excellent satisfaction and service. The outside of the spindle was left rough, the inside of the hub likewise, saving two operations of machining.

For assembling, the spokes and rim were first riveted to the hub casting. The bored-out spindle was placed over a pin set vertically in a large floor-plate, and the wheel was set over this and carefully centered. The cracks at the bottom were closed with a putty made of fireclay mixed with a little linseed or machine oil (using oil for this because it does not cause the molten metal to spatter, as water or dampness may do, the molten metal was then poured in at the top, and the job was complete.

One feature of a spindle so set that is an advantage over a pressed-on spindle is the possibility that an engine expert has of replacing it in the field; by building a small fire under the hub the spindle can be melted out, and a new one put in place in the same manner as was accomplished in the shop.

[Shrinkage difficulties sometimes encountered in work of this kind may be largely decreased by the addition of a small amount of antimony to the zinc.—Editor.]

Cutting Large Radii on a Lathe

By Lewis F. Moody

I have noticed on page 714 of the *American Machinist* an interesting, though brief article by H. L. Turner, describing an ingenious method of cutting large radii on a lathe.

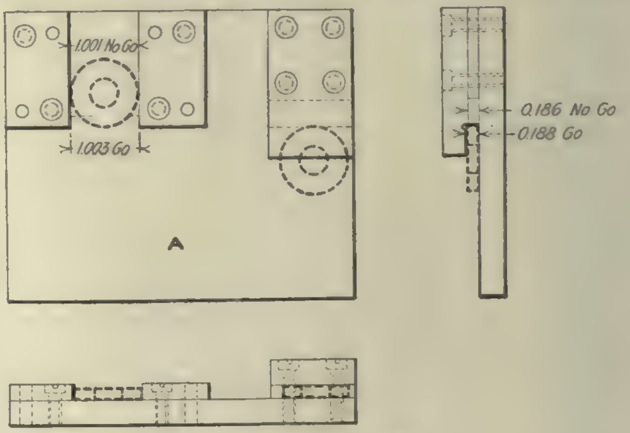
I would like to call attention to the fact that the surfaces cut by this method will have varying and not constant radii; in other words, the surface will not be that of right circular cylinder, and the method should not be used when the work is intended to fit against an ordinary cylindrical surface unless an approximate fit will be satisfactory, as was no doubt the case in the application described in the article; namely, pipe flanges to fit a plate-steel tank. The surface produced by this method is an oblique cylinder with circular base; the base being the plane of the faceplate, and the axis being parallel to the motion of the compound rest. A section of the surface by a plane perpendicular to the axis will be an ellipse and not a circle, so that the surface produced can be considered as an elliptical cylinder. This may in many cases form a sufficiently close approximation to a circular cylinder to be used as a substitute.

The method should be viewed as a means of cutting elliptical cylinders or portions of such surfaces, and it should be capable of producing this form of surface with accuracy. It may avoid misapplications to make this point clear.

Inspection Gage

By M. W. Mann

The illustration shows a gage used mainly by the inspection departments. The inspector puts a number of parts to be gaged on the base *A* and then simply pushes the work under or through the gage. The same idea can be carried out for gaging work with several diameters and shoulders. All the parts are made of tool steel hardened and ground, and when necessary lapped.



THE INSPECTION GAGE

Governmental Suggestions for Arsenals and Manufacturers

THE following summary of General Orders No. 13, issued by the Chief of Ordnance, Nov. 15, 1917, is of interest to all manufacturers and should be carefully considered.

In view of the urgent necessity for a prompt increase in the volume of production of practically every article required for the conduct of the war, vigilance is demanded of all those in any way associated with industry, lest the safeguards with which the people of this country have sought to protect labor should be unwisely and unnecessarily broken down.

SAFEGUARDS OF EFFICIENCY

It is a fair assumption that for the most part these safeguards are the mechanisms of efficiency. Industrial history proves that reasonable hours, fair working conditions, and a proper wage scale are essential to high production. During the war every attempt should be made to conserve in every possible way all of our achievements in the way of social betterment.

In the preparation of the following memoranda no effort has been made to establish or even to suggest definite rules of conduct. The memoranda present what may be considered a fair, if tentative, basis of action.

The department wishes to be assured that schedules of hours obviously excessive or wage scales distinctly unfair or working conditions such as should not be tolerated, will certainly be brought to its attention.

HOURS OF LABOR

1. The day's work should not exceed the customary hours of an establishment or the standard already attained in the industry and in the community. It should certainly not be longer than 10 hours for an adult workman.

The drift in the industrial world is toward an 8-hour day as an efficiency measure.

It has been shown also that hours of labor must be adapted to the age and sex of the worker, and the nature of the occupation.

2. The theory under which we pay "time and a half" for overtime is a tacit recognition that it is usually unnecessary and always undesirable to have overtime. The excess payment is a penalty and intended to act as a deterrent. There is no industrial abuse which needs closer watching in times of war.

3. Eight hours per shift should be a maximum in continuous 24-hour work.

4. The half holiday on Saturday is already a common custom in summer, and it is advantageous throughout the year, especially if the work day be 10 hours long the other days of the week. The working period on Saturday should not exceed five hours.

An occasional shift of two or three hours on Saturday afternoons is unobjectional if essential, but the additional hours should be regarded as overtime and paid for on that basis.

5. It is desirable that the hours of labor for every tour should be posted.

6. The observance of national and local holidays will give opportunity for rest and relaxation which tend to make production more satisfactory.

7. One day of rest in seven should be a universal and invariable rule.

STANDARDS IN WORKROOMS

1. Existing legal standards to prevent danger from fire, accident, occupational diseases, or other hazards, and to provide good light, adequate ventilation, sufficient heat, and proper sanitation should be observed as minimum requirements.

2. All toilets should be sanitary and readily accessible.

3. Those processes in which workers are exposed to excessive heat—that is, over 80 deg.; or excessive cold—that is, under 50 deg.—should be carefully supervised so as to render the temperature conditions as nearly normal as possible.

When extreme temperatures are essential, workers should not only be properly clothed but avoid sudden changes.

4. If any light is at the level of the worker's eyes it should be so shaded that its rays will not directly strike the eyes.

WAGES

Standards already established in the industry and in the locality should not be lowered. The minimum wage rates should be made in proper relation to the cost of living, and in fixing them it should be taken into consideration that the prices of necessities of life have shown great increases.

NEGOTIATION OF DIFFERENCES

The need of preserving and creating methods of joint negotiations between employers and groups of employees is especially great in the light of the critical points of controversy which may arise in a time like the present. Existing channels should be preserved and new ones opened, if required, to provide easier access for discussion between an employer and his employees over controversial points.

THE EMPLOYMENT OF WOMEN

1. Existing legal standards should be rigidly maintained, and even where the law permits a 9- or 10-hour day, effort should be made to restrict the work of women to 8 hours.

2. The employment of women on night shifts should be prevented as a necessary protection, morally and physically.

3. No women should be employed for a longer period than 4½ hours without a break for a meal, and a recess of 10 minutes should be allowed in the middle of each working period.

4. At least 30 minutes should be allowed for a meal, and this time should be lengthened to 45 minutes or an hour if the working day exceeds 8 hours.

5. Meals should not be eaten in the workroom.

6. The Saturday half holiday should be considered an absolute essential for women under all conditions.

7. For women who sit at their work, seats with backs should be provided, unless the occupation renders this impossible. For women who stand at work, seats should be available and their use permitted at regular intervals.

8. No woman should be required to lift repeatedly more than 25 pounds in any single load.

9. When it is necessary to employ women in work hitherto done by men, care should be taken to make sure that the task is adapted to the strength of women. The standard of wages hitherto prevailing for men in the process should not be lowered where women render equivalent service. The hours for women engaged in such processes, of course, should not be longer than those formerly worked by men.

10. No work shall be given out to be done in rooms used for living purposes or in rooms directly connected with living rooms in any dwelling or tenement.

EMPLOYMENT OF MINORS

1. No child under 14 years of age shall be employed at any work under any conditions.

2. No child between the ages of 14 and 16 years shall be employed more than 8 hours a day or 48 hours a week, and night work is prohibited.

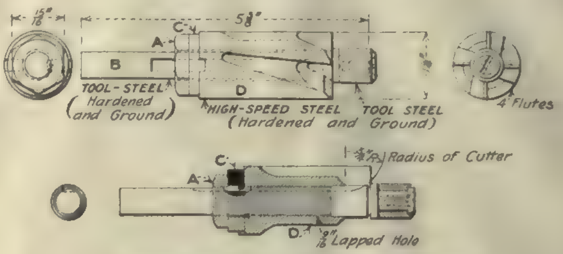
3. These and other provisions of the Federal child labor law must be strictly observed.

4. Minors of both sexes under 18 years of age should have the same restrictions upon their hours as already outlined for women employees.

An Economical Counterbore

BY M. W. BOSSMANN

In these days of high-priced steel many ingenious ways have been devised whereby the waste of the steel has been brought down to a minimum. The illustration shows a four-fluted counterbore. The body is made of high-speed steel and the rest is made of carbon tool steel. When it is necessary to grind the counterbore it is disassembled by unscrewing nut *A*, and pulling out the lock washer *C*, when the body *D* can then be pressed off. The body *D* should be a ring fit over spindle *B*. It can be seen that as the counterbore is ground off the nut and lock washer are brought closer to its end until there is hardly any of the body left.



AN ECONOMICAL COUNTERBORE

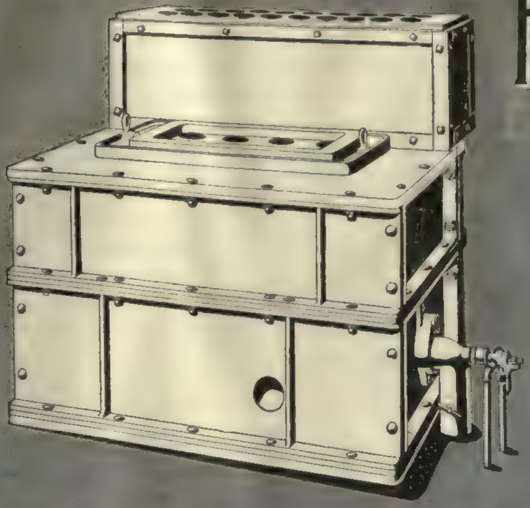
Another good feature of this counterbore is the movable pilot. The hole that this pilot was to run in was a very particular one, with only 0.001 in. limit. The ordinary pilot would wear the hole large, but in this pilot there is no wear on the hole in work.

Packard Technical Training School

BY C. R. LESTER

The Packard Motor Car Co., Detroit, Mich., has organized a technical training school under the management of C. R. Lester, which is open to all men who have had mechanical experience in the automobile industry; the idea being to provide technically trained workmen for service stations. The company is conducting this school on the theory that the average worker must earn while he learns, and they have, therefore, adopted the plan of paying a living wage to all students enrolled in the school irrespective of age and have formulated a plan for their advancement based on: (1) Usefulness to the company while learning. (2) Previous application to similar problems. (3) Previous practical experience in mechanics. (4) Previous technical training, if any. A night school is also conducted in which drafting, arithmetic, etc., are taught.

A GROUP OF STUDENTS ON ACTUAL ASSEMBLYING OPERATIONS AT PACKARD SCHOOL



HEAT TREATMENT AND TEMPERATURE MEASURING for SHELLS

BY
J. R. VAN WYCK

The following is a description of a successful method of heat treatment and temperature measuring that was used in the manufacture of two million three-inch Russian shrapnel shells.

THE parts treated as described in this article were shells manufactured from blank forgings with the melt number of the pouring stamped on each, and the ladle analyses given and afterward checked. The proportion of carbon in the steel averaged about 0.50 per cent. A close estimate can be made by comparing the pearlite (dark) and ferrite (white) areas found by grinding, polishing and etching normalized samples. It is well-known that the physical properties of steel having certain chemical properties, can be changed by using the proper heat treatment, and this was done between the rough and the finishing operations.

LEAD BATH FURNACES

Lead bath furnaces, with room for 8 shells, and a preheater, with room for 20 shells, like that shown in headpiece and manufactured by Tate-Jones & Co., were used. The advantage of the lead bath of this particular type of furnace was the uniform heat distribution in the lead pot; elimination of burning, scaling, hard spots; and the ease of regulating the oil burners to the exact temperature desired. All shells were heated and cooled in exactly the same manner.

The shells in the preheater were heated from 700 to 900 deg. F. before being placed in the lead, and were held in place by being pushed down in the lead by plugs through holes in the cover. Pure lead was used for the bath. The recess at one end of the pot was used at first for the thermocouples, but they were placed afterward in the center where more accurate readings of the temperature of the bath are given.

Fig. 2 shows the plan of one floor, the arrangement of the heating and drawing furnaces, signal bench, etc. Each furnace heated the shells at the rate of 60 per hour. The shells were kept in the lead bath 8 min. and all were evenly timed by a flasher system described elsewhere. The labor required to operate was a foreman in charge, an operator at the signal bench, a floorman to regulate the burners from the signals, and three men for every two furnaces. There was also an electrical engineer in charge of the pyrometers and testing, and a man to look after the oil burning and cooling systems. This type of furnace has, at another installation, heated shells at the rate of 96, and as high as 115 shells per hour; that is, 5 min., and 4 min. 10 sec. in the lead bath; and the direct labor meant an average required of about 5 men for two furnaces. A system of ventilation was provided for carrying off the fuel gases, the furnace heat and the poisonous vapors given off from the lead.

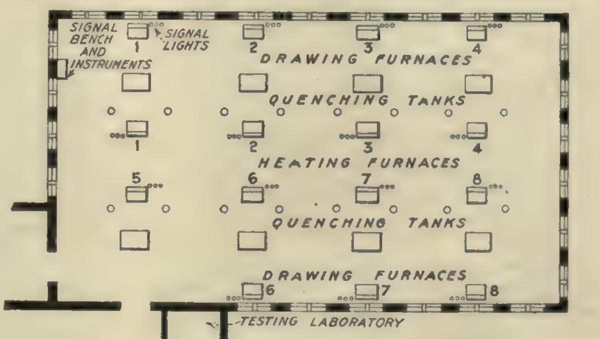


FIG. 2. FLOOR PLAN

The automatic furnaces came next to the lead-bath furnaces for uniform heating and cooling, and possessed advantages over the hand-operated furnaces, by increasing the output in proportion to the labor and fuel, by reducing the cost of operation and by eliminating the poisonous vapors given off from the melted lead.

Texas fuel oil, which had an average density of 0.88 and 18,850 B.t.u. per lb., was stored in three large tanks in the yard and from there pumped by a No. 1 Tate-Jones pumping and heating system placed in the basement to the burners on floors *A* and *B*, Fig. 3. Daily readings of the oil in the tanks were taken, and for cold weather (in order to have the oil flow freely) the oil was heated by steam coils from 90 deg. to 100 deg. F. Duplicate steam pumps were mounted on the frame of the heater that utilized the exhaust steam for heating the oil. An air dome on each pump was used to take up any pulsations, and a relief valve that could be set for any pressure to discharge any excess oil back into the tanks. Each pump had a strainer, that could be easily removed and cleaned, for catching any dirt, etc., that might clog the burner.

A steam pipe ran along the oil pipe (after it left the heater), and both were inclosed in the same pipe covering to prevent the oil cooling, reducing its consistency, and to make it atomize satisfactorily at the burners. A return oil system was installed with a valve on each floor for regulation, so that the operator could maintain a constant pressure of 14 to 15 lb. The burners were of the mechanically atomizing type made by W. S. Rockwell Co., and consumed about 2¼ gal. of oil per hour.

An oil-pressure gage and an air-pressure mercury gage placed in the wall over the signal bench, as shown in Fig. 4, were for the operator's use in regulating the burners. The air for the burners was supplied by three blowers; two No. 2 Roots horizontal and one No. 7 Sturtevant; which maintained a 2½-lb. pressure.

The shells were uniformly placed in and removed from the quenching tanks and were not allowed to bunch. To prevent any irregular heating in the bath the oil in the quenching tanks (62 x 48 x 42 in.) was maintained at a uniform temperature by being pumped through a series of coils in a tank (24 x 8 x 5 ft.) out in the yard filled with flowing water pumped from the river.

The proper heating or hardening temperature for steel, as given in "Heat Treatment of Steel," is as follows: "When tungsten or carbon steel ceases to increase in hardness with the temperature; that is, 35 to 50 deg. above the hardening point, provided the heating is sufficiently prolonged for the steel to acquire thoroughly the condition pertaining to the temperature." "One of several indications of this change-point is the shortening of bars hardened in water at a temperature below that point, whereas the bar lengthens, if this temperature is exceeded at the time of quenching."

The temperature of the lead at the heating furnaces was maintained constantly at 1500 deg. F.

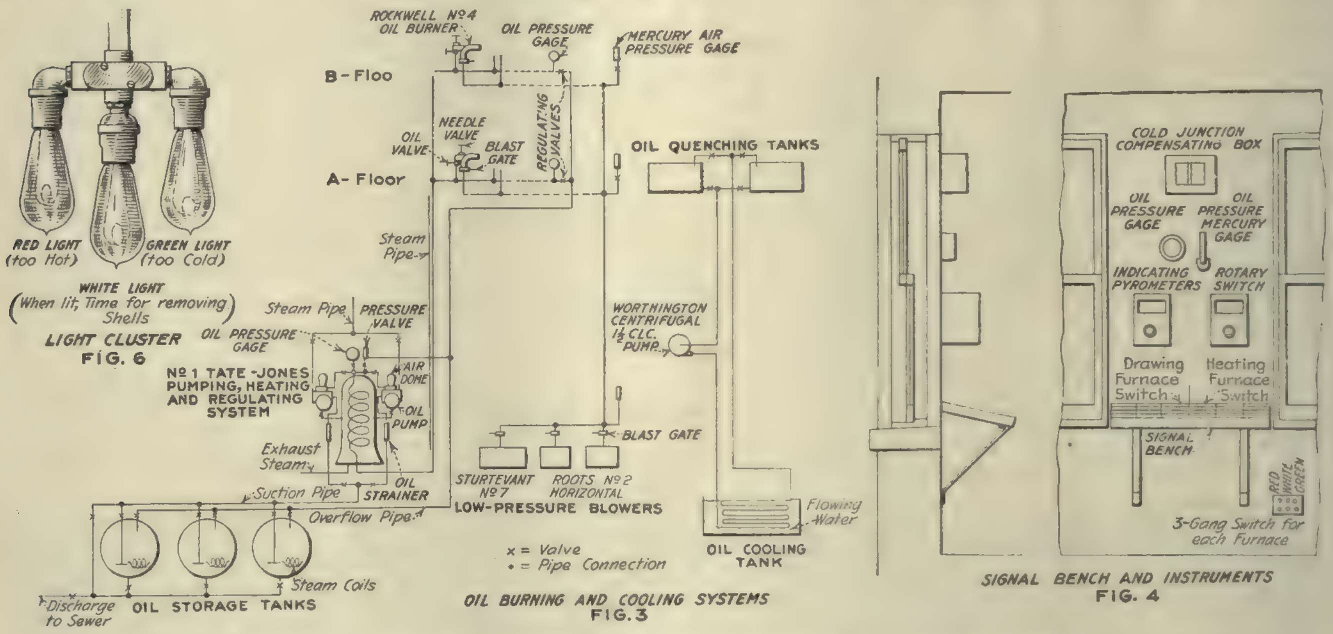
The temperature of the lead in the drawing furnaces was maintained at first at 1050 deg. F. as the annealing temperature, but afterward tests were made at different drawing heats from given melt, and the physical properties plotted on a curve as shown in Fig. 5, and the most satisfactory annealing temperature selected. Ordinarily 50 deg. difference in the drawing temperature changed the tensile strength from 7000 to 8000 lb. per sq.in. and sometimes as much as 10,000 pounds.

SIGNAL SYSTEM

A signal system of colored lights was mounted at the right of each furnace for regulating the burners as shown in Fig. 6, and operated from a signal bench as shown in Fig. 4 was used. When the temperature was too hot the operator lit the red light and when too cold, a green light, and for timing the shells in the bath, a white light (operated by a flasher) flashed for about twelve sec. at 1-min. intervals.

Had there been time for delivery of a variable-speed motor, or by using different size pulleys on the flasher, the time for heating the shells in the bath could, by experimenting, have been adjusted to the minimum, the output materially increased, and the cost of heat treatment for shells in a lead-bath furnace, greatly reduced.

In front of the signal bench an operator was stationed for constantly taking the temperature of the furnaces, for signaling the floor man and for watching the oil and pressure gages. The flasher was so connected that each flasher could signal either or both floors. The bench was a metal box with a top made up of standard 3-gage push button plates with switches mounted on them. Each plate had a number corresponding with the furnace it signaled. Fig. 7 shows this signal and flasher wiring.



LIGHT CLUSTER FIG. 6

OIL BURNING AND COOLING SYSTEMS FIG. 3

SIGNAL BENCH AND INSTRUMENTS FIG. 4

FIGS. 3, 4 AND 6. A NUMBER OF DETAILS OF THE HEATING SYSTEMS

The pyrometers, thermocouples, compensating box, wire, etc., were furnished by the Brown Instrument Co., and the temperature of each furnace was taken by the thermoelectric method, which made use of the well-known principle of heating the junction of two dissimilar metals or alloys, and measuring the e.m.f. set-up. Wiring diagram of the pyrometers and thermocouples is shown on Fig. 10.

An indicating high-resistance (600 ohms) pyrometer of the millivoltmeter type having a rotary switch for connecting the several working thermocouples and graduated to 1600 deg. F. for the heating and 1200 deg. F. for the drawing of the furnaces was used. These instruments having such high resistance made many errors due to slight variations in the length or resistance of the circuits negligible. The workmen and others were all instructed and warned that static electricity could be developed by rubbing on the glass front of the instrument and, in some cases, it was found that simply blowing on the glass was sufficient.

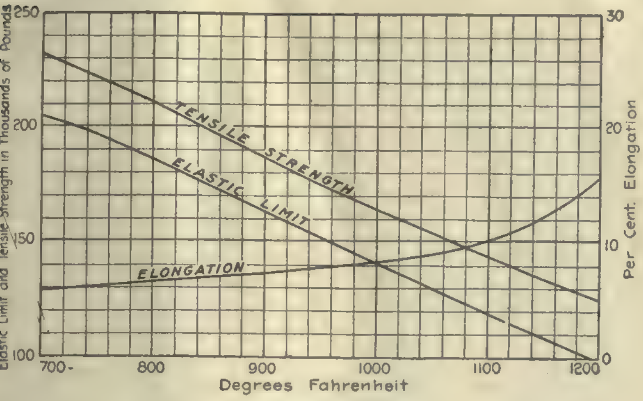


FIG. 5. PHYSICAL PROPERTIES AT VARIOUS TEMPERATURES

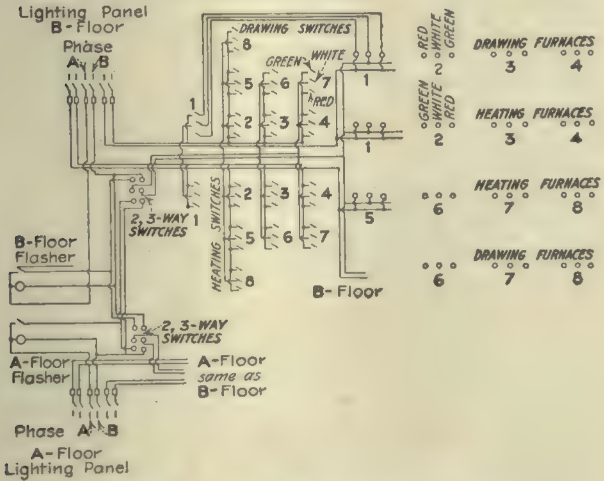


FIG. 7. SIGNAL WIRING SYSTEM

Some installations have (in addition to the indicating pyrometers) recording pyrometers that can be plugged in on any thermocouple circuit, and the temperature recorded.

A compensating box was used to keep all the cold junctions at the same temperature, and prevent any errors due to differences. This box consisted of lamps connected to the light circuit, operated by a thermostat set for any given temperature slightly above that of the room. By the making and breaking of the lighting circuit the heat of the lamp kept the temperature to within 2 deg. constant. In this box the compensating lead from the couples and the copper leads from the pyrometers were connected.

Base-metal thermocouples were selected on account of being inexpensive, rugged and suitable for temperatures of this class of work. These couples were made up at first in angle form (8 x 22 in.), formed of the wire $\frac{1}{8}$ in. in diameter, 90 per cent. nickel, and 10 per cent. chromium with a resistance of 0.0243 ohms per ft. as the positive lead, and the other $\frac{1}{8}$ in. diameter, 98 per cent. nickel, and 2 per cent. aluminum with a resistance of 0.00816 ohms per ft. as the negative lead. They were standardized to duplicate to within $\frac{1}{10}$ millivolt or 4 deg. F., the voltage of the platinum rhodium thermocouple used as a standard. The wiring for each base-metal thermocouple is shown on Fig. 9. Below the binding posts was a shunt of manganim wire with enamelled insulation withstanding 800 deg. F. This shunt was used to reduce the voltage of the thermocouple to a definite standard and the shunting effect amounted to $\frac{1}{10}$ of the total voltage. The shunt and welded junction had to be watched when in service, for open circuit.

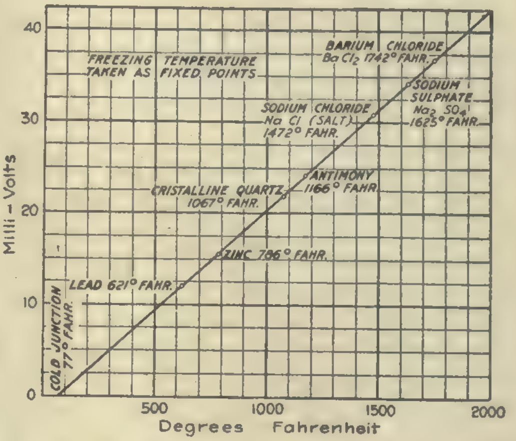


FIG. 8. CURVE FOR CALIBRATING THERMOCOUPLES

The base-metal thermo-couples were at first furnished by the manufacturer, but afterwards only the material was purchased, and we made the thermocouples ourselves. In making the thermocouples, wire was cut in 32-in. lengths; the ends of the wires twisted and welded, and the other ends threaded and well tinned. Pipe stems were placed on the wires, and the wires screwed into brass studs and carefully soldered fast, and the couple inclosed in a $\frac{3}{4}$-in. conduit with a nickel chromium protecting tube for inserting in the lead. The other end extended out where the heat was less, and on the conduit was placed a condulet with a porcelain or preferably a composition cover through which the brass studs passed.

It was found that at the end of the brass studs an e.m.f. was set up which was not always neutralized, owing to some differences in temperature between the end inclosed in the condulet and the end outside, and permitted of some errors in the readings. This error could be eliminated by using some sort of a solderless connector made of the same material.

Compensating leads of exactly the same material as used in the thermocouples covered with asbestos insulation and having a resistance of 0.126 ohms per ft. connected the couples with the cold junction box.

A platinum rhodium thermocouple formed of chemically pure platinum; and platinum 90 per cent., rhodium 10 per cent., insulated with clay tubes and placed in a porcelain tube for protection, was used as a standard for calibrating the standard base-metal thermocouples and for checking the working couples; base-metal thermocouples were used as standards.

An electric furnace for heating and calibrating the couples with the standards was made by winding No. 24 Nichrome wire on 2-in. burned clay tubes, and covering with ordinary steam pipe insulation. For melting salt, a furnace was made of a rejected 3-in. shell covered with $\frac{3}{32}$ in. asbestos and cement, and double wound with 25 ft. of No. 24 Nichrome wire and covered with $\frac{1}{8}$ in. asbestos and cement, and a pipe covering. A sensitive double-scale millivoltmeter was used in calibrating.

METHOD OF CHECKING AND CALIBRATING

A very careful and systematic method of checking, once a week, the working base thermocouples with the standard base-metal couples in the electric furnace was used.

The manufacturer furnished us a curve with millivolts as ordinates and degrees Fahrenheit as abscissae for checking the type of thermocouples we were using. This curve can be plotted by taking the millivolts of the freezing temperatures of different substances that are sharply defined, as shown in Fig. 8, or by taking the millivolts and freezing temperatures of only two and by Holman's formula calculating the other points, or work by working out a curve that is the resultant of both. Holman's formula is the simplest and best suited for general use, and from 500 deg. to 2000 deg. F. has a maximum error of only 4½ deg. F.

In checking the standard platinum-rhodium thermocouple, salt chemically pure (NaCl) was heated in the electric heater and brought up to 1550 deg. to 1600 deg. F., and the thermocouple in another furnace brought up to approximately that temperature and then placed in the melted salt; care being taken not to subject the couple to any sudden changes in temperature. Current was turned off, cold junction temperature taken, millivoltmeter needle set at zero and readings of the salt taken every 10 sec. By plotting these readings of the cooling salt, there was a gradual drop till the salt began to freeze, when the readings became constant until the salt solidified, then the readings dropped again. The constant reading was taken as the freezing point, and with corrections made for the temperature of the cold junction should be very close to 1472 deg. F.

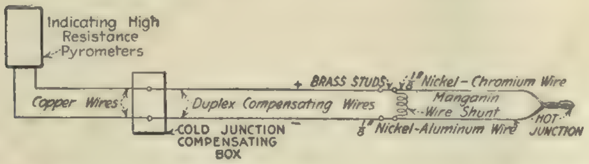

Indicating High Resistance Pyrometers
Copper Wires
+ BRASS STUDS
1/8" Nickel-Chromium Wire
Duplex Compensating Wires
Manganin Wire Shunt
COLD JUNCTION COMPENSATING BOX
1/8" Nickel-Aluminum Wire
HOT JUNCTION

FIG. 9. WIRING OF BASE-METAL THERMOCOUPLES

The standard base-metal thermocouples were calibrated with the platinum thermocouples by removing the protecting tubes and tying together (not touching) with asbestos tape. It is important that the tips of the couples be close together and centrally located within the furnace, that the heads of both be at the same temperature, and that the furnace be maintained at a constant heat for at least 15 min. before testing. By adjusting the shunt wire below the binding posts with a soldering iron the standard base-metal thermocouples should read within $\frac{1}{10}$ millivolt or 40 deg. F. of the platinum thermocouple. The shunt method of adjustment reduced the e.m.f. at the binding posts of the thermocouple by about 2 millivolts, and made it possible to duplicate the e.m.f. of the base metal couples to within 2 deg. F., whereas without this or some other method it would not be possible to duplicate the same within 15 deg. F. In the same way the 12 ft. standard base-metal couple was calibrated with the platinum couple; care being taken to have both heads at the same temperature, or to make corrections for any difference.

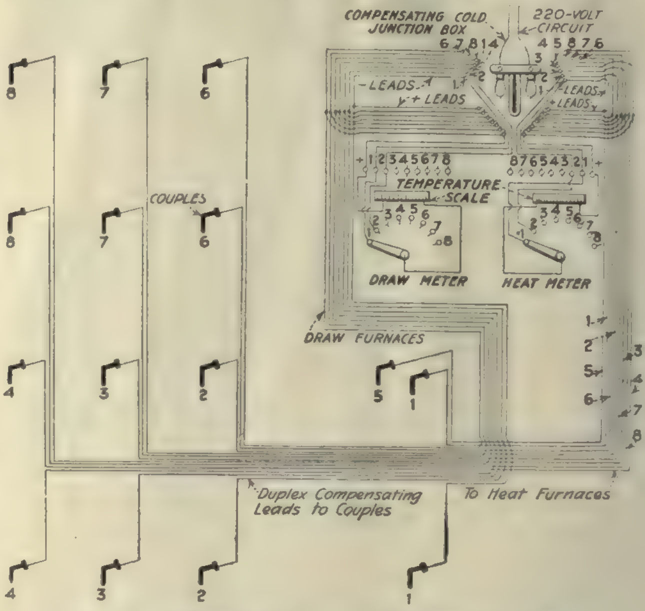


FIG. 10. WIRING DIAGRAM FOR PYROMETERS

A sufficient number of extra couples were kept constantly on hand for changing during the 24 hours, should there arise any question as to the accuracy of the working couple.

In checking the pyrometers mounted on the wall over the signal bench, as shown in Fig. 4, with the millivoltmeter, both instruments were set to the same degree on the scale as zero and then compared by taking simultaneous readings from any one of the working couples.

The working system was checked and calibrated by placing the 12-ft. standard-base couple in the lead as close as possible to a working couple that had just been calibrated. The millivoltmeter needle was set at zero temperature, cold junction temperature taken of the 12-ft. couple and corrections made for any difference, and simultaneous readings taken of millivoltmeter and pyrometer. They should agree within 10 deg. and if not, the needle of the wall pyrometers was adjusted.

The writer desires to thank Hugh Hamilton and R. P. Brown for their assistance in the preparation of this article.

Series for Executives

Inspectors and Inspection

By W. B. SEIGLE

SYNOPSIS—*The problems that confront inspectors in their work and the selection of inspectors by the management, are here discussed by one who is in a position to know just what these problems are, and their more logical solution.*

THE words "inspectors" and "inspection" have such a varying meaning in the actual practice of different manufacturing corporations as to mean a great deal or practically nothing. Several articles that have been lately published in the *American Machinist* seemed to be incomplete, in that they only scratched the surface and did not go into detail sufficiently.

Inspection means more than checking work to see if it agrees with blueprints, and from a number of years' experience with a force of from 165 to 225 men, inspecting the product of over 9000 operators, the fact has impressed itself that the real inspector is born, not made.

Men with the highest mechanical qualifications and ability to read intricate blueprints have proven absolute failures as inspectors through inability to use the essential quality, "common sense," and to drop pre-conceived notions when they left their machines and became the judges of other men's product; while in turn bright, ambitious, high school graduates with intelligence and readiness to grasp new conditions and situations have become in a few months, with correct training, so satisfactory that their decisions as to what is O. K. for use, and what is unfit, are seldom or ever appealed from and not in one-half of one per cent. of such appeals have they been over-ruled. This is because their minds were open to the instructions received, and, as they had never attempted to have work that they considered "good enough" passed, were deaf to the suggestions or pleadings of careless or inefficient operators.

AND the matter of wages for an inspector should be carefully considered, and never under any circumstances should an inspector be paid by the piecework system, for such method of payment is simply putting a premium on dishonesty. Where an inspector's envelope at the end of the week depends on the amount of work he passes any manufacturer can rest assured there will be few rejections regardless of quality. It has been found to be the best policy to pay somewhat more to the inspector, than to the men of the group whose work he inspects, placing in him the responsibility for the quality of the work from his department. This method has been found to lend dignity to the position and causes desirable men to try for such positions.

A good genial, but not over-friendly man, with an even temper and well poised judgment is almost a necessity where one considers that he must deal with all types and conditions of workmen. An inspector can be one of the most costly employees of a firm by living strictly to the letter of the drawings from which he checks or by the use of ordinary horse sense, differentiating between those parts that function, and must necessarily be held close, though not always exactly to the 0.0005 part of an inch, and such parts as have finish only for appearance and general contour he can save the company thousands of dollars, help expedite production, and have the men whose work he checks understand that he is not there to hinder them, but to help them to do good work and become their adviser and in a measure instructor as to what constitutes good commercial product.

IN MANY places only such work as the inspector accepts is paid for and one can readily see how much of a diplomat a man must be to retain the good will of the operators while touching their pocketbooks, keeping the foreman good natured while reducing the amount of his production, having an engineer smile when some piece of work he is exceedingly anxious for is relegated to the scrap heap, yet realizing all the time that the management has entrusted to his integrity and judgment the reputation of the company, that nothing shall go out to a customer that in any way reflects on the product of the concern, or that will tend to reduce or entirely end repeat orders.

The inspection department must of necessity always be independent of the manufacturing and production departments and must always coöperate with the engineering department, though free from any interference by any of the engineers, except occasionally the designing engineer who for commercial or other reasons is willing to make some exceptions from the drawings and let some apparatus be sent out that in his judgment will do the work required.

In other words the inspection department, having learned the standard, should be responsible to the management only if best results are to be obtained; and invariably where such is the case, rejections fall off, complaints from customers decrease and the regular, unvarying, rigid inspection pays for itself many times.

The operators knowing that only good work will pass bend every effort to produce only such; and the sub-inspectors, making daily or weekly reports to the different head inspectors of parts accepted and parts rejected with the name of the operator who is responsible for any faults above the average and knowing that at any time work that they have passed and stamped as O. K. is likely to be taken at random and reinspected by the head or chief inspector, adhere rigidly to the standard set and good results become a habit.

IN TURN the head inspector of each building makes a monthly report to the chief inspector, copies of which go to the management, designing and mechanical engineers and general foremen, keeping both the foreman and chief inspector in touch with any weak spots in his department, and by comparison of percentage rejections, measures are taken to correct such weakness and operators changed to places where they will perhaps fit better. If it is found that the same operator's name appears repeatedly in the weekly reports, and when he is changed to some other line of work still continues to appear, it is to the company's interest to discharge him. Then too, the monthly reports stimulate a healthy desire among the general foremen to have their departments make as good or a better showing than others, and all this tends to make and keep the standard of the completed work good.

WHERE a plant is large, making a wide and varied product, having its own foundries for steel, iron, brass and white metal, forge and blacksmith shop, press and drawing department, machine shops for the largest type of apparatus, and others making the smallest and finest kinds of machine work, drafting and tool designing rooms, the chief inspector must of necessity be one with a wide experience, and preferably one who has some practical knowledge of all these departments.

The head inspector of each of the departments should always be chosen from the employees in that particular department, as there is always some one person in any group of workmen who stands out a little above the rest in intelligence, ambition, and desire not only to get out the best work, but also has in odd times visited the other departments where his product is used, and having a large bump of inquisitiveness, knows why the certain standards are necessary that he has been compelled to live up to. Then too, choosing from its own employees to fill important and better paying positions, helps to get a better class of men, as they know that if they have the ability and proper qualifications their future is assured.

The head inspectors must have a working knowledge of trigonometry as used for checking purposes, and it is a sorry reflection on our high school educational system that not one man of every hundred questioned at the employment office as to his ability to use sines and tangents in solving simple problems, can truthfully say, "Yes, I can use them." When one considers the time saved by an employee who can use these simple trigonometrical formulas it is easy to understand why such a man is worth from five to eight cents more per hour than one who knew, but has neglected their use until he would practically have to be born over again.

In each department working with the head inspector, and takng his place in his absence, there should be a jig, fixture, and template checker who must absolutely use "trig" in his work and who should also be capable of judging jig design.

IN FACT, best results are obtained where the tool or jig designer consults with the inspector and submits to him his designs for criticism, as frequently the theory of the design is fine but its practical working is far from being desirable, and the inspector, being familiar with its functions, can then suggest modifications that will save time and money instead of waiting until the jig is finished and then having it rebuilt.

Inspectors interested in their work, and not being hampered with getting out production, can often suggest changes in tooling or methods of machining that will increase production at no increase in cost. The operator sees only the job he does continuously, while the inspector in moving about the shop has a chance to observe, and if at all studious, benefits by such observation.

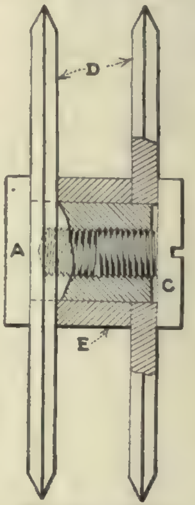
Then too, the drafting room makes errors at times in dimensions, particularly where a number of different lengths or sizes make up an overall dimension. Part of a good inspector's work is to go over all dimensions and check them before passing on any work that is to be done to such drawings.

From the duties outlined in this article it is easy to see that true inspection; the kind that reduces rejections, costs and complaints, builds up production, and makes all concerned feel comfortable; is a job of no mean pretensions.

Thread-Lead Gage

By Leonard M. Thorn

In the illustration is shown a thread-lead gage, which in addition to being very simple in construction, has been found extremely efficient and satisfactory in use.



THREAD-LEAD GAGE

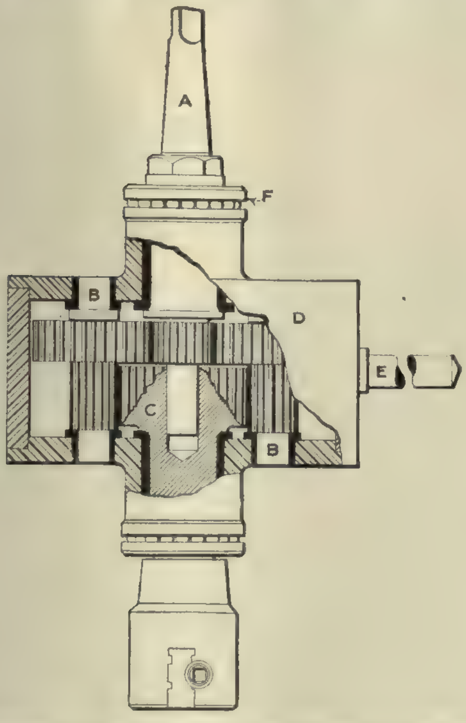
The gage consists of a supporting hub *A*, shouldered as shown, and provided with a threaded opening to receive the threaded end of a binding plug *C*, which is also shouldered. The test pieces are shown at *D*. One of them is placed on the hub *A*, abuting against its shoulder. The spacing and retaining collar *E* is then placed upon the hub, and a second test piece placed on the latter, The plug *C* is then screwed into the threaded opening of the hub, and up against the test piece. If a light is placed behind the gage and work to be tested and any suitable background, such as a sheet of paper placed about 2 ft. back of gage, any defect is shown and readily detected.

Different sizes may be made for use on different size leads when these are encountered in the class of work being done.

Reduction Head for Drilling Machine

By E. D. Dunning

The accompanyng illustration shows a specially designed gear reduction head to be used in connection with the drilling-machine spindle, where low speeds are not available. This head may be designed to give any gear ratio required, according to the safety strength limit of the drilling spindle and the nature of the work being done. The head is able to clean up castings that have too large a projecting portion to be conveniently swung in a lathe, and as an auxiliary to the milling machine it will prove very handy.



REDUCTION HEAD FOR A DRILLING MACHINE

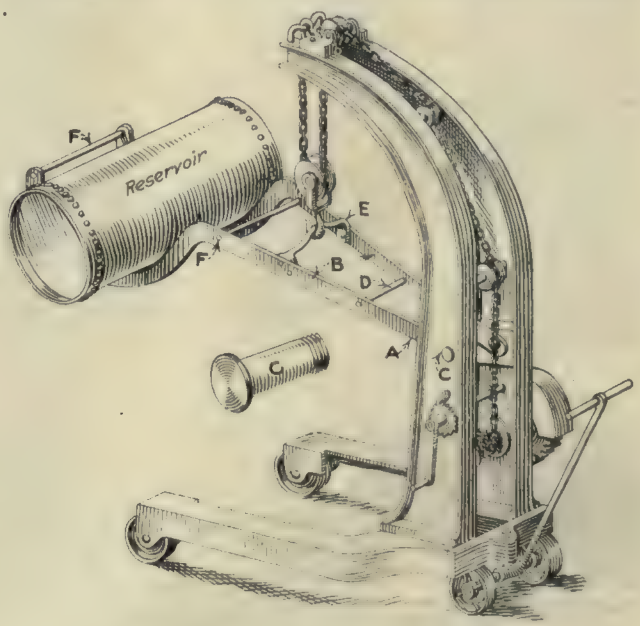
At A is the driveshaft, fitted the drilling-machine spindle. The latter on its lower end, is cut to form a pinion, engaging in the two idler gears B. These idler gears are compound, having been stepped down, and in turn they engage in the reduction shaft C. The idler gears, being mounted in a floating case D, have a tendency to turn backward or creep around the reduction shaft when load is applied; but this action is prevented by applying to the case a rod E, which is allowed to rest on the upright of the drilling machine. There is a bearing of the extreme end of the shaft A in the shaft C; this gives rigidity and prevents wabble, while the ball races F take up all the end thrust.

A great variety of work can be done with this head, especially in experimental shops and jobbing shops. It will be found to be a very accurate and handy tool for reaming and in using fly cutters.

Attachment for Floor Cranes

By W. H. Westbrook

Noting that the *American Machinist* occasionally runs some very interesting articles for railroad shop men, prompts me to submit an illustration of an attachment to one of the several makes of portable shop floor cranes now in use. This attachment was made for the purpose of hoisting locomotive air reservoirs into their place under the running boards. The practice generally followed is to raise them up by a chain with the overhead traveling crane; if the shop has one; and then a number of men push them, or otherwise force them under the running boards into position, which is a very laborious and awkward method.



ATTACHMENT FOR A FLOOR CRANE

Other shops having no overhead cranes raise them up by an air jack, but they first have to be lifted upon the jacks which also takes the time and labor of several men.

With this attachment, which is quite easily and cheaply made, the reservoir is rolled upon two wedges on the frame, then elevated into position with very little effort aid a few men. I think the illustration is self-explanatory. It will be noticed that the arms *A*, of the frame or attachment *B*, pivot on two 1¼ x 3 in. pins *C*, which are made an easy fit through the holes in the end of the arms, but a snug fit in the web of the crane. This has been reinforced inside by welding a steel pad on each web of the crane to give the pin more bearing. I am not sure that this is absolutely necessary, but it was thought best.

The arms *A* are connected and braced by the tie rods *D* and *F* as illustrated. The rod *E* is provided with means for the connection of the lifting hook of the floor crane. The outer ends of the arms are shaped to form a cradle to receive the air reservoir and suitably tied together as shown at *F*.

It will be noted that this attachment can be quickly placed in position on the crane, and almost instantly removed therefrom when the work is completed.

I am sure it will soon repay for the slight trouble it takes to make and on account of the rigid test requirements of the interstate rules, these reservoirs frequently have to be removed to receive the hammer tests, and for this purpose both backshop and roundhouse forces will appreciate this device.

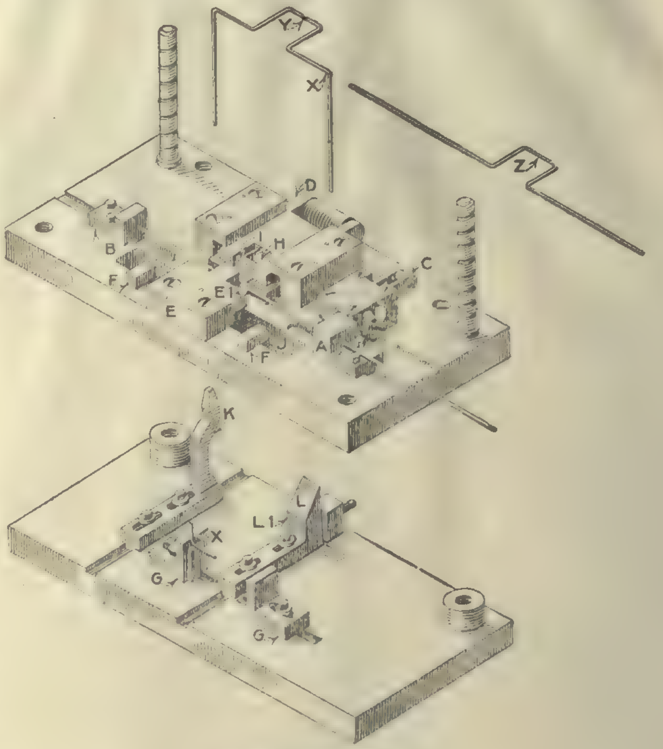
I might add without trying to boom any particular manufacturer's product that the portable shop crane is not used to nearly the extent that it deserves and in these times of labor shortage it is really surprising the amount of labor they will save. Even where there is an overhead traveling crane, there are times when it is wanted in several places at the same time, and by actual observation it has been found that a large percentage of lifts can be made quite as handily, and in many cases, especially around the erecting shop, by the portable shop crane. I have in mind a 20-pit erecting shop using three of these continuously as well as keeping the overhead traveling crane fairly busy. In putting up guide bars, rocker arms and boxes, steam chests and covers, side rods, etc., the men prefer the floor crane, but it is an actual fact, that I have seen in many shops men waiting for the overhead crane, or else getting the assistance of several others and lifting the work in place, on account of there being no portable cranes in the shop. The cost of these is so insignificant that one wonders why they are not generally adopted in big repair shops and roundhouses.

A Wire Bending Die

By Frank A. Ball

Referring to the illustration the wire is pushed through the cutting block *A* to the stop *B*. The press is tripped; the cam punch *K* is entered between the rolls in the slide *C*, which moves forward cutting off the wire. *C* now remains stationary while the bending slide *D* is moved forward by the cam punch *L* to the stationary punch *E*, forming the wire in the shape shown at *Z*. (In this bend the wire slides on the gage blocks *F*, which prevents the wire from getting under the corner of the bending punch *E* lettered *E1*.)

The slide *D* now becomes stationary by reason of the roll in *D* riding on the straight part of the cam *L* lettered *L1*. At this instant the punches *G* engage the wire at *X*, completing the bending operation. The chisel cutters *H* of which there are two, one in the stationary punch *E*, and one in the slide *D*, have severed the wire at *Y* with an angle point (for driving into wood) at the finish of the stroke of the slide *D*. The slide *D* is returned to its starting position by means of a spring in the die shoe. The stripper *I*, which is under the spring tension, ejects the wire from the shelf on slide *D*, allowing the wire to fall through the slot *J* in the die shoe into the separate boxes under the press.



WIRE-BENDING DIE

Efficiency in the Pattern Shop

By M. E. Duggan

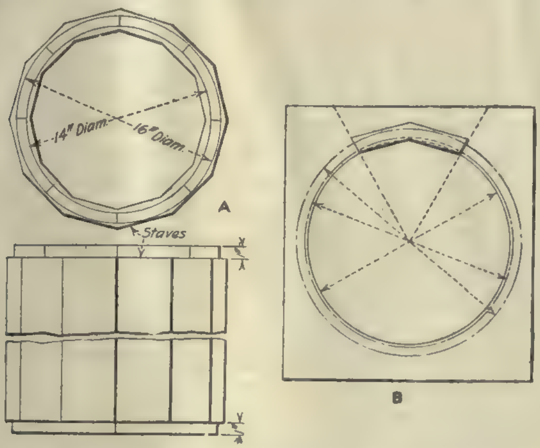
At the entrance of the pattern shop in a large factory, the following notice is posted:

"Material, supplies and machinery in this department are for patternmaker's use only. Employees from other departments are forbidden to use, take or remove from this department, any of the material or supplies, or to use or operate the hand-tools or machinery, without first being given permission to do so by the foreman of the pattern department."

Economical methods and greater production at reduced cost have brought about a general demand for better machine tools, conditions and machining methods to perform many of the operations formerly performed by hand, or by old, worn out and neglected machine tools. The pattern shop has long embraced a number of these antiquated machines and rough methods in the cutting of stock, followed by costly tooling operations at the bench in removing much of the extra stock purposely left by the workman to be cut and shaped by hand, rather than take the chance of spoiling the work already performed in attempting to cut or dress the stock to the finish line or dimension on a machine that is not dependable and in bad cutting condition. "Welcome" is the notice posted at the entrance of a great many pattern shops; in other words, the pattern shop tools and machinery are free for every Tom, Dick and Harry to use and abuse as he may please. In the shop where this free and easy system prevails, pattern cost is excessive, and some manufacturers have been slow to realize this.

The most used and useful tool in the pattern shop is the band-saw. The cylinder pattern shown in the illustrations, is a very good example of the adaptability and economy of this tool in the making of wood patterns. The method followed by me in the building up of this, and similar patterns may be of interest.

A shows the stave and binder-ring method for assembling the pattern in the rough. The beveling of the staves was done with the staves standing on end on the band-saw, and assembled standing on end on a flat board as at *B*. They were cut inside and out on the band-saw to the required diameter, and afterward finished with a sandpaper rubdown.



STAVE AND BINDER METHOD OF ASSEMBLING

A good band-saw tool and a sharp saw made it possible to produce this pattern in short time. A band-saw ¼ in. wide was used. Never use a wide saw when cutting thick stock that is to be sawed irregular in shape; in fact, I never use a saw over ¼ in. in width at any time. Good work cannot be done on a saw that has several rebrazed joints in it, unless the repair is made by a man who understands the work, and has the proper tools with which to do the job.

Sawing close to the finish line through 14 in. of stock with a ¼-in. saw-blade is only one example of the adaptability and economy of the band-saw in the pattern shop.

Adding Life by Taking Care of a Micrometer

By Herbert M. Darling

Some time ago there was a discussion in the *American Machinist* as to "Who Ever Discards a Micrometer?" Most of the writers on that subject, and most other mechanics, seem to think that a micrometer should in some miraculous manner last forever. During the past three years the rush of gagework has tended to change such ideas. Many good mechanics have found that the old reliable "mike" carried ever since their apprenticeship days is not quite good enough for the new gagework. At present, it is so hard to get prompt deliveries on new tools that it seems a good time to say a few words regarding the proper care of micrometers already in use.

Good micrometers are generally adjusted correctly when they leave the maker; but when any perceptible wear has taken place, the spindle nut should be properly adjusted. This is also a good time to clean and oil the threads. For purposes of cleaning ordinary gasoline or naphtha should be avoided, as they nearly always contain minute particles of dirt. To get good results, the gasoline should be filtered through ordinary filter paper, which may be found at any druggist's. The best method of cleaning is to use about a quart of gasoline and "slush" the micrometer parts around thoroughly. Above all, do not try to run a fuzzy brush or a piece of cotton waste through the nut, as small fibers will certainly cling to the edges of the saw slots in the nut. And do not let anyone try to make you think he has a regular micrometer tap. A few years ago, I saw a good micrometer spoiled in this way. One of the apprentices had a "mike" in which there was a little dirt, so he borrowed a so-called micrometer tap from one of the old hands, who had picked it out of the scrap box, years before, in one of the small tool shops down East. It not only removed the dirt, but so much metal that the nut could not be adjusted to a reasonably tight fit on the spindle.

After cleaning your micrometer, be sure to use a good thin oil, but not too much. I find sperm oil very satisfactory, although some toolmakers keep a little watch oil stowed away in their kits for oiling micrometers.

For accurate work, the measuring faces of a micrometer should be perfectly parallel. To true up the anvil and the end of the spindle, I have made the device shown in Fig. 1. To use this, proceed as follows: Remove the spindle from the micrometer and insert it in the holder *A*, as shown in Fig. 2. It is unnecessary to tighten the setscrew *B* for this operation. A little rubbing on a cast-iron lap plate will true up the end of the spindle. Now remove the spindle from the holder and, after cleaning thoroughly, replace it in the micrometer. Then put the holder *A* in position, as shown in Fig. 3. Tighten the screw *B*. The lap *C* is placed in position and the micrometer spindle adjusted so that it will just slide between the holder *A* and the anvil. The side next the anvil is of course charged with an abrasive. By rubbing *C* back and forth, the anvil is lapped true with the spindle. The lap *C* is about 2½ in. long.

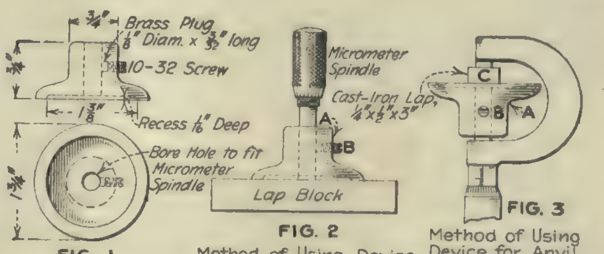


FIG. 1 Device for Lapping Micrometer Spindles

FIG. 2 Method of Using Device for Micrometer Spindle

FIG. 3 Method of Using Device for Anvil of Micrometer

FIGS. 1 TO 3. DEVICE AND METHOD OF TRUING A MICROMETER

If intelligent care is given a micrometer, it should last almost a lifetime; but when I see micrometers continually abused by careless workmen, I am not surprised to hear of their being discarded.

Driving the Shop with an Automobile

By C. L. Edholm

Making use of a roadster as a stationary power plant to operate his machine shop, was the lucky thought of W. J. Burt of Los Angeles, when his regular source of supply failed. This would have been a serious interruption of business, as the electric power gave out in the middle of a rush of orders, and his force would have been tied up for almost a full working day if the roadster had not come to the rescue. The installation of the car for this purpose was readily accomplished.

AUTOMOBILE BELTED TO LINE SHAFT

The rear-right wheel was jacked up, the fender removed and the belt from the main line shaft was slipped about the wheel without removing the tire. For several hours the machine did duty on the intermediate gear and it showed no tendency to overheat the engine, though it was supplying power for the full equipment of the machine shop. This equipment consisted of six lathes, three drilling machines, two milling machines, one cylinder grinding machine and one shaping machine. Besides this several smaller machine tools were employed. There was no great delay in the work and the ingenious proprietor found himself a day's profits ahead because of this adaptation of power.

Calculating for Electromagnets

By W. Thomas

It often happens that I wish to use an electromagnet or solenoid in some of my work, and for this purpose it is almost always necessary to know quite definitely the greatest average pull that I can get with a fixed amount of current.

The questions as to the amount and size of wire or mechanical construction do not enter into the problem as limiting features, to any appreciable extent. I am in nearly every instance willing to use any reasonable amount and size of wire and follow almost any design, provided I can get the results I desire.

What I usually want is the maximum pull—that is, the maximum of pull times distance that can be obtained with a specified voltage and amperage. If the pull does not vary in intensity in different parts of the stroke to a very great extent, it can be evened up in most cases by the use of levers or cams; and even if the range is great, the addition of some simple mechanism can probably spread the resultant pull over a workable length with sufficient constancy.

Where the current is limited and is the governing item to be considered, the voltage and amperage are usually low, and dry cells or storage batteries would be the source to figure on. Where the current does not happen to be the limiting feature, the voltages and amperages are usually high; but I see no reason why the same basis—that is, the amount of current taken—should not be used for these heavy solenoids.

Such calculations as I have been able to discover are comparatively complicated and oftentimes do not seem to fit the conditions I may have in mind.

I would therefore like to know why some of our electrical experts could not give us some charts for a number of different conditions, which would form a basis for quickly determining whether what I am after is within reason or not.

Take, for instance, a definite case of six volts and twenty amperes. What construction of solenoid will give me the maximum of pull times distance and, roughly, the curve of pull for different distances of plunger travel?

I assume there is a certain length of core that will give the maximum working efficiency. If there is no well-defined proportion at which this is a maximum, then there would of course be no objection to giving an approximation; 5 or 10 per cent. would be allowable. The assumptions as regards material and construction could be the very best for efficiency, but the assumptions should be given.

I do not know whether any of the charts could be combined or not; but I do not think that a great many charts would be necessary, even if they had to be constructed separately. For instance, if we take a battery cell to be good for two volts, then up to sixteen volts, with two volts interval, there will be required eight charts, and on each of these charts could be shown the pull for, say, a flow of five different amperages. A table attached to these charts could be referred to to give the size and length of wire and other dimensions necessary in the construction.

After leaving the range of batteries, I should assume that the next voltages would be 110 and 220, but again, it would seem as if curves for five different amperages would cover the field fairly well.

There would probably be some cases where the size of the solenoid would be the limiting feature, and the amount of current required could be disregarded. This might require another set of charts, but even so the number of charts would not be excessive and we would have something that the average mechanic and designer could go to and quickly determine the main features and dimensions of the strongest solenoid he could make, to use with the current available, or the strongest solenoid he could put in a given space.

Thirty Eighth Annual Meeting of the

This is the first annual meeting of the American Society of Mechanical Engineers since this country entered the war, and, as is very natural and proper, its papers were confined largely, either directly or indirectly, to war problems. The first step toward a standardization plan was the meeting of the Gage Committee and the public hearing on gages, the latter being very largely attended by representatives of both army and navy as well as by the manufacturers of gages. Methods of the Canadian Imperial Munitions Board were discussed.

REPRESENTATIVES of the various Government departments, including the Bureau of Standards, and a large number of the leading experts of the country on manufacturing of munitions have met for conference. A resolution was adopted recommending that the Government coöperate in all contracts for munitions; a clause therein requires all standard and reference gages and standards of measurement to be submitted by the contractors to the Bureau of Standards for certification as to accuracy, before being used in the manufacture of their products.

This action was deemed highly important in view of the fact that we need a central authority as to dimensions; otherwise productions manufactured in one plant might not be interchangeable with those produced in another and very grave consequences might ensue. Such disastrous results were experienced during the Civil War and it is to avoid serious difficulties that this action was taken.

In the first evening meeting, on Tuesday, Dec. 4, honorary membership was conferred upon Major-General Geo. W. Goethals with introductory remarks by President Ira N. Hollis. The new president, Chas. T. Main, was then conducted to the platform, after which immediately followed an address by ex-President Wm. H. Taft, on the nation's call to the professional man. His was such a fine presentation of the case that it will be printed in the near future.

Mr. Taft outlined very clearly and forcibly the legal and logical side of the entrance of this country into the war, as well as showed by conclusive evidence from German sources, how the plans for world domination had been carefully laid and perfected during the past 40 years.

ENGINEERING AND MEDICAL STUDENTS

Among the other striking points emphasized by Mr. Taft was not only the inadvisability but the actual danger either of drafting or allowing to enlist, students in either engineering or medical professions. Mr. Taft pointed out very clearly how not only the winning of the war but the future of this country and of the world, depended on both of these professions more than on any others, and how it was a vital mistake to allow education along these two lines to be interfered with. It is, in his opinion, not only the duty of the individual student to remain and complete his course that he may better serve the country and the world in the years to come, but it is also the duty of the nation as a whole, to compel him to do so, that the nation itself, may not be robbed of the skill and knowledge which it so sadly needs.

Although a lawyer himself, Mr. Taft pointed out that neither the profession of the lawyer, the minister nor any other were nearly so important to the welfare of the world as the professions of engineering and of medicine. This clear and logical exposition of the needs of the country should be of great help to those students of either profession who are honestly and earnestly trying to determine in which direction their duty lies.

The morning session of Dec. 5 included papers on "Universal Public Service in Peace and War," by Dr. Ira N. Hollis; "The Engineering Societies in the National Defense," by Gano Dunn; "Special Education in Time of War," by Dr. Chas. F. Howe; "Engineering Research," by T. E. Skinner; "The Agricultural Problem," by Dr. W. H. Jordan; and "The Fuel Problem," by Prof. L. E. Breckenridge.

THE AFTERNOON SESSION

The afternoon session was devoted to the service of the engineer to the public in times of crises. This included papers on "Motor Transportation," by Wm. T. Kennedy; "Army Transportation," by Major L. B. Moody; "The Air-Craft Problem," by Prof. W. F. Durand; and "The Solution of the Cantonment-Construction Problem," by Leonard Metcalf. Simultaneous discussions were held in the various sessions, which included the power plant session, the general session, and the industrial-safety session; each of these fields being represented by the following papers:

Power-Plant Session: "Preventable Waste of Coal in the United States," David Moffat Myers; "A Commercial Analysis of the Small Turbine Situation," W. J. A. London; "Bagasse as a Source of Fuel," E. C. Freeland (received honorable mention student prize contest, 1917); "The Cooling of Water for Power-Plant Purposes," C. C. Thomas; "The Steam Motor in the Automotive Field," E. T. Adams.

General Session: "The Transfer of Heat Between a Flowing Gas and a Containing Flue," Lawford H. Fry; "A Study of Surface Resistance with Glass as the Transmission Medium," H. R. Hammond and C. W. Holmberg (awarded student prize, 1917); "Apparatus for Cooling, Drying and Purifying Air," W. J. Baldwin; "Recent Developments in Balancing Apparatus," N. W. Akimoff; "Plotting Blower-Test Curves," A. H. Anderson (by title only); "Cross-Current Predeterminations from Crank-Effort Diagrams," Louis Illmer (by title only).

Industrial Safety Session: Under the auspices of the Sub-Committee on the Protection of Industrial Workers. Two tentative codes were presented for discussion by the sub-committee on protection of industrial workers, on "Safety Standards for Elevators and Woodworking Machinery."

The grand informal get-together occurred Wednesday evening, beginning with a talk by past-President John R. Freeman, who gave some extremely interesting illustrations from a trip through the Orient last winter, in company with Dr. Brashear and Ambrose Swasey. The smoker following this entertainment exceeded any previous attempt of the kind, and made the foregathering a pronounced success from every point of view.

The paper on army transport by Major Moody was extremely interesting, and pointed out some of the difficulties of the problems presented at the firing line. There it must always be assumed that no roads are available, and that the ground is sure to be very rough, because of shell holes or natural unevenness of the surface. This transportation at the front includes the transporting and placing of artillery in position, and the handling of ambulances, portable searchlights and wireless outfits. Gun-transportation, however, requires that the guns must be hauled directly to the firing line over all sorts of earth surfaces, and against every obstacle. This requires nothing less than 100 per cent. efficiency because unless the guns can be placed in position at the proper moment, the opportunity is lost.

HORSES VS. TRUCKS

These problems have made it extremely difficult to replace horses in the handling of artillery; yet the question of carrying forage which occupies 25 per cent. more shipping space than the necessary motor fuel, the susceptibility of horses to poisonous gas attacks, and the extreme difficulty of using camouflage in connection with horses, has made it desirable to concentrate attention on motor haulage. As a result, there will be motor equipment for every battery. Also schools have been established for training officers and men for the repair work —which single phase alone, of the war problem, will probably require at least 50,000 men and cost more than the entire Panama Canal.

Some of the aircraft problems as outlined by Professor Durand are extremely interesting, and give some idea of the immensity of the whole air program. The mortality of airplanes varies widely, but it is estimated that on the average they will probably last three months. This, however, does not mean that there is not considerable wastage, as is necessarily the case. The increasing capacity in manufacture, however, is extremely gratifying, and it is perfectly safe to say that airplanes will soon be produced so as to be counted by thousands instead of by hundreds; this is the aim of the Aircraft Production Board and the Aviation Section of the Signal Corps.

In connection with the great development in the manufacture of airplanes every effort is being made to secure an extremely large corps of aviators of the highest capacity.

At the same time manufacturing is going on, there are also experiments and developments along new lines, so that we shall not be found lacking from over-standardization, as appeared in some cases; another hopeful sign is the work of the International Aircraft Standard Committee, a meeting of which is to be held in London in the near future.

The address by the president dealt with the activities of the Society for 1917, and was in the nature of a report. Following it was the presentation by Commander George W. Magee of a bust of Rear Admiral B. F. Isherwood. Simultaneously there was a joint meeting with the S. A. E. Committee on "Steel Roller Chain," this being an evidence of a coöperation which is fortunately becoming much more common than formerly.

Representatives of twenty-two sections held a session to discuss the work of sections and of Society affairs while the general session included papers on "An Account of the Engineering Work of E. D. Leavitt," F. W. Dean; "An Exact Volume Regulator for Blast-Furnace Engines," L. C. Loewenstein; "Expenses and Costs," H. L. Gantt; "By-Product Coke and Coking Operations," C. J. Ramsburg and F. W. Sperr, Jr.; "The Submarine," C. H. Bedell; "Combined Stresses," A. Lewis Jenkins; "The Trumble Refining Process," N. W. Thompson.

An innovation in the form of a table lunch, followed by a short address on the "Relation of Industrial Management to Engineering," was thoroughly enjoyed.

The session of the Committee of Machine-Shop Practice was extremely interesting and presented several phases of the problem. The discussion was opened by A. L. De Leeuw on the "Logic of Inspection" who, in a humorous way, pointed out many of the phases of inspection as now practiced. The aim he contended, is to make the imperfect piece answer the purpose since the perfect is unattainable; in other words, to get a perfectly functioning product from imperfect parts.

In pointing out the absurdities of some inspection, he cited the case of a 20-ft. airplane wing spar which was placed on two horses and tested by a strong man trying to break the spar between them. If the spar cracked before the man got tired, it was rejected; if he tired before it cracked, it passed, even though incipient-weakening cracks may have developed.

MAIN DIFFICULTIES OF INSPECTION

The main difficulties of inspection were due, he pointed out, to insufficient inspection in the drawing room. In other words the design, with the tolerances necessary, should be determined before the piece goes into the shops; also the same close tolerances should not be demanded on non-essentials as on vital parts. He pointed out however that large tolerances did not necessarily mean easy manufacturing; especially where a wide variation in one part may affect the accuracy of an operation on another.

The human element in all inspection work also makes advisable the occasional re-inspection or checking of work which has been passed, as well as that which has been rejected. This is almost sure to bring out glaring discrepancies, and work passed one day is very apt to be rejected the next, particularly where the inspection is visual rather than by positive gages.

F. W. Waldron also laid stress on the necessity of careful designing and of rational specification; he presented the case differently but emphasized very strongly the same points as had his predecessor. In addition, he pointed out the effect of over-rigid inspection and too close tolerances on the cost of tools and gages, for the manufacture of the product; these things mean delay in turning out the tools and gages, hindering the starting of production as well as the rapid output in large quantities. Such hinderances are especially dangerous at present owing to the scarcity of good toolmakers.

Owing to indisposition on the part of Col. B. W. Dunn, his paper was presented by Major Erdman. He showed the dangers of the mutual distrust which too often exists, and how this element is not only bad for both inspector and manufacturer but how in its turn it delays production, which is all-important at this time. He outlined his plan of having a supervisor of inspection in each district who shall act as a sort of court of appeals for the manufacturer. The chief inspector of a plant and his assistants can also carry their troubles to supervisor. Col. Dunn's paper pleaded for coöperation as the only way to secure the best results.

Sir Charles Ross, of the Ross Rifle Company, discussed the question of inspection and suggested a plan, which his long experience in this work leads him to believe will go far toward solving the difficulties. He advocates the creation of a body of engineers, independent both of the manufacturers and the Government, but with direct access to the Secretaries of War and Navy. Their function shall be to hear complaints of both manufacturers and of inspectors, to advise with both and to report to both the Secretary of War and the Secretary of the Navy.

This idea afterward crystalized into a resolution that the members assembled should advocate the appointment of such a committee to be selected from the Engineering Societies. This resolution was referred to the Council of the Society and it is hoped that speedy action may be taken; while the selection of the proper men would not be an easy task, such men can be secured and much good can be accomplished with such a committee in good working order.

The question was further discussed by several other members who brought out the importance of inspecting raw materials, the difficulty of preventing small flaws which in nowise impair proper functioning, and other interesting points.

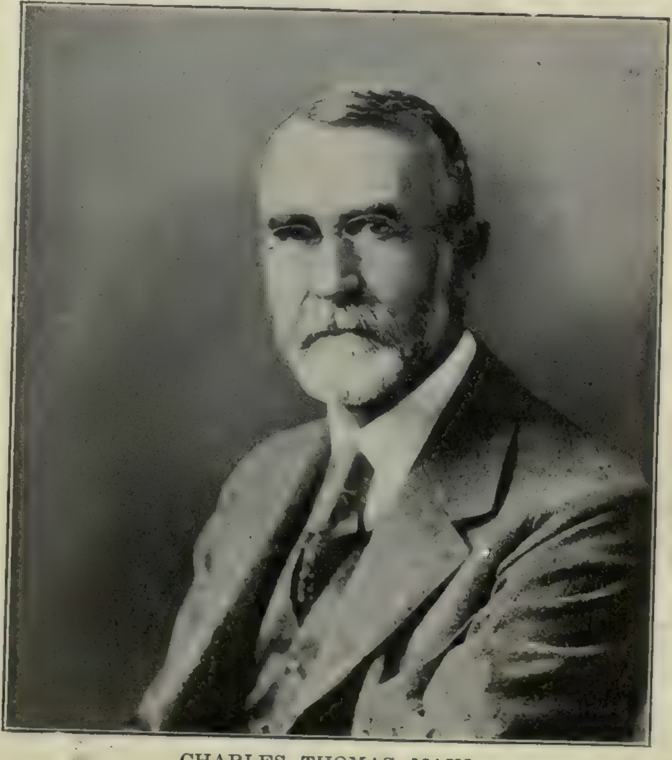
The Textile Session included a number of papers as follows:

"Labor-Turnover Records and the Labor Problem," Richard B. Gregg; "Accident Prevention in the Textile Industry," David S. Beyer; "The Moisture Content of Textiles and Some of Its Effects," William D. Hartshorne.

The last session was especially interesting to those responsible for employing women, and also in its regard to the big problem of re-educating cripples—both of industry and of war. This first was introduced by John W. Upp, of the General Electric Co., the latter by Major Frank B. Gilbreth.

Charles T. Main, President of the American Society of Mechanical Engineers

CHARLES THOMAS MAIN was born in Marblehead, Mass., on Feb. 16, 1856. He attended the public schools in that town and was graduated from the Massachusetts Institute of Technology with the degree of S. B. in the department of mechanical engineering. He remained at the institute as an assistant in the department of mechanical engineering, during three years after graduation. In the fall of 1879 he went to the Manchester Mills, Manchester, N. H., as draftsman. From there, on Jan. 1, 1881, he went to Lawrence, Mass., as engineer for the Lower Pacific Mills; in March, 1886, he was made assistant superintendent, and in July, 1887, superintendent of the mill, also having in charge the engineering work during the later periods. During this period of eleven years he had charge of the reorganization and rebuilding of a large portion of the above-mentioned plant, and for something over five years had charge of its operation.


CHARLES THOMAS MAIN

About this time Mr. Main decided that he preferred to follow engineering rather than administrative work, and resigned his office at the Pacific Mills. After one year in Providence, R. I., spent in engineering and mill work, he formed an association with Mr. F. W. Dean and conducted a business under the name of Dean & Main which was devoted largely in the early days to textile-mill work, but gradually broadened so as to include other industrial plants. This association existed from January, 1893, to January, 1907, when it was dissolved. Since that time he has conducted an engineering business under the name Chas. T. Main.

During the period from 1893 to the present, a large number of industrial plants have been designed and constructed under his direction, and many others reorganized; steam engineering for industrial plants, developed into steam-power-plant work, and the water-power work led on into hydro-electric developments.

Among the largest undertakings in the industrial plants are the Wood Worsted and Ayer Mills in Lawrence, Mass., and in the hydroelectric work, four developments for the Montana Power Co., aggregating about 280,000 horsepower.

He has acted as consulting engineer on many projects and as expert witness or referee in many important cases and has placed valuations on many industrial plants for various purposes.

Mr. Main was elected to membership in the American Society of Mechanical Engineers in 1885, and has been a manager for three years. He is also a member of the American Society of Civil Engineers, the American Institute of Consulting Engineers, the Boston Society of Civil Engineers (past-president), and of other technical societies; is president of the Engineers' Club of Boston, and is serving his second term as term-member of the Corporation of the Massachusetts Institute of Technology.

He has written several papers on engineering subjects, some of which have been presented at meetings of the Society he now heads.

Mr. Main has been interested for many years in public affairs and has served in several municipal offices for the purpose of advancing the idea of good government and doing his share of public work.

Expenses and Costs*

BY H. L. GANTT

IN DETERMINING the cost of a manufactured article, should we include all the expenses incurred while that article is being manufactured, or should we include only those expenses which contribute to its production? It does not require any knowledge of cost accounting, bookkeeping, or other office art to enable the practical man to say that costs should include only those expenses needed to produce the article in question, and that those people who insist on including in their costs, expenses which do not contribute to the production of the article are simply trying to recover from the public, through a higher selling price, the expenses which they incur through inefficiency and waste.

All cost figures may be divided into three parts: (a) The expense for material; (b) The expense for labor; (c) The overhead expense, or "burden."

There is no great difficulty about getting the expense for material and the expense for labor, and most concerns get these elements quite accurately, but there is a great variety of opinion as to what the "burden' charge on any particular work should be. This overhead or "burden" may be divided into two parts: (a) That which is incurred through simple ownership or rental of the plant and keeping it ready for operation; (b) That which is incurred by operating the plant, exclusive of direct labor and material.

Analyzing further the meaning of the term "burden," we see that the first part is made up of ownership or rental of a number of machines or work benches, properly housed. The second part consists of the expense of operating the various machines, which consists of power, oil, waste, repairs, etc. Inasmuch as the rental which we should pay for the plant is made up of the rental of the individual machines and work spaces, we must be able to determine the proper rental for each of these in order to form an intelligent idea of the proper rental for the whole plant. In the same way we can determine the amount of supervision, power, oil and waste needed to run these machines individually. Working along these lines, we are able to determine for each machine in the factory both an idle- and an operating-expense rate.

Any article manufactured on a machine should undoubtedly bear the operating-expense rate for the time during which the machine was operated on it. The expense of maintaining the machine in idleness during the time it was not operated cannot legitimately be charged to the work done while it was operated, and should be put into another account.

We thus see that every plant has two kinds of burden: (a) That which produces goods and which can legitimately be charged to the cost of those goods, and (b) That which produces nothing, and must be put into some other account.

In the past it has been too much the fashion to put these two kinds into one account and make the product bear both. This has led to so much confusion and is so evidently wrong that it is not worth discussing. On the other hand, a careful consideration of the expense incurred while the plant is idle leads to very fruitful results: First, through an attempt to find out why the plant is idle; second, through an attempt to eliminate the causes of idleness,—which are lack of work, lack of help, lack of material, repairs, etc. Without going into the details of those subjects, it may be readily appreciated what advantages will be derived from a careful study of each of these causes.

This general view of the cost question leads to a further simplification of the problem which is worthy of careful consideration. First, the expense of owning and maintaining a certain machine in idleness, properly equipped for efficient operation, should be substantially the same in any part of the country where the machine could be bought at substantially the same price. Second, the amount of power, oil, waste, and repairs, and even supervision, of a certain machine should be substantially the same in any part of the country, if it were engaged upon substantially the same kind of work. Following these lines of thought, we readily see that a standardization of cost methods and of costs is possible: a fact which was unsuspected a few years ago.

While the writer and those with whom he has been associated have done quite a good deal of work on these lines, and while the results have been satisfactory to a degree that was entirely unanticipated, he does not yet feel that the matter has been developed to such a degree as to warrant detailed publication. The fact however, that the Federal Government has placed so many contracts on a "cost plus" basis, leads him to set forth these ideas, which are the only ones that seem to him to give promise of avoiding an almost intolerable situation resulting from a complication of interests which is bound to arise in the near future.

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*Extracts from a paper presented at the annual meeting of the American Society of Mechanical Engineers, December, 1917.

It seems to the writer that much of the confusion on the subject of costs in the past has been due to a misconception of the subject. The intimate relation between production and costs has not been sufficiently recognized, and the accountant has looked upon costs as a bookkeeping proposition, whereas in truth costs are much more closely connected with engineering and production than with bookkeeping and accounting. If the engineer will recognize this fact and insist that money spent without any corresponding production must be kept separate from that which was productive, either directly or indirectly, many of the apparent contradictions with which we are so frequently faced will be eliminated.

As soon as we establish these methods, the following question is immediately put to us by the accountant and financier, "What are we going to do with this expense of idleness?" they having never before realized that it cost something to be idle.

My frank answer to that is that I do not know. Moreover, I don't care, provided they do not charge it to me against the products which I buy from them. My recommendation, however, would be that they see how they can eliminate such expense by proper managerial methods. I am perfectly aware that it is extremely difficult to eliminate all of such expense, but I am also aware that it is extremely easy to eliminate a large proportion of it. The solution of this problem is one of the economic questions which the war will shortly force to our attention, and I insist that it is primarily a question to be solved by engineers rather than by financiers.

Labor-Turnover Records and the Labor Problem*

BY RICHARD B. GREGG

THE application of rational methods of analysis to the conduct of the operative details of industrial establishments has long been accepted as an effective means of approaching the maximum efficiency of output, and in recent years production problems of all kinds have been studied and solved by such methods. In this paper the author advocates the application of a similar mode of analysis to an increasingly important phase of the labor problem, namely, the labor turnover, or the shifting of workers from one place of employment to another. He considers various causes that have given rise to the problem and suggests other aspects of the subject that still remain to be explored, leaving a discussion of the remedies which have proved successful for future treatment.

The particular part of the labor problem which scientific method has recently done much to clarify is that shifting of workers from one place of employment to another, known as labor turnover. Some refer to it as "hiring and firing." The subject has been written and talked about considerably in the last two or three years, and no doubt is very familiar to most people. The time has come now when we can profitably examine its scientific aspect in order better to realize its implications and extend its usefulness.

There is, of course, a certain amount of labor turnover which is unavoidable and normal. A factory will always be losing employees from old age, death not caused by industrial accident or occupational disease, marriage, changes of residence or domestic events wholly uninfluenced by the character of work or pay. What this normal amount will be, will vary from factory to factory according to local conditions. A careful estimate in one instance placed it at 21 per cent. of the total working force. The amount of turnover in excess of this normal, excepting lay-offs due to slackening demand for product, may be considered a kind of barometer of dissatisfaction, either of employer with employee or of employee with position. The quittings are in effect a sort of gradual continuous strike. These things demand careful thought.

First of all we must get the facts. How great is the labor turnover? To get this we must examine the payroll or keep a record of the hirings and quittings and discharges from the entire factory for a given period of time—say a year. By comparing the total number of leavers for all reasons with the total normal number of workers in the factory we may obtain the turnover in terms of percentage, which is useful for comparisons with other periods or other groups of workers. In getting the percentage for a smaller group, the basis will be the normal number in that group. For purposes of thorough analysis it will be well to obtain the amount and percentage of turnover for each department and each job within the departments. In one factory the annual turnover for the entire concern for several successive years was in the region of 45 per cent. Again, in one department in a certain cotton mill the turnover last year was over 500 per cent. The turnover on some positions will occasionally run much higher than that. These figures, after making allowances for lay-offs and normal turnover, point to economic defects and begin to clarify our problem.

Carrying out our analysis and arrangement of facts still further, we can often obtain very valuable indices of the reasons for high labor turnover. For instance, grouping the leavers according to their actual earnings will show the significance of the wage factor as a cause for leaving. To illustrate how this works out: A certain cotton mill learned that there was a high labor turnover in its power department. Upon further analysis the turnover was found to be confined almost entirely to the coal handlers. Inqury showed that these men were receiving fifty cents a week less than the coal handlers at the local railroad station. The wage was raised fifty cents, the turnover ceased, and the management was relieved of its worry about demurrage charges. Usually a large part of the shifting will be found in the low-paid groups. The result of most experiments with this fact seem to show that low wages are much more the cause of the high turnover than any inherent and unchangeable characteristics of that group of workers.

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*Extracts from a paper presented at the Annual Meeting of the American Society of Mechanical Engineers, December, 1917.

Other groupings which might prove significant are sex, nationality, age, foremen, rooms, heaviness of work, amount of illumination or ventilation of work place, dirtiness of job, method of pay, amount of accident risk, anxiety, amount of other fatigue factors, distance of workers' homes from the factory, etc.

A further aid in learning the causes for leaving is making inquiries from the foremen and from the leavers before they go. Not too much reliance can be placed on this information, however, as it is very apt to be distorted or wholly falsified by anger, fear, prejudice and all sorts of personal motives.

As a result of all this recording of facts, we find ourselves able to determine the real causes for the turnover in a large number of cases. Sometimes the causes will be simple, as in the case of a motor company which learned that most of its leavers resided a considerable distance away from the plant. By giving preference to applicants living nearby the turnover was gradually reduced very greatly. Usually, however, there is a complex set of causes. Often the apparent cause merely serves to release discontent that has gradually been accumulating for a number of reasons. With patience and skill we can usually arrive near the truth.

Measurement and Analyses for the Cost of Loosing a Worker

By further measurement and analysis we can determine, or at least approximate, the cost of losing a worker in a particular position and training another. These costs may be roughly divided into overhead costs and operating costs.

Among the overhead costs there are:

1. More rapid depreciation of machinery because of ignorance or lack of skill of new workers.
2. Extra floor space and extra machines to provide against idleness of a certain amount of machinery due to shifting labor.

Operating costs may include any or all of the following:

1. Time of increased superintendence or office work, including: (a) Time spent by foremen or superintendent in discharging a worker where that is the way the vacancy occurred; (b) Time spent by foremen or other workers in training the new employee; (c) Time spent by clerks on additional payroll or other records.
2. Machine costs, covering: (a) Time machinery is idle when a new worker cannot be obtained immediately; (b) Idle machinery for temporary stoppages due to ignorance or lack of skill of new worker; (c) Repairs to machines or renewals of tools broken for the same reason.
3. Material costs, including: (a) Waste or damaged material due to ignorance or lack of skill of new worker; (b) Difficulties in subsequent processes due to poor work by new employees in previous processes; (c) Lower production while new employee is working up to his best skill.
4. Additional accident cost due to higher rate of accidents among new employees.

These two kinds of overhead costs and four groups of operating costs, while not exhaustive, serve to illustrate the method of observation, recording, measurement and analysis which is just as helpful in this aspect of the matter as elsewhere. With knowledge so obtained the factory manager is in a position to estimate more truly the importance of this problem and to judge whether he can afford to take certain steps to reduce the turnover.

Accident Prevention in the Textile Industry*

By David S. Beyer

The author emphasizes the fact that the textile plants have an abnormally high proportion of mechanical accidents. This condition arises from the combination (1) of a relatively large number of machines in operation in textile plants, (2) female and child labor, much of which is non-English-speaking, and (3) an ever-present temptation to clean the machines while they are in operation.

As a means of accident prevention interlocking guards, gear guards, belt guards and belt shifters are discussed fully, and other safety provisions such as the elimination of all protruding set screws, keys, bolts or other dangerous projections from revolving parts, and the guarding of projecting shaft ends, are touched upon.

The process of guarding existing and new machinery is then taken up and a set of safety standards in actual use in a textile plant is given, specifying the safety equipment for gears, sprockets, dangerous projections, pickers, cards, lap machines and doublers, drawing, winding, ring spinning and twisting frames, looms, etc.

In the majority of manufacturing industries the number of machines is less than the number of employees. For example, the combined insurance records from a number of states show the following average conditions:

Earthenware manufacturing	17 machines per hundred employees
Furniture manufacturing	40 machines per hundred employees
Rubber goods manufacturing	60 machines per hundred employees
Printing	67 machines per hundred employees

In the textile industry, on the other hand, the number of machines usually exceeds, by several times, the number of employees. Sixty-one characteristic cotton mills contained 33,393 employees and 119,078 machines; or,

Cotton Mills	357 machines per hundred employee

The average cotton mill in Massachusetts has nearly a thousand employees, and several thousand machines. These machines are usually belt-driven and some of them have auxiliary belts in addition to the main driving belt. Most of them have gears at several points on each machine. So it is a simple process of multiplication to see that the exposure points quickly run into the thousands or tens of thousands for a single plant. Thus we can form some idea of what an extensive problem it is to guard completely all the belts and gears in the average cotton mill.

A large percentage of cotton-mill employees are foreigners, to whom it is difficult to explain fully the hazards of their work. A statement of race distribution in the New England mills (from the Government report mentioned above) shows the following conditions:

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*Extracts from a paper presented at the annual meeting of the American Society of Mechanical Engineers, December, 1917.

American	7.2	French Canadian	41.8
English and Irish	22.1	Italian, Portuguese, Polish and other foreign races	28.9

Thus we see that less than 10 per cent. of the employees are American or American-born, although the number who speak English is much larger than this.

EXTRACTS FROM A TABLE OF CLASSIFICATION OF MECHANICAL ACCIDENTS IN MASSACHUSETTS

July 1, 1914-June 30, 1915

Belting	1,039	Gears	1,087
Cranes	328	Lathes	869
Drilling machines	481	Milling machines	256
Elevators	967	Planing machines	99
Engines	182	Portable tools	70
Eye injuries: Belts, emery wheels, etc	4,373	Presses	1,408
		Shafting (set screws, etc.)	667

While safety education of employees through the organization of safety committees, safety talks, the posting of safety bulletins and signs, etc., are important in this industry, as in all others, there is probably no other industry where so great weight should be given to mechanical guarding, or where effective guards will produce such important results, as in the textile industry.

Combined Stresses

In a paper presented at the annual meeting of the American Society of Mechanical Engineers, December, 1917, by A. Lewis Jenkins, the author discusses the six possible hypotheses upon which a formula for combined normal and shearing stresses may be based; namely, the maximum apparent and the maximum true or equivalent stresses in tension, compression and shear. His conclusion is that the equivalent stresses are a refinement over the apparent stresses, and he finds that both theoretical and experimental results show them to be the more accurate.

Equivalent-stress formulas for tensile, compressive and shear stresses are given in the paper, and their uses are indicated (1) with respect to the value found for the ratio of the unit tensile and shearing stresses at the yield point, and (2) with respect to the nature of the failure of the material.

The design of shafts subjected to bending and twisting is dealt with at length and formulas are recommended for use with hard or brittle materials, such as cast iron or hard steel, and with soft or ductile materials, such as very mild steels.

Two Special Machines

By M. E. Hoag

The Davis Manufacturing Co. of Milwaukee, builds internal combustion engines for farm tractors and other purposes, and they have developed a number of special machines for handing this work to the best advantage. Two of these special machines are shown in Figs. 1 and 2.

The machine shown in Fig. 1 was designed to rough and finish bore forged-steel connecting rods, two of which are shown at *A*, and another in position at *B*.

Simplicity and solidity of construction mark all of the special machines used in these shops and this boring machine is no exception to the rule. The bed, table, heads and boring bars are all of sufficient strength and rigidity to carry the heaviest cuts that the tools will stand.

The head *C* is adjustable for center distance of connecting rod openings, and this adjustment, together with a change of jig block *D*, permits quite a wide range in the work being handled. Suitable levers, etc., on the front of the machine give easy control. The boring bars are given their movement by gears from the main drive shaft pulley *E*.

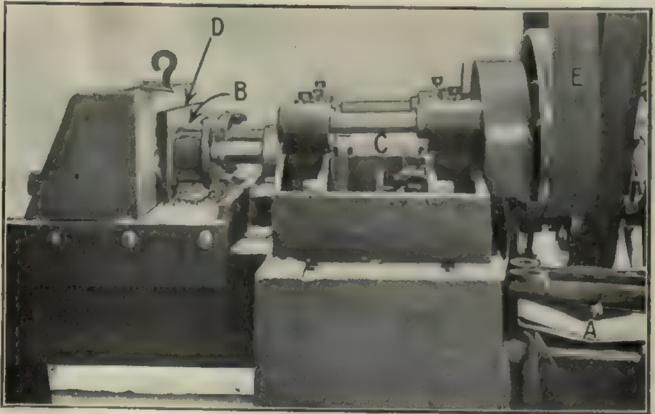


FIG. 1. CONNECTING-ROD BORING MACHINE

In one type of tractor engine made in these shops the cylinder has a cast-iron liner, the bore of which must be ground true with certain turned flanges on the outside.

For this work the standard cylinder grinding machines in common use were not found satisfactory so the special machine shown in Fig. 2 was designed for the job and has proven satisfactory in every way. Owing to its special and extra heavy construction the output is considerably greater than was possible with the standard grinding machines formerly used.

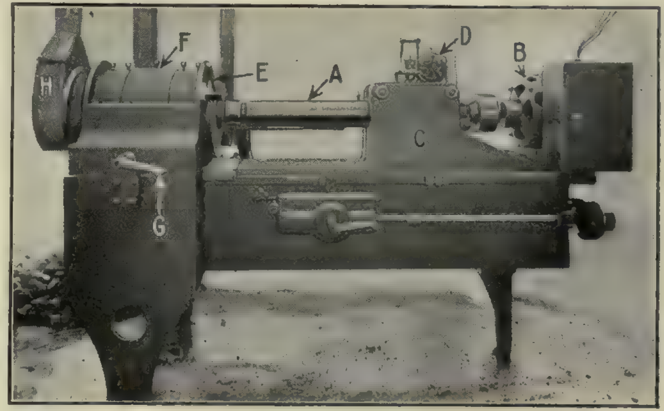


FIG. 2. GRINDING MACHINE FOR CYLINDER LINERS

The grinding spindle *A* is driven by the direct connected motor *B*, the entire unit being mounted on the table *C*, which travels on the bed of the machine and is supplied with suitable driving and reverse mechanism. The small motor *D* keeps a constant supply of oil flowing to the spindle which is carried inside of the spindle *A*. The cylinder liner is chucked inside of the head *E*, which in turn rotates within the housing *F*.

The work is fed to the wheel by the crank *G*. The dust hood *H*, which is connected with suitable exhaust pipes, carries off all dust and draws a constant supply of cool air through the liner that is being ground.

Editorials

Export Embargoes and Foreign Trade

OF FAR-REACHING interest are the questions of foreign trade and foreign exchange which have arisen in connection with the war. They will illustrate the fact that all our industrial and economic problems dovetail one with another to form one great intricate war problem of how to make effective use of our resources and energy.

Here, as elsewhere, the first question is one of transportation. The matter of ships apparently goes to the heart of most of our war problems and the amount of foreign trade which is to be done during the war rests upon the vital question of what proportion of our ships must be devoted to transporting food, war supplies and troops from this country to Europe.

To determine the raw materials which must be imported for war production in this country, and for the maintenance of our essential industrial life, involves what we are to produce for our armies and the extent to which normal industries are to go forward during these times, and how far our raw material requirements can be met from our own production. At the same time there must be discussed the great problem of what industries are essential and what are nonessential.

Before a conclusion can be reached as to what is a nonessential industry during the war there must be known what is needed from abroad and what we may send in exchange, for what is apparently a nonessential here may be productive of most important materials for the war by being sent abroad in exchange for essential materials.

For example, we need nitrate and copper from Chile. These are essential to the production of munitions of war. We may, however, procure this nitrate and copper by shipping jewelry or automobiles to Chile. Again, we need from Argentina wool, wheat and hides and these necessities may be obtained by shipping in exchange sewing machines or typewriters. Thus the manufacture of a limousine or a typewriter may be in fact the means of producing nitrate or wool.

What may be shipped to foreign countries depends upon what they are willing to receive from us and, therefore, it may be impossible to secure what is needed by shipping nonessentials. Cases may arise where we must draw upon our store of much needed raw materials and finished products in order to procure raw materials which are in even greater demand. Thus, we may have to send coal or agricultural implements to Argentina in order to procure wool, wheat or hides. The extent to which we can afford to reduce our own much-needed supplies of coal and agricultural implements would depend upon the extent that we needed wool, wheat or hides.

Behind all this is the question of our gold supply, the great balance wheel of our foreign trade. This aspect of the situation may be illustrated by citing the situation with India. Among other things we need jute and burlap from India; in return we can send clocks and watches, typewriters, cloth and general merchandise, iron and steel pipe and fittings, etc. But this is not enough. The balance of trade is against us. To India we can send silver in settlement of this balance, but if this is not sufficient we must send gold or else allow American exchange to be at a great discount.

The extent to which our gold supply may be drawn upon to settle foreign exchange balances raises all the questions of domestic finance—the Government's borrowing, the protection of our currency, and in fact our entire financial structure.

Thus it will be seen that in this general question of foreign trade there are involved questions which affect not only the War Trade Board, but the Shipping Board, the Food Administration, the Fuel Administration, the Treasury Department, the War Department, the Navy Department, the Council of National Defense, the War Industries Board, the Priorities Committee, the Federal Reserve Board, not to mention the State Department or the Department of Commerce.

Here is another problem, therefore, for a great War Board or Council. This, of course, does not mean that a general conference must be held to determine whether a structural steel bridge is to be sent to Cuba, or an embargo to be put upon the export of automobiles. Such decisions, however, might well be reached by the War Trade Board according to policies formulated from time to time by such a War Council.

Care in Giving Orders

THERE is a natural tendency in these strenuous times to work hurriedly and this tendency in too many cases serves to emphasize the old adage that "haste makes waste." This is particularly noticeable in the sending of orders for machinery, for repairs, or for supplies. Mistakes are too frequent, when every error means so much more than in peace times. It is a good time to school ourselves in real efficiency by seeing that every move counts. It is not how hard you have worked, but what you have accomplished, that really matters.

It happened recently that drawings and specifications received for gages for ammunition were not at all clear, and the order which accompanied them was equally vague. It required several letters, three telegrams, two long-distance telephone calls, and a trip of 250 miles to straighten the matter out, when a little care would have made it clear in the beginning. This meant two weeks delay in beginning the work; it meant unnecessary clogging of the mails, the telegraph, the telephone, and the railroads, at a time when they are all being overworked.

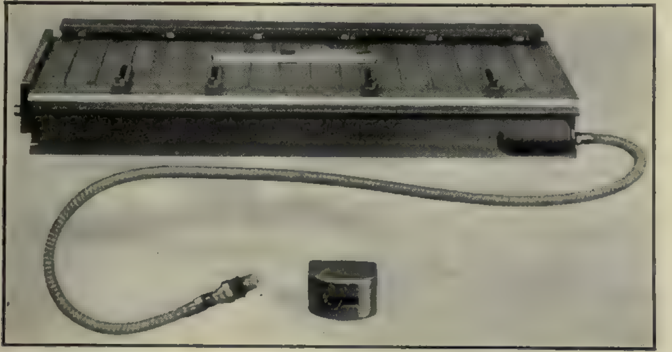
Only the millenium will find us free from all errors, but the present emergency should offer every incentive to reduce their number to the minimum. *It is better to do a little less work and have it right,* for every mistake means wasted material, wasted labor and the loss of time which can never be replaced.

SHOP EQUIPMENT NEWS

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Heald Magnetic Chuck

The illustration shows the latest rectangular magnetic chuck placed on the market by the Heald Machine Co., Worcester, Mass. It is known as their style 1436. The holding power is approximately 200 lb. per sq.in., with a current consumption of about 300 watts. Inside of the body there are two cores and two coils to each pole-piece, the coils being made up of enamel insulated wire. It is claimed that enamel insulation is better and of longer life than that secured by the use of silk-covered wire. There is considerable air space between the coils, so that no ventilation is required—it being possible to use the chuck either wet or dry without change. At the right end of the chuck is the volt box which allows a change of voltage from 110 to 220 or vice versa without returning the chuck to the factory. Access to this box is secured by removing a pipe bushing which, when again screwed into place after the change in voltage has been made, makes the chuck waterproof. The lead wires are protected by heavy armored conduit, and terminate in a standard plug. A special demagnetizing switch is furnished. The face or top plate is removable and interchangeable with others, this arrangement making it possible to place a new plate on the old body and coils. The top plate is attached to the body by capscrews from the underside, there being no screw holes in the working surface. The front edge of the top plate is provided with a T-slot, and the ends of the chuck are machined so that it is possible to use two or more chucks on long work.

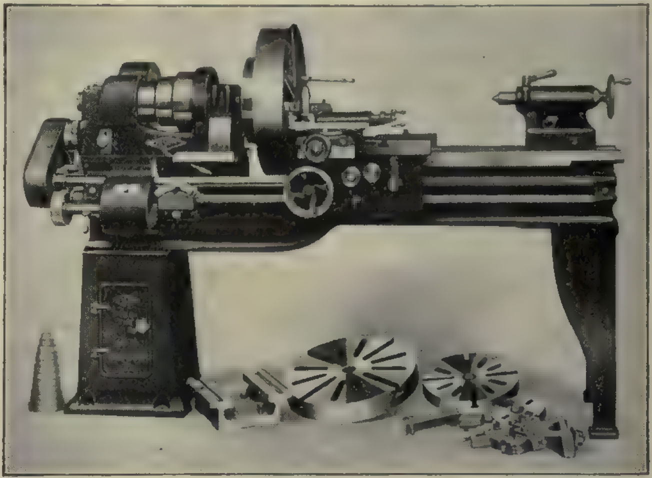


HEALD TYPE 1436 MAGNETIC CHUCK

Working surface, $15\frac{3}{8}$ x $40\frac{1}{2}$ in.; dimensions of base, $14\frac{1}{2}$ x $40\frac{9}{16}$ in.; height, $5\frac{7}{8}$ in.; magnetic surface, 12 x 35 in.; watts used, 300; number of coils, 32; number of holes in top of plate, 16; strength, 200 lb. sq.in.; weight, 625 lb.

"Filsmith" Gap Lathe

The Philip Smith Mfg. Co., Sidney, Ohio, is now manufacturing the gap lathe shown in the illustration. The gap piece has four bearings on the bottom and is bolted and doweled in place. At the same time the construction is such that the gap may be removed in a few moments. As an ordinary lathe the swing is 14 in., while with the gap piece removed the swing is increased to 22 in. The machine is furnished with lengths of bed of 5, 6, 8, 10 and 12 ft. and a quick change gear box is incorporated if desired. The illustration shows the lathe with the gap piece removed.



"FILSMITH" GAP LATHE

Swing with gap piece in place, 14 in., with gap piece removed, 22 in.; maximum face of work with gap removed, $6\frac{1}{2}$ in.; lengths of bed, 5, 6, 8, 10 and 12 ft.

Fastening a Hammer Head on the Handle

By R. M. Peterson

I have read articles on fastening hammer heads on the handles, but have found the following method most satisfactory: An ordinary wedge was made and slightly nicked on each side, after which it was bent into an S-shape and driven into the handle. Hammer heads fastened in this way several years ago are still on their handles.

Draft Registrants

The new "Questionnaire" is now being sent out to draft registrants throughout the country. It is of the greatest importance that the forms should be properly filled out, and each employer should delegate a competent employee to see that the requirements are met.

Four classifications are recognized for those engaged in industrial occupations.

CLASS I

Any registrant not found to be engaged in a "necessary" industrial enterprise, or, if found to be engaged in such enterprise, not found to be "necessary" to the effective operation of the enterprise.

CLASS II

Any registrant found to be engaged in a "necessary" industrial enterprise and found to be "necessary" to such enterprise in the capacity of a skilled laborer especially fitted for the work in which he is engaged.

CLASS III

Any registrant found to be engaged in a "necessary" industrial enterprise and found to be "necessary" to the effective operation of such enterprise in the capacity of—A highly specialized technical or mechanical expert, or an assistant or associate manager of the enterprise, or a manager of a substantial, integral part thereof.

CLASS IV

Any registrant found to be engaged in a "necessary" industrial enterprise and found to be "necessary" to such enterprise in the capacity of sole managing, controlling and directing head of the enterprise.

APPEALS

Appeals to the President from decisions of District Boards may be claimed only in accordance with the provisions of section 111 of the Selective Service Regulations.

Such appeals may be claimed only by or in respect of a registrant classified by a District Board in Class I—or by or in respect of a registrant classified by a District Board in a class more deferred than Class I, when and after the immediately preceding class is exhausted; and only when there has been at least one dissenting note in the District Board.

Such appeals may be claimed only by the person who preferred the claim of deferred classification to the District Board (either originally, in an industrial or agricultural case, or by appeal, in a dependency case).

Such appeals may be claimed from a classification by the District Board, which is less deferred than the classification claimed before such District Board in the following cases only:

When in industrial cases the appeal is accompanied by the written and signed recommendation of one member of the Local Board, and either the Government Appeal Agent or the Adjutant General of the State.

Where exemptions are claimed great care should be exercised that the claims for exemption are properly filled and that the accompanying affidavits are correctly made out and sworn to.

Personals

N. B. Payne, formerly associated with Manning, Maxwell & Moore, Inc., New York, has opened an office in the Havermeyer Bldg., 25 Church St., New York City, where he will deal in new and used traveling cranes.

David F. Noble has resigned his position with the E. L. Essley Machinery Co., to become associated with the David A. Wright Machinery Co.

J. C. Bannister has been made vice president of the Walworth Manufacturing Co., Boston, Mass. Mr. Bannister has recently been in charge of the Kewanee works, which were purchased from the National Tube Co. last August. He will have headquarters at Kewanee, Ill., but no change in the management there is contemplated at the present time.

C. R. Burt, assistant general manager of the Russell Motor Car Co., Ltd., Toronto, has been appointed general manager and director of the Russell Motor Car Co., of Buffalo. **J. E. MacArthur,** formerly factory manager and **C. F. Heckman,** formerly superintendent of the Toronto plant, have accepted similar positions at Buffalo.

New Publications

Lefax Data Sheets—Lefax, Inc., Sheridan Bldg., Philadelphia, Penn.

The publishers of "Lefax" are now including a number of sheets on military subjects as a part of their loose-leaf, data-sheet service. The sheets so far issued consist of digests of Government publications on such subjects as the cleaning and care of the rifles, semaphore and other forms of signalling, drill regulations, range tables, description and operation of rifles, principles and modern developments of trench warfare, and methods of estimating distances.

Business Items

The Carrier Engineering Corporation, 39 Cortlandt St., New York City, has greatly expanded its department for the design, layout and installation of piping systems for plants using air conditioning apparatus, power units, heating and purifying apparatus, etc. The department is now in charge of George G. Schmidt, who has had considerable experience in this line of work.

The Abell-Howe Company, 565 Washington Boulevard, Chicago, has established a number of branch offices. These are located at 30 Church St., New York City; 5086 Jenkins Arcade, Pittsburgh, Penn., and 803 Ford Bldg., Detroit, Mich. J. R. Shays, Jr. is in charge at New York, C. W. Wheeler and Wayne Paulin at Pittsburgh and H. G. Bates at Detroit. The company is also represented in connection with the sale of Howe trucks by the Boston Steel & Mfg. Co., Boston, Mass., and the Howe Scale Co. and the J. S. McCormick Co. in the Pittsburgh and Cincinnati territory. The Watkins Engineering Supply Co., Boston, Mass., and the Frank J. Rose Co., Minneapolis, Minn., represent the company for the sale of American high-speed chain.

Trade Catalogs

Getting Maximum Pulley Efficiency. The American Pulley Co., Philadelphia, Penn. This is the title of a pamphlet containing data and information compiled by this company relating to belt pulleys and ought to be of value to those interested. Pp. 38; 6 x 9 in.; illustrated.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Feb. 7, 8 and 9. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

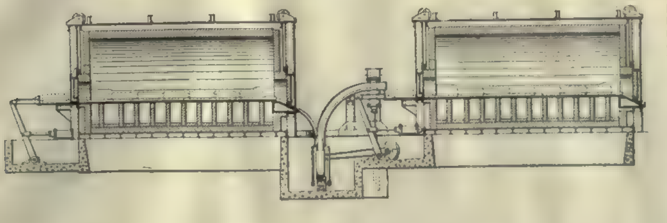
Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Furnaces, Automatic Electric-Shell-Heating

Electric Furnace Co., Alliance, Ohio



"American Machinist," Nov. 29, 1917

These automatic heat-treating furnaces are used for shells and other similar work, the control of all movements being centered in a number of pyrometers. All operations from the loading to the delivery of the shells are entirely automatic and it is claimed that the results obtained are very accurate and uniform

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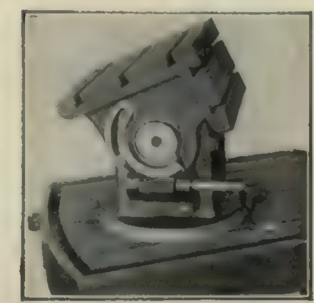
Table, Universal Tilting for Drilling Machine

Morris Machine Tool Co., Cincinnati, Ohio

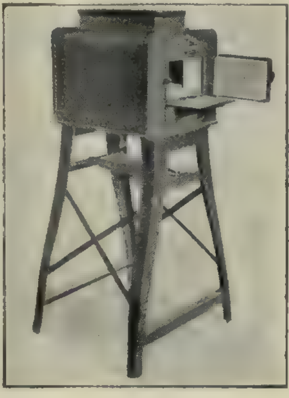


"American Machinist," Nov. 29, 1917

A universal tilting table intended for use on the base of a drilling machine. May be tilted to any angle, being controlled by a worm and worm wheel segment, graduated in degrees. The base of the machine is cylindrical so that it may be readily swiveled in a horizontal plane to any required angle. When top of the table is horizontal, the adjustable portion rests on positive stops. The upper working surface of the table measures 18 x 18 in. while the side measures 11 x 18 in. The T-slots are ¾ in., there being three on the top, and two on the side.

Furnaces, Gas, "Ever Ready"

Capital Die Tool and Machine Co., Columbus, Ohio



"American Machinist," Nov. 29, 1917

One of a considerable line of furnaces operated without a blower, and claimed to be very economical in gas consumption. They are made in a number of sizes from 4 x 6 x 12 in. with a gas consumption of about 30 cu.ft. per hour, to 6 x 12 x 20 in. with a gas consumption of about 90 cu.ft. per hour. The illustration shows the smallest machine, which is known as the No. 2

Grinding Machine, Poppet Valve

Ott Grinder Co., Indianapolis, Ind.

"American Machinist," Dec. 6, 1917

Especially intended for grinding the seats of poppet valves for internal-combustion engines. The wheel base may be set to grind any angle from 15 to 60 deg. The table traverse is operated by hand, and the valves are held either between centers or in a draw-in collet chuck. The grinding wheel used has a face parallel to the axis of the whee and is traversed across the valve seat.

Truck, Elevating, Type RL-10

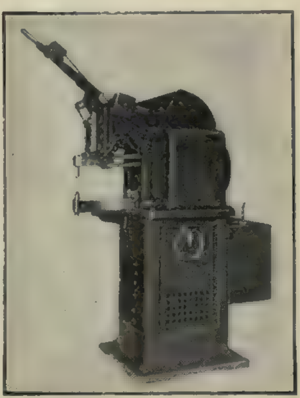
Holyoke Truck Co., Holyoke, Mass.

"American Machinist," Nov. 29, 1917

Capacity, 5000 lb.; extreme length with handle raised, 60 in.; length of truck platform, 40 in.; extreme width of truck, 27 in.; height of platform lowered 10 in., raised 12 in.; two front wheels, 8¾ x 2½ in.; rear wheels, 10 x 3½ in.; wheel base, 48 in.; size of platforms accommodated, 33 x 32 in. to 52 x 40 in.

Spot Welding Machine

Taylor Welder Co., Warren, Ohio

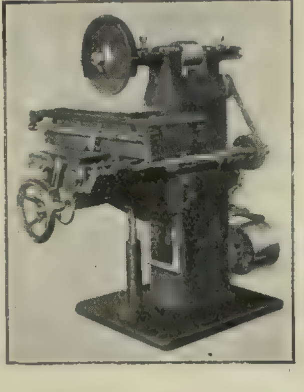


"American Machinist," Dec. 6, 1917

A line of spot-welding machines built on a new principle which, it is claimed, enables strong welds to be made in a shorter space of time than has heretofore been possible. It is also claimed that thicker plates may be welded. Made in a number of styles, the one shown being known as type D-12-4, to which the following specifications apply: Welding capacity, two ¼-in. plates; depth of throat, 12 in.; distance between copper bands and lower horn, 8 in.; floor space, 28 x 54 in.; height, 70 in.; distance from floor to top of lower welding point, 44 in.; maximum opening between electrodes, 3 in.; weight, 1800 lb.; transformer, 25 kw.

Grinding Machine, Surface No. 2

Noble and Westbrook Manufacturing Co., Hartford, Conn.



"American Machinist," Nov. 29, 1917

Capacity, work up to 8 x 20 in.; distance between bottom of 12-in. wheel and top of platen, 7½ in.; diameter of spindle, $1\frac{9}{16}$ in.; diameter of spindle between flanges, 1¼ in.; wheel used, ¾ x 12 in.; size of bearings, $1\frac{9}{16}$ x 6 in.

Drilling Machine, "Demco," Numbers 31 and 32

DeMooy Machine Co., Cleveland, Ohio

"American Machinist," Dec. 6, 1917

No. 31 machine—diameter of spindle, $\frac{7}{16}$ in.; distance from center of spindle to column, 8 in.; traverse of spindle, 8 in.; traverse of feed rack, 4 in.; traverse of table, 15 in.; width of belt, 1 in.; distance between spindle centers on multiple-spindle machines, 6¾ in.; number of speeds, 5; maximum spindle speed, 12,000 r.p.m.; width of oil groove around table, 1⅜ in.; capacity in soft material, ⅝ in. Specifications for No. 32 machine are the same as above except as follows: Diameter of spindle, $\frac{11}{16}$ in.; maximum spindle speed, 3500 r.p.m.; capacity in soft material, ⅝ in.

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Dec. 14, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$23.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	30.00
*Bessemer, Pittsburgh	37.25	36.30	35.95
*Basic, Pittsburgh	33.00	33.00	30.95
No. 2X, Philadelphia...............	33.75	33.75	29.50
*No. 2, Valley...................	33.00	33.00	31.00
No. 2, Southern Cincinnati............	35.90	35.00	25.90
Basic, Eastern Pennsylvania...........	33.75	30.00	30.00

*Delivered Pittsburgh; f.o.b. Vallley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Dec. 14, 1917	One Month Ago	One Year Ago	Dec. 14, 1917	One Year Ago	Dec. 14, 1917	One Year Ago
Structural shapes ...	$4.20	$4.20	$3.75	$4–4.04	$3.85	$4.20	$3.70
Soft steel bars......	4.10	4.10	3.75	4–4.04	3.85	4.10	3.60
Soft steel bar shapes.	4.10	4.10	3.75	4.14	3.85	4.10	3.60
Plates, ¼ to 1 in. thick	4.45	4.45	4.75	4.39	4.50	4.20	3.60

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Dec. 14, 1917	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York..................	4.25	3.75
Warehouse, Cleveland	3.95	3.70
Warehouse, Chicago	4.10	3.65

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Dec. 14, 1917	One Month Ago	One Year Ago	Dec. 14, 1917	One Year Ago	Dec. 14, 1917	One Year Ago
*No. 28 black......	5.00	6.445	6.445	5.25	6.45	4.75	6.445	4.75
*No. 26 black......	4.90	6.345	6.345	5.15	6.35	4.65	6.345	4.65
*Nos. 22 and 24 black	4.85	6.295	6.295	5.10	6.30	4.60	6.295	4.60
Nos. 18 and 20 black.	4.80	6.245	6.245	5.05	6.25	4.55	6.245	4.50
No. 16 blue annealed.	4.45	5.645	5.645	4.85	5.65	4.45	5.645	4.50
No. 14 blue annealed.	4.35	5.545	5.545	4.75	5.55	4.35	5.545	4.40
No. 12 blue annealed.	4.30	5.495	5.495	4.70	5.50	4.30	5.495	4.30
No. 10 blue annealed.	4.25	5.445	5.445	4.65	5.45	4.25	5.445	4.25
*No. 28 galvanized..	6.25	7.695	7.695	7.25	7.70	6.50	7.695	6.75
*No. 26 galvanized..	5.95	7.395	7.395	6.95	7.40	6.20	7.395	6.45
No. 24 galvanized...	5.80	7.245	7.245	6.80	7.25	6.05	7.245	6.30

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Dec. 14, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Dec. 14, 1917	One Year Ago
New York	$15.00	$7.50
Cleveland	15.30	7.50
Chicago	15.00	5.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00 @ 30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16 ..	
No. 18	
No. 20	

* Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Dec. 14, 1917	Cleveland Dec. 14, 1917	Chicago Dec. 14, 1917
Tire	5.00	5.00	4.04
Toe calk	5.70	5.50	4.35
Openhearth spring steel...	7.50	8.25	8.00 @ 8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Coppered bessemer rods....	7.00	....	....
Hoop steel	4.04½	....	....
Cold-rolled strip steel.....	9.00	....	....
Floor plates	6.19½	....	....

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4.......	29%	17%
4½ to 6......	44%	32½%	4½ to 6.......	28%	16%

Note—National Tube Co. quotes on basing card dated Apr. 1.

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Dec. 14, 1917	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	36.00
Tin, in 5-ton lots................	86.00	74.00	43.00
Lead	6.50	7.25	8.00
Spelter	7.75	7.88	11.75

*Government price.

ST. LOUIS

	Dec. 14, 1917	One Month Ago	One Year Ago
Lead	6.37½	7.13	7.80
Spelter	7.50	7.63	11.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Dec. 14, 1917	One Month Ago	One Year Ago	Dec. 14, 1917	One Year Ago	Dec. 14, 1917	One Year Ago
Copper sheets, base.	35.00–37.00	35–37	41.00	32.00	45.00	35–36	42.00
Copper wire (carload lots)	36.00	36.00	36.00	28.50	44.00	33.50	36.50
Brass pipe, base...	38.50	38.50	47.50	40.00	52.00	41.00	46.50
Brass sheets	35.75	35.75	45.50	33.00	47.00	35.00	44.00
Solder ½ and ½ (case lots)	40.50	40.50	27.50	43.25	28.25	41.00	28.25

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Dec. 14, 1917	One Year Ago
Mill	$29.00	$42.00
New York	30.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

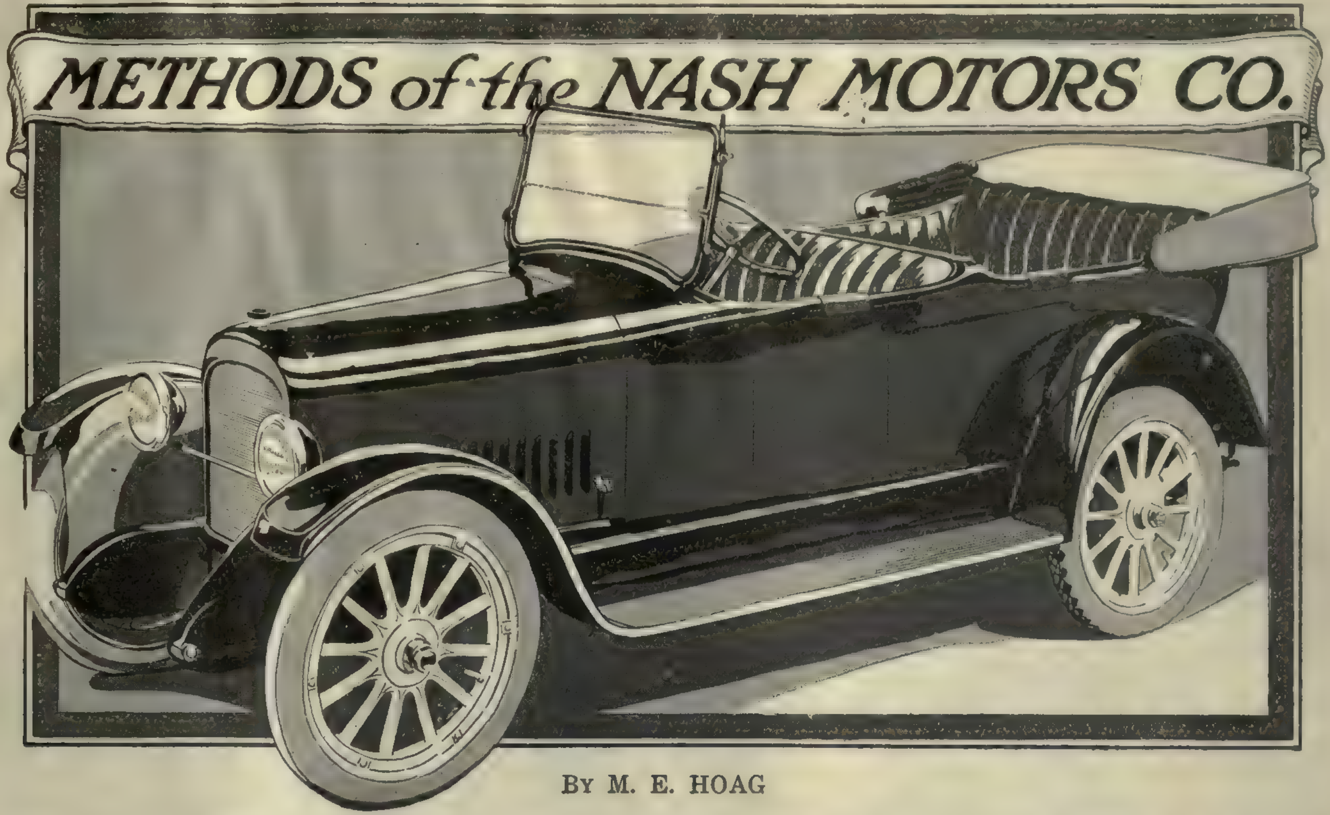
Carload lots f.o.b. mill.................................. 19.00

	In Casks		Broken Lots	
	Dec. 14, 1917	One Year Ago	Dec. 14, 1917	One Year Ago
Cleveland	21.00	23.00	21.25	23.25
New York	20.00	22.00	20.50	23.00
Chicago	21.00	22.75	21.50	23.25

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Dec. 14, 1917	One Year Ago
New York	15.50	14.75
Cleveland	17.50	16.00
Chicago	16.00	15.00

METHODS of the NASH MOTORS CO.

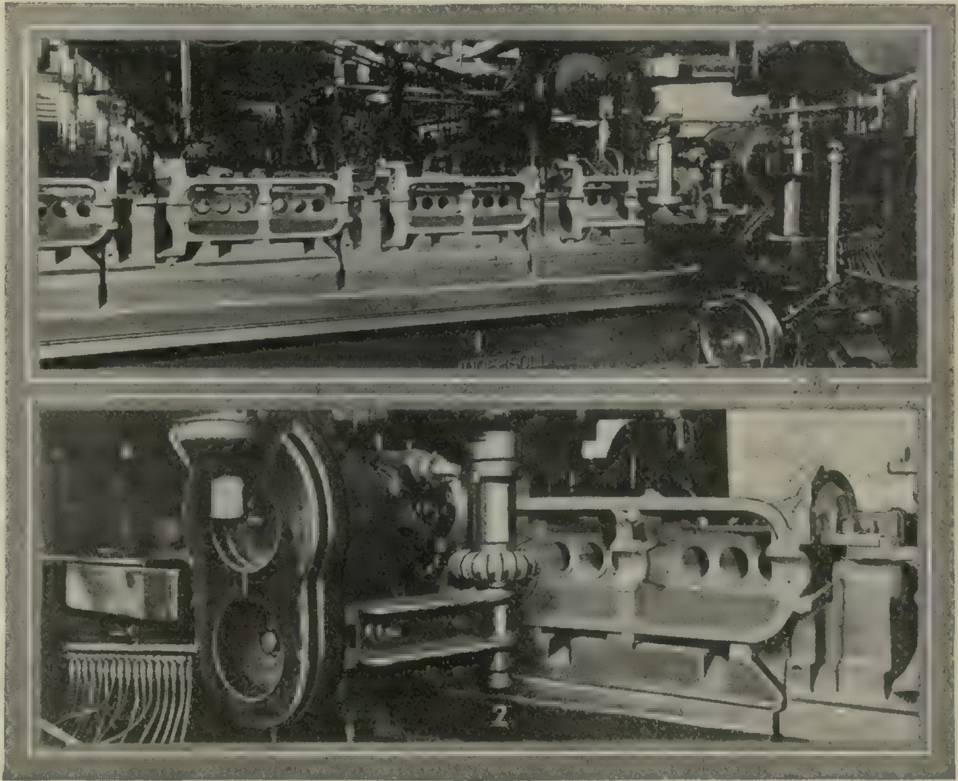


By M. E. Hoag

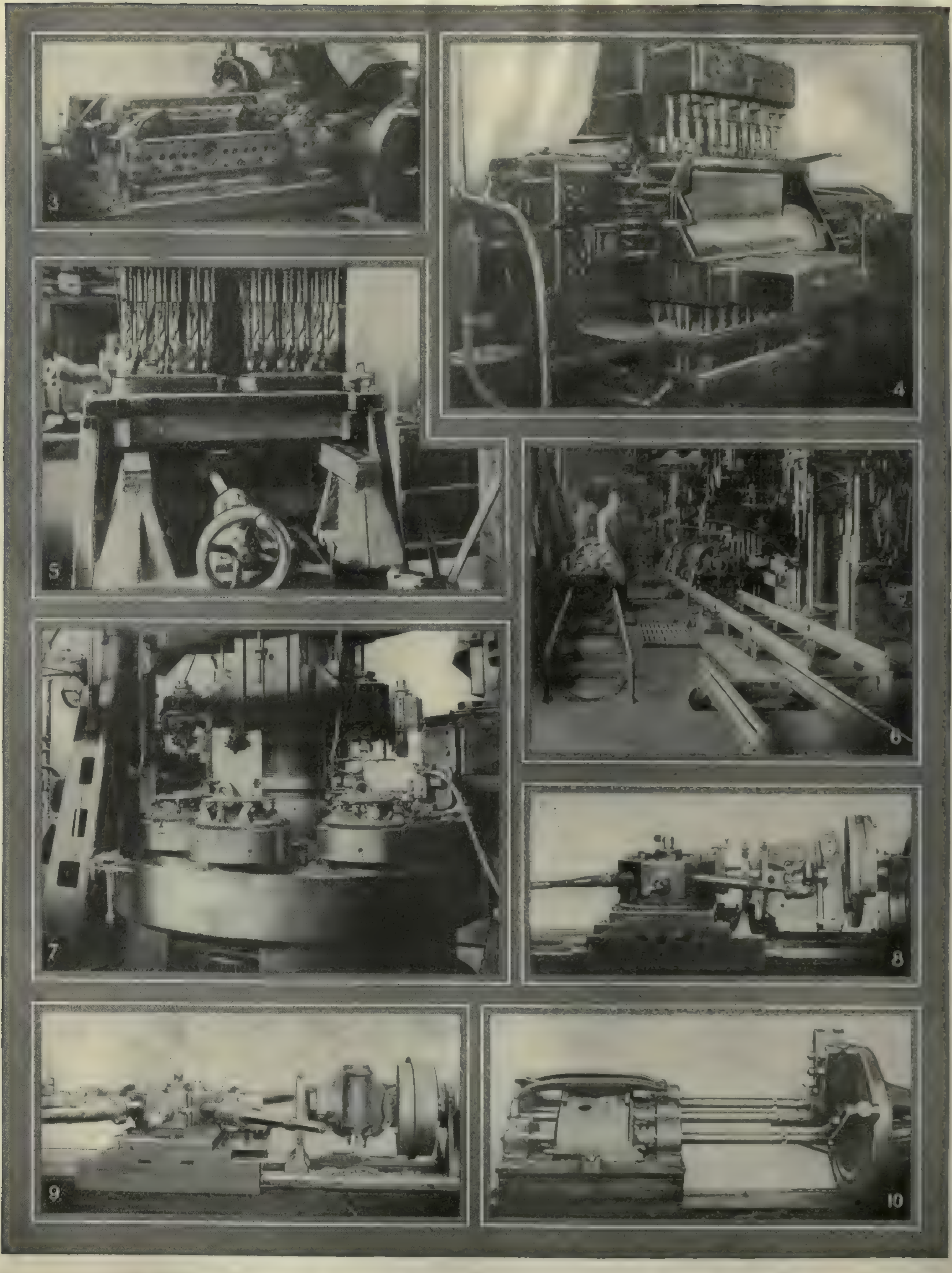
It is the general practice of this company to use single-purpose machines wherever possible and some very interesting applications are shown.

IT IS the practice in the shops of the Nash Motors Co., Kenosha, Wis., to machine the cylinder castings on an Ingersoll milling machine as shown in Fig. 1, on which 9 cutters operate at once roughing and finishing a number of cylinders at one setting. Two radius cutters mill the crankshaft-bearing seats during this operation. The cutters are of the inserted-blade type, the roughing cutter having the blades set at an angle to prevent chatter. The finishing cutter is at the back of the machine as shown in Fig. 2, and has the blades inserted straight, for it is much easier to grind the proper radius on a cutter of this type than on the one in which the blades take the form of a modified spiral.

The cylinder heads are also roughed and finished on an Ingersoll milling machine as shown in Fig. 3. The fixtures for these pieces are so arranged that both faces and two edges are finished before the work leaves the machine, a progressive set-up being followed. The first rough and finish cuts are taken with the work in position as illustrated. The piece is then shifted to the opposite side of the machine, and with the finished surface clamped against the fixture, the other side is roughed and finished. Two pieces with both sides finished are then placed in the center of



FIGS. 1 AND 2. MACHINING CYLINDER CASTINGS ON INGERSOLL MILLING MACHINE



FIGS. 3 TO 10. VARIOUS OPERATIONS IN THE FACTORY OF THE NASH MOTORS CO.

Fig. 3—Milling cylinder heads. Fig. 4—Special Foote-Burt drilling machine. Fig. 5—Multiple spindle-drilling machine for cylinder heads. Fig. 6—Track and jigs for cylinders. Fig. 7—Six-spindle hydraulic automatic. Fig. 8—Boring knuckle body on a turret lathe. Fig. 9—Boring transmission gear case. Fig. 10—Special boring fixture for gear cases.

the fixture as illustrated and the edges roughed and finished. It is thus possible to carry on almost a continuous milling operation.

The cylinder boring and recessing is handled on Moline cylinder-boring machines in practically the same manner as in other shops and as has already been described in the *American Machinist* at various times.

It is general practice in the Nash Shops to use specially built machines in preference to general-purpose machines, wherever the volume of work to be done is sufficient to warrant the investment; it has been found that the greater accuracy secured and the greatly increased production more than offsets the initial investment, even though that may be quite high. An excellent example of a machine designed for a special job is shown in the Foot-Burt drilling machine Fig. 4. This machine carries 77 spindles, and drills the flange-bolt holes in the top, bottom and ends of the cylinders at one setting. Simple locating and clamping devices operated by levers at the front and right-hand side of the machine, permit of quick set-up. The entire time including set-up, drilling, removal of work and cleaning away chips, is a trifle less than three minutes—an operator and helper being employed on the work. This is less time than would be required to jig the piece and drill one hole by older methods.

Another of these special fixed spindle multiple-drilling machines is shown in Fig. 5, together with the fixture for holding the cylinder heads while drilling 12 holes, and drilling and counterboring 12, making the 24 holes at one operation. The 12 front spindles carry drills, and the 12 in the back row carry combination drills and counterbores.

The Fixture Used

The fixture or jig for this work is quite massive, but permits rapid and easy handling of the work. The cylinder-head is laid on the ways and shoved back under the bushing plates until it strikes stops in the back of the fixture. A few turns of the handwheel brings locating stops into action on the underside of the piece and raises and clamps the casting against the underside of the fixture as indicated in the illustration.

There are a number of drilling, counterboring and spot-facing operations that cannot be handled to advantage on special machines, and for this work the track system shown in Fig. 6 is used with excellent results.

The jigs for holding the cylinder castings during these several operations are built in the form of cars as shown, with cradles pivoted at each end and turned by worm gear and handwheels, so that the various parts to be drilled can be brought under the drilling-machine spindles.

The tracks and machines are accurately located so that when a jig is loaded at the upper end of the tracks it can be sent clear through without changing the position of the work or lateral location of the jig.

In order to prevent side-play of the car on the track, the rail is rounded on top, and the pair of wheels that roll on it are grooved to fit it. The outer rail and wheels that roll on it are flat, hence there is no tendency for them to pull the locating wheels from their rounded track.

The cars are loaded at the far end of the track, and as each workman finishes the operations assigned to his machine the car is passed on down the line to the next machine, and after unloading at the lower end of the track the car is run on a section of track and rolled across to the other line of track and returned to the starting point, where another section of track similar to that in the foreground is used to carry the loaded jig to the machines again.

In the preceding part of this article we have shown operations on parts of the Nash pleasure car. We will now briefly deal with operations on parts of the "Quad" four-wheel drive truck. This truck is being manufactured for the U. S. Army, and on this account certain parts are purchased from outside firms to meet the Government specifications, but a very large part of the machine is built in the Nash shops.

The machine shown in Fig. 7 is one of two in this shop, that are used for turning and boring flywheels, and as shown in the illustrations, for turning and boring the knuckle bodies. These machines are unique, from the fact that the tool feed is handled by hydraulic pressure and not by such mechanical devices as cams or screws as is usually the case with automatics.

The machine shown, is a six-spindle chucking automatic. The front position is not tooled but is the loading and unloading station. The tools for the entire five machining positions are started through one control lever, and at the completion of the cut the superhead automatically rises and the chuck carriage indexes, after which the machine comes to a stop until the operating lever is again brought into action by the workman. The machines were built by Giddings & Lewis, of Fond du Lac, Wisconsin, and are giving excellent service.

The knuckle bodies are cross-bored and certain facing operations handled in the Baush turret lathe shown in Fig. 8. Owing to the great weight of the turret carriage it is operated by an air ram inside the ways of the lathe. Bushings in the faceplate jig engage the ends of the tool bars and steady them so that heavy cuts are practical in these steel castings.

In Fig. 9 is seen another Baush machine used for boring and facing the transmission-gear case. Eight tools are used on this piece of work and much the same proceedure followed as for the kunckle bodies.

A lathe equipped with special fixtures for boring the gear case of the truck is shown in Fig. 10. The tool head is stationary and the boring bars are driven through universal joints connected to the headstock of the lathe.

(To be continued)

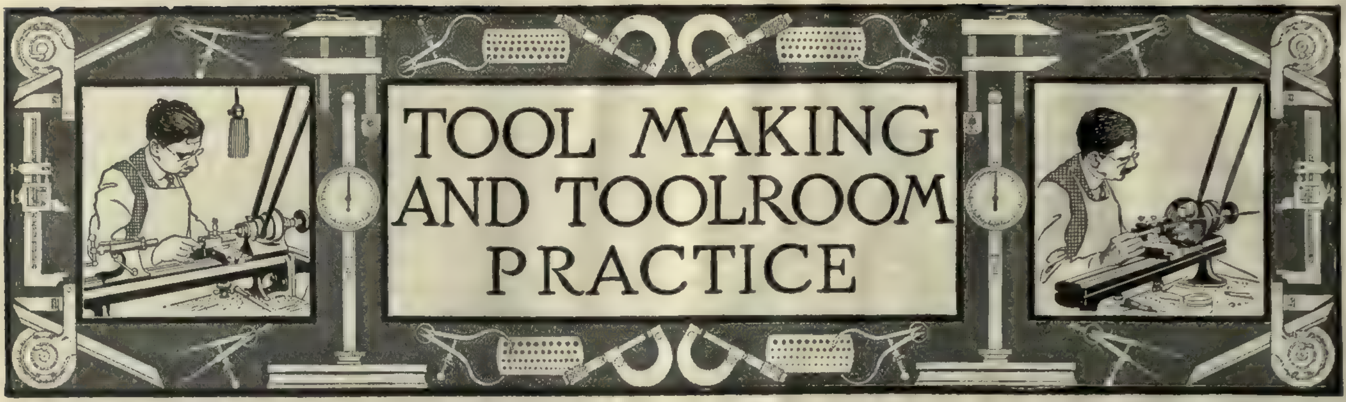
Making Use of the Practical Letters

By William S. Rowell

To help Cathal MacChoinnigh's friend in the garage, as mentioned on page 856, he should be told that shrinking cast-iron cylinders, by heating and cooling, is rare indeed; but that cast-iron pistons are frequently expanded enough by the same process, to allow a refinish that will fit the worn cylinder bore.

If there be those that question the expanding of cast iron when heated and cooled, let them examine a few old grate bars.

[The action of cast iron under heat depends somewhat on the degree of heat applied.—Editor.]



TOOL MAKING AND TOOLROOM PRACTICE

Elements of Gagemaking—III*

By C. A. MACREADY

In ordinary and even in some classes of refined machine-shop work the use of force is frequently permissible, as, for instance, in the making of force fits where a shaft is forced into a wheel. In gagework it may be generally stated that the use of force must be avoided as much as possible, as it is sure to distort the work.

When in use the average gage is under no stresses whatever except those imposed on it by handling and use, and, other things being equal, the nearer these conditions can be maintained throughout the course of its manufacture the more accurate the gage is likely to be. It is therefore advisable to have the "fits," such as bushed holes, and the applied tensions, such as holding straps and clamps, stressed as little as practicable to perform their functions.

Any machinist who has handled any of the ordinary machine tools will know just what is meant. In planing, the planer hand takes his roughing cuts with the straps and clamps tight; so does the lathe hand with work held on the faceplate or in the chuck. But when the surplus metal has been removed, the clamps are loosened up to a point where they will just hold the work against the force of the cut. In this way only can fairly accurate planing or turning be done. The same, but to a greater extent, holds true of gagework; the holding devices must be tightened just enough to resist the stresses of the various tools or operations.

When a piece is to be attached to the faceplate of a lathe, the surface where it seats must be flat. Very few lathes can be depended on to take a cut accurately at 90 deg. to the spindle axis. The result, therefore, is either a male or a female cone, neither of which makes a satisfactory clamping surface for accurate gagework.

In Fig. 40 is shown, exaggerated, the result produced when an attempt is made to bore parallel holes in a piece clamped to a faceplate that in shape is a male cone. It is obvious that the holes will not be parallel to each other, no matter what part of the faceplate is used or how the work is clamped to it; in fact, the error will be increased if the work is also clamped on the *B* side of the faceplate.

This male-cone faceplate will result in greater error in the work than that due to the use of the female cone shown in Fig. 41. In Figs. 42 and 43 are illustrated the location of the holding straps and the distortion produced by the pressure necessary to hold the work while machining it. It can be seen by Fig. 43 that the center of the male cone acts as a pivot and that the clamps bend the work to conform to the shape of the conical faceplate.

The hollow conical faceplate does not distort the work so much, because the clamps are almost directly over the bearing points *D* and *D'* as shown in Fig. 42. They therefore have less tendency to distort than they would have on work not similarly supported immediately below the clamps.

Faceplate errors are corrected by the use of an adapter made of cast iron tapped to receive screws that pass through the radial slots in the faceplate. The entire face of the adapter is drilled and tapped for ¼-in. screws, which are used to the best advantage for securing the work. The faceplate and adapter are shown in Fig. 44. The faceplate is first trued with a cut; the adapter is then carefully fitted to the faceplate so that there is no distortion. There must be enough surface surrounding the attaching screw holes *A*, Fig. 44, to give a good seat and properly cover the radial slots in the faceplate. When thus carefully fitted, if the plate and adapter are marked for replacement, they can be disassembled when the faceplate is required for ordinary work; this is not, however, good practice. If they are taken apart, the adapter should be tested with an indicator when it is replaced upon the faceplate.

After being attached, the adapter is trued in position by a facing cut. If found not flat, it must be scraped to a surface plate and, if possible, lapped after scraping; the nearer it is to a plane the more accurate will be the work that comes from it.

As stated previously with reference to Fig. 29, the removal of stock in several different places will distort plane surfaces. The reason for this is that all metal is under stresses that under certain conditions of time or temperature, or both, balance themselves; the removal of this stock destroys the balance and the stronger stresses overcome the weaker until a new

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*Prepared for the author's forthcoming book on gagemaking; copyright, 1917, McGraw-Hill Publishing Co., Inc.

equilibrium is established. This condition is what is termed "seasoning."

This is mentioned at this point to call attention to the action due to the introduction of stresses that in turn will set up other stresses and unbalanced conditions in the work. These stresses are the effects of force; and as previously stated, force as generally understood by machinists must be avoided in gagemaking, for if it be used, for instance, when inserting the bushings, the gage, Fig. 45, will be distored.

Normal Conditions

By normal condition is meant a condition as nearly as possible devoid of external or internal stress—in other words, not abnormal. Normal conditions may be so made use of that they assist in attaching objects together, which after being so attached will require considerable force to separate them. This normal condition is taken advantage of when bushings are to be securely placed without setting up undue stresses in the piece being bushed. The closer two surfaces fit each other the firmer they will hold together and prevent each other from moving. In a cylindrical form we have an ideal illustration of this effect, proved by the force required to separate a perfectly fitting plug and ring gage that have been allowed to stand assembled. The plug, if lubricated with vaseline or mutton tallow and kept moving, will slide in and out of the ring. But if allowed to stop moving, it will "take a set." If the same amount of force that is required to separate gages that have "taken a set" were applied to force a similar plug *into* a hole in a piece of steel, the piece would be distorted. This effect of "taking a set" is used advantageously when bushings are fitted—by reaming the holes in the gage as smooth as possible and then lapping them and also grinding and lapping the outsides of the bushings to a plug fit for the holes in the gage.

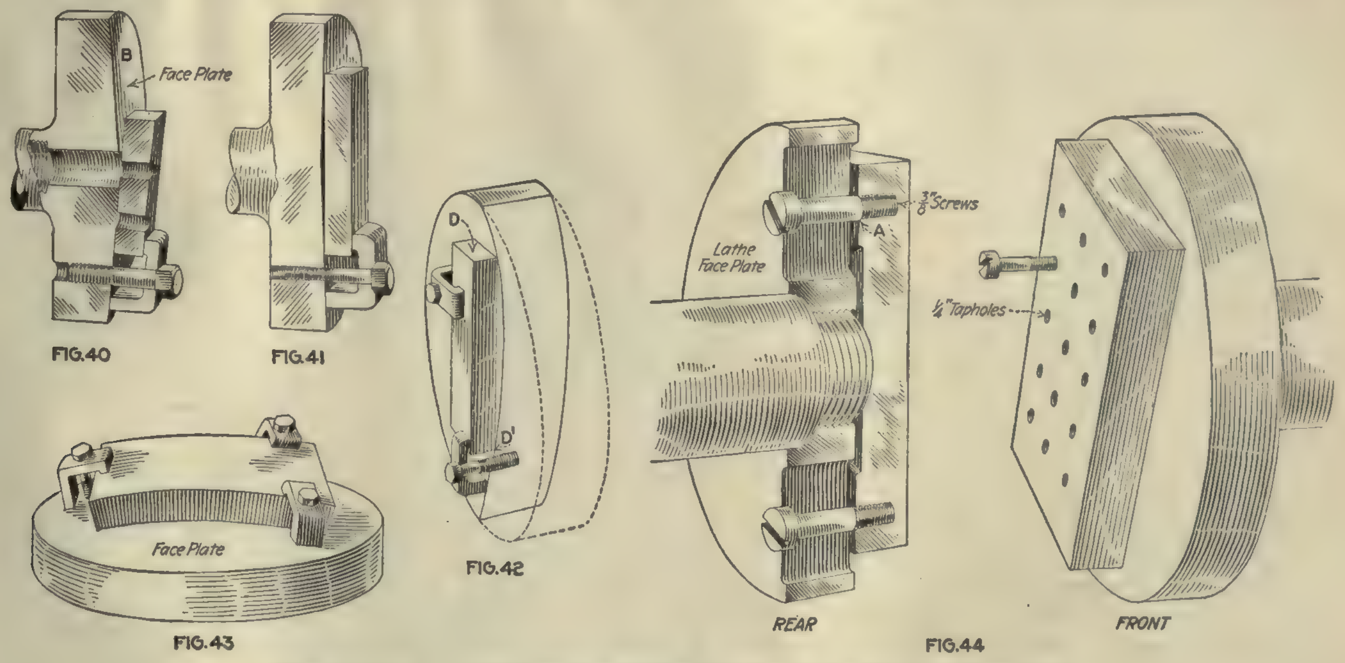


FIG. 40 FIG. 41 FIG. 42 FIG. 43 FIG. 44

FIGS. 40 TO 44. A NUMBER OF DIFFICULTIES IN USING A FACEPLATE

In Fig. 45 is a gage in which all the holes have been laid out and drilled in a drilling machine, as described in connection with Fig. 22. The button attached with the nut and screw in proper relation to the base lines *A* and *B*, is indicated at *C*, Fig. 46, and the gage is rapped to the position required to make it run true with the axis of the lathe spindle. A center-punch mark would be positioned the same way except that the pointer *B*, shown in dotted lines, is substituted for the button *C*.

When a button is central, or "runs true," the indicator needle *A*, Fig. 46, will not move. The button is then removed and the hole bored. Each hole, in the same manner, is bored and tested for accuracy of position by measuring over temporary plugs fitting the holes to be tested and comparing the measurement with the one desired. If found correct, the bushing is finished and replaces the temporary plug. A final test is taken now to see that the bushing has gone home true.

Wherever possible, it is good practice to have all the bushings of the same outside diameter, even if it makes some of them look large in comparison to their bore. However, this itself is desirable, as a thick-walled bushing will not distort in hardening as much as a thin one. Keeping them one size also reduces the number of temporary plugs that will have to be made to test the locations of the bushing holes. The temporary plugs also assist in determining the size to make the bushing to fit the hole. Each bushing, when wrung home, may be the beginning of distortion that must be checked before it assumes too great proportions. Distortion accumulates with each bushing adding a little bit more to that due to the insertion of previous bushings.

The two holes *C* and *D*, Fig. 45, are 0.10 in. in diameter and introduce a condition that has to be handled differently from that of ordinary bushed holes. We have here a center to center distance that does not allow the outside of the bushings to be cylindrical. As it is only 0.120 in., the wall of each bushing at the center of the holes is only 0.01 in. thick. While this wall, 0.01

in. thick, would alone be too weak, still when in contact and supported by the other bushing wall of the same thickness their combined strength will be sufficient to withstand ordinary use.

The arithmetic of the measurements of these bushings may be a little confusing; but if the solution of the problem, given in Fig. 47, be studied, it will serve as a simple and accurate method applicable to many other problems of a like nature.

There are several points that it is desirable to know accurately when dealing with overlapping bushed holes like these: Four dimensions covering their position in the gage, the fit of each bushing in its hole and the combined fit of the two bushings in contact with each other when in the gage.

To make plain the fitting of the bushings to their holes and in contact with each other, we will separate this part of the gage, Fig. 45, and make a separate example of it in Fig. 48, where the two holes are shown with one bushing in place. So far as merely locating the centers of these holes correctly is concerned, the buttons are sufficient. But it is obvious that the fit of one bushing in its hole will cause it, to some extent, to be forced over into the unoccupied hole. For this reason the two bushings must be in contact with each other. Their being in contact with each other also replaces the holding or retaining contact of the wall of the hole and part of the friction or gripping effect that tends to hold the bushings in place without undue force having been used to place them.

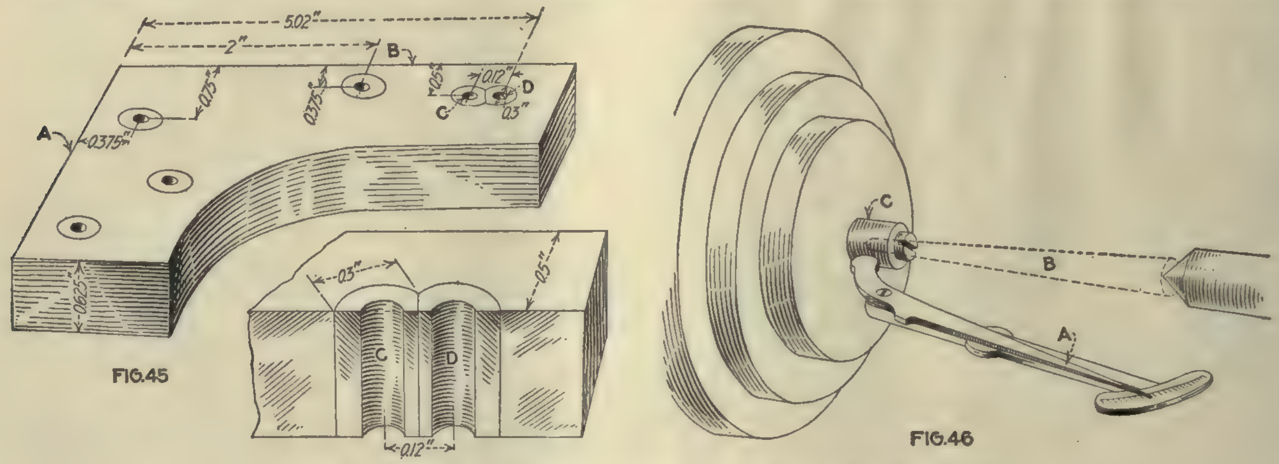


FIG. 45

FIG. 46

FIGS. 45 AND 46. GAGE BUSHING AND DRILLING PROBLEMS

The best results will be obtained if one hole is bored to fit the temporary plug that is used to test the hole for position in the gage. When the position of the hole is proved correct, take a piece of drill rod that is a snug push fit in the hole just bored and solder it in. This plugs the hole, and the gage can be shifted on the faceplate and drilled and bored for the other bushing hole and then tested. In Fig. 49 the plug is shown. The edges of the ends are beveled for the solder that is used to hold it in position while the hole is being bored. As a large part of the hole and plug is to be removed, friction alone would not be sufficient to resist the twisting action of the boring tool. The part of the plug which remains in the work is removed by a light, sharp blow with a hammer, using a piece of brass rod as a drift. The last hole having been positioned correctly, we know that we have each hole where it belongs; therefore, if after placing the bushings in the gage body they do not when tested prove to be in the right place, we know that the fault is in their contact with each other, or in lack of concentricity of the holes in the bushings themselves.

MAKING ACCURATE BUSHINGS

A bushing of small internal diameter that has, in hardening, distorted to a curve, as shown exaggerated in Fig. 50, is difficult to correct, because the small lap used to correct it has not sufficient stiffness to shape the curved hole into a straight one—in other words, it is not strong enough to resist following the curve. The chances are that the gagemaker will be apt to decide that it has shrunk, or the metal has expanded in the center of the hole, and it will therefore be logical to do most of the lapping at the center. This causes a hole shaped like that shown, exaggerated, in Fig. 51. The feel of the plug following the curve of the hole will induce one to assume that the hole is a certain size, not knowing what part of the "feel" is caused by the bending of the plug as it passes through the distorted hole.

This hardening error can be detected with a piece of drill rod that fills the hole closely and extends beyond the hole about a half-inch. If the end of the drill rod runs true when rotated in the lathe without the bushing on it, it should, if the hole is straight, also run true when the bushing is placed upon it. Generally, it will not be good practice to try to save bushings that show decided error in this test. It will take longer to make laps and lap out the holes than it will to make and harden new bushings.

After the hole is finish lapped, it should be tested with a straight-edge that is cut out at the center to allow the body of the bushing to clear it. In Fig. 52 one of these straight-edges is shown. It is made from a piece of ⅛-in. ground flat stock and is straight on the surface *A*. The finish size plug should be long enough to extend through the bushing about ⅜ in., so that the ends of the plug can rest upon the ends of the straight-edge. The ends of the plug will, if the hole is straight, lie flat upon the straight-edge. The final and most accurate test comes when the bushing is in place upon its arbor to be ground on the outside. The end of this arbor must run true with or without the bushing on it.

All lapped holes are "bell mouthed," caused by the expansion of the lap as it passes out of the hole. The surface of the lap in contact with the hole, and the pressure of the work on the lap, increase and decrease as the lap enters and leaves the hole. These variations in pressure cause a difference in the diameter of the lap. Further, the ends of the work are always smeared with loose abrasive that has a full chance to exert its cutting power. The ends are also more fully lubricated, so the loose abrasive is washed down to the lap, which starts to cut the narrow edges of the hole at both ends. This is why a lapped hole is larger at the ends than at the center. A part of the length of the hole is parallel; to have the bushing parallel when finished, it is made longer than the required finished length, and the bell-mouthed ends are ground off to the finished length. In making ring gages, hubs are left extending from each end to take care of bell mouthing. They are afterward ground off. In Fig. 53 is shown a ring gage with the hubs on each end. The extra length of bushings is used to good advantage when pressing them into the holes. If the extra length is made slightly smaller than the driving fit required, it acts as a pilot to guide the bushing straight. It is well to remember that a bushing that is shorter in length than in diameter, unless piloted, is liable to start into the hole at an angle and not straighten itself. This is likely to happen even when the sharp edge of the bushing is stoned to keep it from cutting.

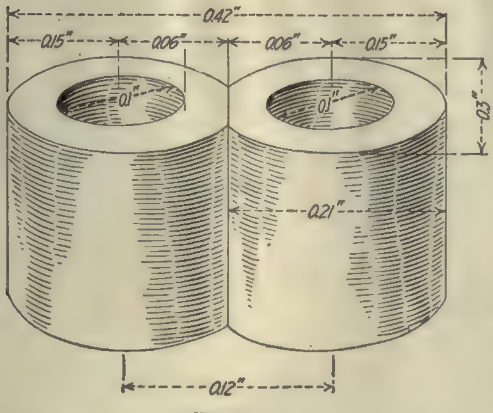


FIG.47

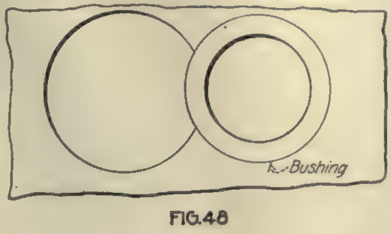


FIG.48

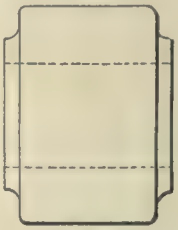


FIG.53

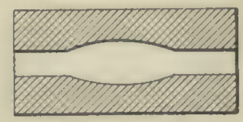


FIG.51

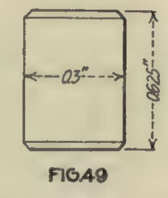


FIG.49

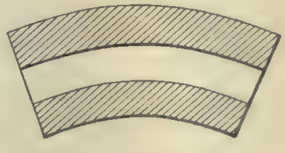


FIG.50

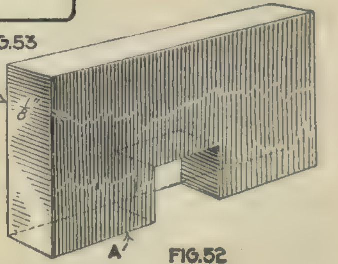


FIG.52

FIGS. 47 TO 53. VARIOUS PROBLEMS RELATED TO GAGEMAKING

DIFFERENT STYLES OF LAPS FOR SMALL HOLES

The lapping of holes that are of small diameter, say 0.031 to 0.0625 in., is a very delicate job. It requires diamond dust and plenty of patience, *not force.* The lap, Fig. 54, is split and is expanded by a taper plug. It is used for finishing and sometimes for roughing. The tapered plug *B* of this lap is forced into a straight drilled hole in the lap and allowed to wear a seat for itself, not very much, but enough to hold the plug in place when the lap is in use. It will be noticed that the hole is stepped, and one part of the hole is made the body size of the plug. This lap will expand in the middle, where it should, and not at the ends. If the lap were split to the end, the end would naturally open more than the center, and the work from it would be bell mouthed.

Another reason why these laps are not split all the way to the end is because it is difficult to hold the tapered plug in a thin-walled lap split the entire length. Small laps having little spring to them, say those below 0.0625 in., are not usually slit with a saw. The hole for the taper plug expander is made large enough to leave a very weak wall. This wall is weakened still further by creasing the outside of the lap lengthwise, so that it will split when the plug is tapped in to expand it as it wears. As was mentioned before, laps must be as solid as possible to reduce the expansion that is one of the causes of "bell mouthing." However, expansion is not the only cause, as it is a well-known fact that, if it is kept flooded with abrasive, even a solid rod will bell mouth a hole.

The small end of the lap plug is of the same diameter as the small hole in the lap. This small hole should leave about 0.005 in. of a wall to be split when the tapered plug is driven in by light taps to expand it. As the creasing has some depth, the lap splits easily at the creases.

These small laps can be easily turned to size if, when the hole is drilled in them, a short tapered plug is entered and used as a male center, running in a female center in the tailstock of the lathe. The length of their lapping surface should be as long as possible, as they will wear most at their ends. A study of Fig. 50 will show that the ends must take most of the pressure caused by a curve. Because of this a short lap will wear "egg shaped" until it assumes a shape that will pass through the curved hole. If the lap is shorter than the hole and worn egg shaped, it will pass through the hole lengthwise without straightening the curve. Roughing laps and those used for extremely small holes can be made of annealed music wire, which gives a variety of sizes that can be filed down to the size wanted. When worn small by lapping, these can be enlarged by rolling them between two files, No. 6 cut, upon which diamond dust has been placed, and using enough pressure to knurl the lap. This embeds the diamond dust in the lap, and the metal is forced up into ridges and closed around the abrasive.

The reaming of small bushing holes must be as near perfection as possible. The smoother the hole the less lapping is required. If a hole is not oxidized in the hardening operation, the amount necessary to finish it smooth and to size is less than 0.001 in. Bushings are hardened in brine, after which they should be washed in boiling soda water to prevent rusting, which is sure to take place if they are left standing as they come from the quenching tank.

In Fig. 55 is shown a good working lap for holes from 0.0625 up to 0.250 in. This lap has a tapered plug to expand it. It is drilled, and the tapered plug is fitted to it in the same way as the one in Fig. 54. It is split between the holes *AA'*, Fig. 55, with a jeweler's saw or a thin slitting saw. The holes *AA'* must of course be large enough to allow the saw blade to pass through. The saw blade is held in a bow frame the same as a hacksaw blade. This style of lap is also often used for holes larger than 0.250 in., as it makes a good solid lap that expands easily.

Some very handy laps use a taper arbor. One of these is shown in Fig. 56, and a bushing that is lapped out with it; *A* is the arbor or driver for the brass lap *B*. The bushing *C* is made of "Midvale Special" steel. It is as hard as sulphuric acid (used as a quencher, or hardening solution) will make it. The part *C* is made in halves split lengthwise, as the required hardness cannot be obtained throughout the length of the hole if they are in one piece, because the steam prevents the quenching acid from chilling and hardening the surface of the hole. The soft-steel sleeve *D* is lightly pressed over the piece *C* and holds it together while it is being lapped.

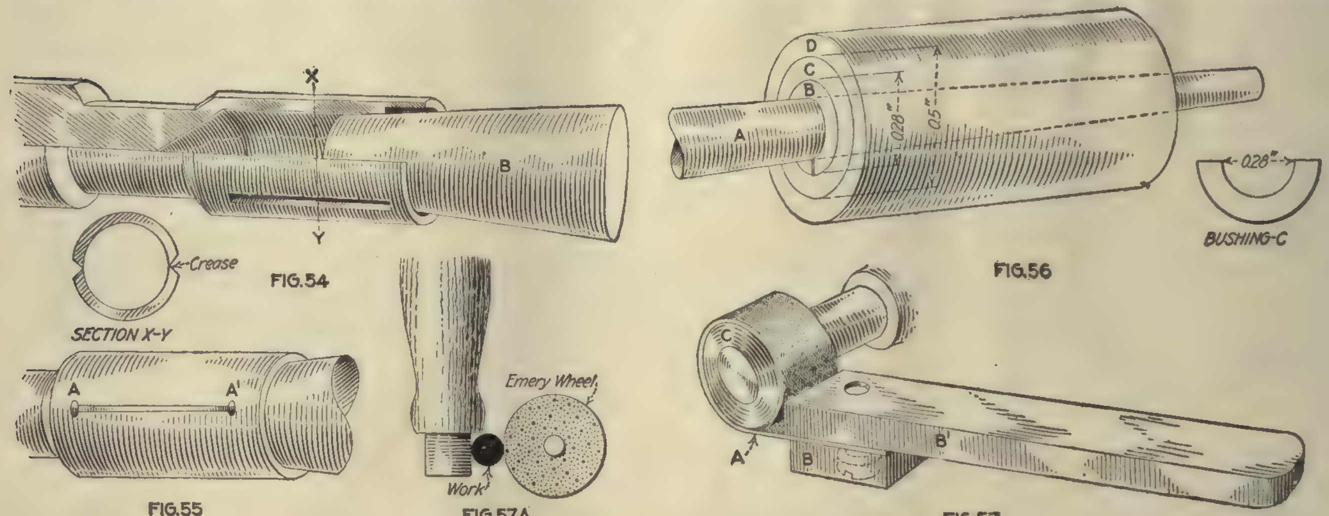


FIG.54 FIG.55 FIG.57A FIG.56 FIG.57

FIGS. 54 TO 57. A NUMBER OF LAPPING PROBLEMS

When the work *C* is completed, it is used for marking the tools used for rifling the Springfield rifle, in precisely the same way that a surface plate is used for marking work to see how flat it is. The rifling tool is rubbed back and forth in the half-bushing to mark the high spots on the tool; these are then removed with an oilstone.

In Fig. 57 is illustrated a good device for holding bushings while being lapped. A piece of emery cloth *A* is gripped in the clamp *BB'*. The end of the emery cloth is caught between the bushing *C* and the heel. The grip is self-acting and adjusts itself to the varying friction of the lap on the work. It will not distort a thin-walled bushing.

The arbors on which small bushings are ground are not usually steadied by the tail center. A piece of hardened drill rod is generally used, the hardening increasing the stiffness. The end that extends from the chuck is ground, if hardened; or if unhardened, it is turned to the size that will enable it to drive the work that is to be finished. This is the most accurate method, as it eliminates all the errors except those inherent in the lathe spindle itself.

There are sizes and lengths where it is advantageous to use a steadyrest. Several different kinds of steadyrests can be used, but generally a piece of wood held in contact with the arbor is sufficient to overcome the vibration of the wheel when grinding. A file handle with a brass ferrule is satisfactory for this work. The brass is held in contact with the arbor in such a position that there will be a combination of brass and wood, as shown in Fig. 57A, to absorb the vibration.

There are other lengths of arbors or plug gages that will require the tail center as well as a steadyrest to prevent the vibrations from spoiling the work. The end of the arbor may be turned to an included angle of 60 deg. and run in a female center; or if sufficiently large, the common drilled and countersunk center can be used.

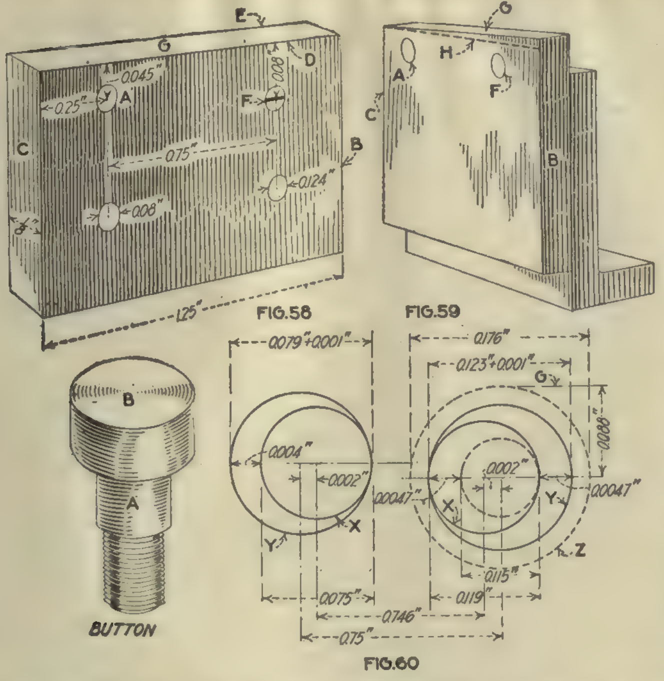
When making arbors to test small holes, the end controlled by the tail center must run true. This will be explained when the making of plug gages is taken up later.

Correcting Position of Holes Displaced by Hardening

In Fig. 58 is shown a gage that is hardened all over. The centers of the holes in this gage are located as close as possible to exact position by the method described in the first article. Should there be any error in placing the center-punch marks, there is a chance of the error being further increased by distortion due to hardening. It is also true that a slight error may possibly be corrected by distortion in hardening. It is, however, not safe to rely on distortion to correct an error. This style of gage is required to be hardened all over, as the wall between the surface *G* and the hole *A* is too thin to permit bushing. This gage will afford an excellent example of the process of correcting error in position of a hole. When correcting such a hole, the other gaging surfaces are ignored except that care is taken to see that, when the hole is corrected, there will be enough metal left on them to finish to correct position.

It is a fact that it is usually easier to bring flat surfaces to proper position with relation to a hole than it is to bring a hole to proper position with relation to surfaces that are finished. This fact should be taken advantage of, as it reduces the time required to position gaging surfaces. Generally speaking, external surfaces can be finished more rapidly than internal ones. When finishing external surfaces the work is set up in proper relation to the finished hole. In the gage shown in Fig. 58, two types of error occur. The holes must be corrected for center to center error and for incorrect location—that is, out of squareness with the surfaces *E* and *D*.

The allowance necessary for finishing to the desired sizes is dependent on the distortion due to hardening. The amount of distortion that will take place is more or less a matter of guesswork, and the gagemaker must make sufficient allowance to be safe. There are two factors that determine this "factor of safety"—the depth of the "case," if the gage is made of soft steel casehardened, and the amount of distortion of either casehardened or carbon steel. Both these factors must be considered, and they will be taken up later when the operations of making a gage are gone into.



FIGS. 58 TO 60. SECURING ACCURACY ON WORK WHERE HOLES ARE NECESSARY

The gage shown in Fig. 58 is made of carbon-steel ground flat stock, laid out with an allowance for finish of 0.01 in. on the surfaces *G*, *B* and *C*. The allowance in the holes has to be considered from two directions—shrinkage and expansion, or increase or decrease of center to center distance between the holes. Carbon steel, as a general rule, increases about 0.0007 in. per inch of length or breadth. The internal allowance to locate and finish the holes depends upon the diameter of the holes, and of course their diameter determines whether diamond lap or emery wheel shall be used to grind them. In either case it is desirable to keep as low as possible the allowance required for grinding, especially so when diamond laps instead of wheels are used for grinding.

An allowance of 0.005 in. will not be too much on this gage, as the amount has to be sufficient to allow material for correcting the errors of position and parallelism of the holes. This amount would allow an error of 0.004 in. to be corrected, using both holes. The 0.005 in. mentioned as allowance consists of 0.001 in. to correct the surface defects in each hole and 0.004 in. to correct the center to center distances.

After all outside surfaces are ground, the holes are tested to determine the corrections needed to bring them to correct position. Assume that there is required a center to center extension of 0.004 in.; that is to say, the holes are 0.004 in. too close together. As each hole is 0.005 in. smaller than the correct finished size, take 0.002 in. from each hole, as shown in the enlarged view, Fig. 60, where the light full-line circles *X* represent the holes already in the gage, the heavy full-line circles *Y* the finished hole, and the dotted-line circle *Z* the button set in position to correct the error.

BUTTON DETAILS

These buttons are soft, as previously stated, and are usually made up for each job. In this case the body of the button screw would be made 0.004 in. smaller than the diameter of the hole, allowing the shifting of the center one-half this amount, if required. The body *A* of the button screw thus acts as a check for the position of the button within the hole, while the measuring part *B* of the button acts as a check for position on the gage. The diameter of the body is reduced by an amount equal to twice what is ground off the surface *G*, Fig. 59, in the rough grinding and is kept flush with the surface *G* when it is adjusted to position to correct the error.

As stated, there are two conditions: Placing holes properly in relation to surfaces and correcting surfaces in relation to holes. Generally, it will be found necessary to take advantage of all the allowance provided to finish small holes and correct error of position and parallelism. The start of this correction should be from the hole *A*, Fig. 59. The indicator illustrated in Fig. 32 can be used on this job, as it reads to 0.001 in. and will also indicate holes smaller than this one, both at the "back" and the "mouth."

The gage should be attached to a true faceplate of a bench lathe or internal grinder. Care should be taken to avoid clamp and faceplate distortion of the gage, as previously described. Hole *A*, Fig. 59, is made to run eccentric 0.002 in. on the side toward *F* and is then ground truly cylindrical. If when truly cylindrical there is still more than 0.0005 in. required to lap it to finish size, this extra metal can be used to good advantage in correcting the error of location with relation to the other hole. The work can be relocated one-half of the amount over 0.0005 in. (needed to finish the hole) and reground. This affords all the correcting that can be done by relocating this hole. The next hole to be ground is *F*, 0.124 in. in diameter. A diamond lap will make the sparks fly if used in this hole. The button illustrated in Fig. 20 is also used to locate this hole to gage dimensions by measuring over the button and a plug 0.08 in. diameter in the finished hole *A*, Fig. 59, adding one-half of the diameter of the plug and button to the gage dimensions for this measurement.

Diamond dust is used to grind these holes, but is not necessary for lapping, as they are already corrected cylindrically and only require "smoothing" to the finished size. The two lower holes are not used in conjunction with the sides. They simply have the same diameters and center to center distance as the holes *A* and *F* and are used to save wear of the holes *A* and *F*. The surfaces *G*, *B* and *C* are brought to position by first attaching the gage to an angle plate, the center of the hole *A* being positioned the correct distance above the center of *F*, as illustrated in Fig. 59. The dotted line *H* represents the first surface to be finished. The surfaces *C* and *B* are then ground square with this finished surface and the proper distances from the holes.

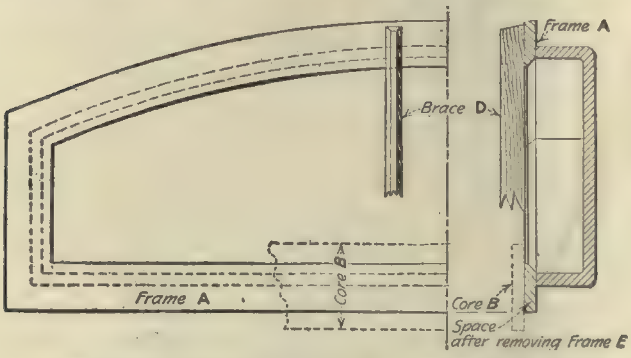
(*To be continued*)

Molding a Furnace Door

By M. E. Duggan

The casting is for a furnace door lined with firebrick. It is designed with a curve at the top, conforming to the arch of the furnace. The principal dimensions of the casting are: Depth, 3 in.; width at center, 26 in.; width at ends, 18 in.; length over all, 9 ft. 10 in.; thickness of metal, ⅝ in. It has a flange, or frame, all around the top edge, shown at *A*, 2 in. wide at the outside and ⅝ in. at the inside, beveled as shown. This lip forms a pocket in the casting to receive and securely hold the firebricks in place.

Ordinarily, this would be considered a very simple job of patternmaking and molding. It is, when constructed in a practical way. I have, however, constructed similar patterns in a way that doubled the labor and expense and wasted time and material. The finished pattern was impractical for molding, for the very good reason (perhaps there are other patternmakers in the same boat) that I did not know the things that every patternmaker should know and understand—namely, general molding practice.



ARRANGEMENT FOR MOLDING A FURNACE DOOR

The following method for making this pattern is a simple and inexpensive way and answers every requirement of the foundry: The flange, or frame, *A* is made in one piece and loosely fitted to the body of the pattern. A slab core, shown at *B*, is used. This is what is termed "cover core." This core is made ¾ or 1 in. in thickness and 2½ in. wider than the flange; in other words, 1¼ in. of the core will rest on the green sand at each side of the flanges.

The core is in sections lengthwise. A single section is one-third the length of the pattern. One core box will answer for both straight and curved sides, also for the end cores. Do not worry about the exact sizes of the different sections and how they are going to match; just leave these details to the molder. Worry is an evidence that you do not understand the molding game and that you are working "by guess." Plan and construct your patterns so that as much of the pattern as is possible can be molded in the drag. This is good molding practice. This pattern, made as described, can be molded in the drag; the cope is a flat body of sand.

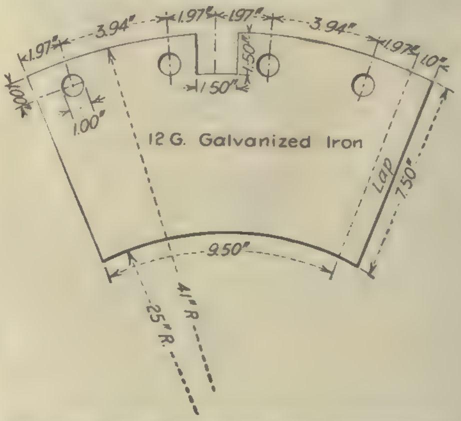
The pattern is placed in the drag, with the bottom down and sand is filled up to the top of the flange, or frame, *A*. The filling in of the sand is now stopped. The flange or frame, *A*, is lifted off, and the slab cores *B* are set in place, the edges resting on the green sand of the mold, the center covering the space in the mold left after the flange has been removed. The mold is now ready for more sand, and the filling in is continued and the mold finished and rolled over to receive the cope. The cope is finished and lifted off, the body of the pattern is drawn out of the mold, a little slicking and the job is finished. The wood braces *D* help to strengthen the pattern. Four are used on this job, although one only is shown.

Guard for Deflecting Compound

By H. D. Parker

Manufacturers who are engaged in the production of munitions on 4½-in. single-spindle Gridley automatics utilizing some cooling compound and individual circulating systems will find that guards similar to the one shown are great time savers.

I know of one battery of 52 machines running 24 hours a day which is using these guards, and since their adoption no time has been lost due to grinding the rotating stuffing-box to a better fit.



GUARD FOR DEFLECTING COMPOUND

The drawing shows clearly how this hood is laid out on sheet metal. When cut out it is rolled into a frustum and the lap riveted or soldered. The hood is slipped over the drawbar, where it projects through the turret. The four hose leads must be disconnected and then screwed in place through the four holes in the guard. This is all that is necessary to hold the hood in place, and there will be no more streams of compound shooting onto the floor.

Series for Draftsmen and Designers

A Plea For the Poor Draftsman

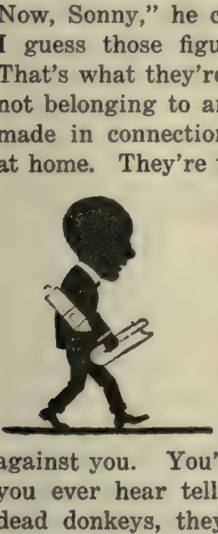
By H. KAY
Didsbury, Manchester, England

It is always interesting to know what the other fellow thinks. This is an English contributor's picture of the relations existing between the average shopman and the draftsman.

I HAVE in my mind's eye a draftsman I once knew who made sheets and sheets of calculations. He usually worked by logarithms, and it was a strange coincidence that instead of working in the regulation calculation book he had a habit of scattering these sheets loose about his table.

Denison was some designer, the pride and admiration of the office and head of the designing section. Now, at that time I was at an impressionable age and remember, whenever I had occasion to visit Denison's table I would look with awe at those sheets, wondering how he ever did it and thinking what a marvel he must be at design.

One day my enthusiasm bubbled over. "Say!" I said, "you must be mighty fond of calculating. Are all these" (indicating the loose sheets) "in connection with that job?" Denison ran his eye up and down my 5 ft. 2 in. two or three times, then his features opened out; "Lor' bless you, no! Pull that stool up. Now, Sonny," he commenced, "I'll give you a wrinkle. I guess those figures have impressed you some, eh? That's what they're there for, to impress folk. They're not belonging to any job here; in fact most of them I made in connection with a chickenhouse I'm building at home. They're there chiefly to create a little respect in the shop superintendents and foremen, who come in with complaints, which they forget and tone down at the sight of 'em and think perhaps these drafting chaps are not so dusty after all. Before you're much older Sonny, you'll find that every man's hand, outside the drawing office, is against you. You're a pariah among engineers. "Did you ever hear tell of an aged draftsman? No! like dead donkeys, they're scarce. They either die at an early age, broken hearted, or leave the profession and get a job in the ribbon department at the stores." After that, I copied one or two of Denison's sheets and left them carelessly on my own table, and whenever I took a stroll round the shops I took care that the end of a slide rule was sticking prominently out of my coat pocket. Of course, as Denison casually remarked, "It's not a bad thing for the 'old man' or the chief to see signs of genius lying around, and it might make half a dollar difference at the end of the week." As I grew older I found by bitter experience that all Denison had said was true. The abuse I mean, not the half dollars. In every shop I have worked I have found that the ordinary draftsman was treated as a great big joke by the shop folk. Any little error, such as an arrowhead in the wrong place or missed, was magnified, and a busy foreman would consider half an hour's lecture to the victim as time well invested. I have often had to deal with such men, and yet when they tried to explain some simple tool they required, and I have meekly asked, "Can you make me a bit of a sketch?" they have shied at once; or if the sketch did arrive, well, to put it mildly, it was no oil painting, unless oily thumbmarks can be considered in that light; and the presence of the sketchmaker was usually required to explain what it was about, and what was wanted.



Of course, mistakes on drawings are discovered after the piece is made, seldom before, and along comes the shopman in high glee. Yet it cannot be that draftsmen are the only people to make mistakes, and recently I had proof that this was so. A cutter had been made to a drawing, but when this came to be tried out it would not stand up to the job.

In came the foreman with the usual line of argument: "Say, do they pay you for this job? Well! Well! Sneeze man, your brains are dusty. Don't bother making any more drawings, wait until we have done the job, then send out to take dimensions," and so on. After a time he came down to the cutter subject, "The rake is wrong on this darned thing; won't look at the job."

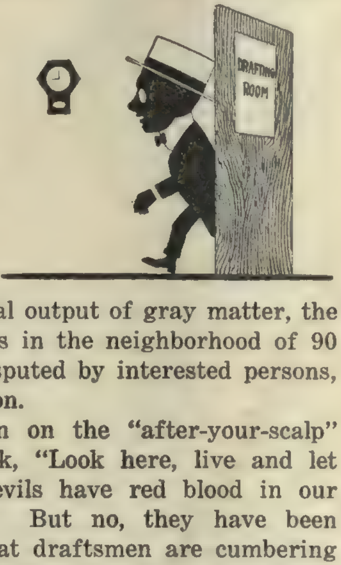
I knew the design was O. K., so I went out to have a look at the cutter. It tallied with the drawing. Funny, then it must be the steel. I suggested this. No! it was proved that high-speed steel had been parted off and given out for the job. During this time the men around had taken the opportunity to make a few suitable remarks. I left the job at that, but later on had a talk with the charge hand of the department where the cutter had been made, and with him went over to the machinist who had made the piece.

Starting the Subject

I plunged at once, "Say, Sam, you made a hash of that cutter job. Let's have it, what happened?" I suppose I surprised him. Anyhow, he admitted that he had scrapped the original piece of high-speed steel, and to get out of it had stolen around the parting-off shop and picked up a piece of mild steel, thinking it was high speed.

"Here's the old piece," he said, and dived into a box under the bench. I took the opportunity to take a peep into that box. I saw enough to enable me to get back at any of this type of man who came mussing around after that.

Now, why is it that draftsmen are looked upon as a joke and a nuisance by shopmen? I confess it is beyond me. Perhaps it is because the draftsmen start an hour after the shop, or maybe it is the "whitewashed wall" a draftsman wears around his windpipe. My only suggestion is professional jealousy. I would like to venture the opinion that, of a factory's total output of gray matter, the draftsman's contribution is in the neighborhood of 90 per cent. This may be disputed by interested persons, still it is my humble opinion.



When shopmen come in on the "after-your-scalp" stunt, I sometimes remark, "Look here, live and let live, after all we poor devils have red blood in our veins just like yourself." But no, they have been brought up to the idea that draftsmen are cumbering the earth, and I suppose nothing will shift that idea.

Wheels for Grinding Stellite

The following article was taken from *Grits and Grinds* and as this is published by The Norton Co. the information should be of considerable value in shops where stellite is used:

Considerable interest has been shown lately in the grinding of stellite. Much depends upon the personal element and grinding conditions. Recent experiments conducted in laboratories and in some shops where considerable of this material is being used, may prove helpful to those who have stellite grinding as one of their problems. The tests were conducted that we might be better prepared to answer the following questions:

1. Do the different grades of stellite require different grinding wheels on the same operation?
2. What grains, grades and abrasives are most satisfactory for cylindrical grinding, surface grinding, tool and cutter grinding and cut-off grinding?
3. Is there any advantage in wet grinding?
4. Are wheels commonly employed for hardened carbon and high-speed steels satisfactory for grinding stellite?
5. Will finer grits be better than those usually employed for steel tools?

The conclusions reached by these laboratory reports and by reports from salesmen from the various territories where stellite is ground successfully are as follows:

1. The No. 38 Alundum is by far the most desirable abrasive for the precision operations and most of the tool grinding. However, regular Alundum is satisfactory for the cut-off grinding, and may be used for free-hand grinding of heavy tools.
2. Vitrified wheels should be used in preference to silicate or elastic.
3. Number 3 stellite seems to require slightly finer and softer wheels than number 2 stellite.
4. The advantage of wet grinding, especially on the precision grinding operations, is in more rapid and accurate sizing of the work and slight retardance of glazing; finish is also somewhat improved. On tool grinding no pronounced improvement in wet grinding, except that it keeps the wheel face cleaner and enables the operator to handle the tools easier.
5. Wheels used for stellite are interchangeable to a certain extent with those used for high-speed steel grinding. This applies especially on the precision-grinding operations. On the free-hand operations, our laboratory tests call for No. 38 Alundum, slightly finer and softer than would be used on steel tools.
6. The general tendency is undoubtedly toward finer grits while grades follow other conditions which vary greatly in different shops. No. 46 grit is the coarsest size which will produce a satisfactory finish in most cases.
7. For cylindrical grinding we suggest 3846-L on No. 2 stellite and 3846-K or 3860-J on No. 3.
8. For surfacing with straight wheels, we suggest 3836 and 3846-H on No. 2 stellite and 3846 and 3860-H on No. 3 stellite. For surfacing with cup wheels, approximately the same wheels may be used, but outside conditions will undoubtedly call for softer wheels on the cup-wheel grinding operations.
9. For tool grinding we suggest 3860-M or N as found satisfactory in our tests. However, outside reports indicate the same deviation from this; namely, 36 and 46-O, also 46-K and 60-J regular Alundum.
10. For cut-off grinding, 60-3 or 46 grades 4 and 5 Alundum elastic should be used.

These suggestions and recommendations may only serve as a starting point in many instances. Outside conditions and practice are so varied that it is impossible to develop standards readily. Undoubtedly, as stellite comes into more general use, more experience in grinding will be obtained and then more definite statements and conclusions can be drawn.

Thirty Eighth Annual Meeting of the

This is the first annual meeting of the American Society of Mechanical Engineers since this country entered the war, and, as is very natural and proper, its papers were confined largely, either directly or indirectly, to war problems. The first step toward a standardization plan was the meeting of the Gage Committee and the public hearing on gages, the latter being very largely attended by representatives of both army and navy as well as by the manufacturers of gages. Methods of the Canadian Imperial Munitions Board were discussed.

Recent Developments in Balancing Apparatus*

By N. W. Akimoff

Improvements have been made by the author upon the balancing machine described by him in a paper presented before the Society in 1916. Also a complete revision of the usual method for securing static balance in a body used as a step in the process of determining its dynamic balance. Two formulas are given to estimate numerically the lack of precision in ordinary methods for obtaining such static balance.

The author now uses a clamp attached to the body to be balanced, whereby a known centrifugal force is introduced when the body is rotated, for the purpose of neutralizing the static or dynamic unbalance of the body. By suitably constraining the motion of the rotating body, either the static or dynamic unbalance, or the combination of both, may be accurately measured through the adjustment of the clamp.

Since my paper on the subject of "Dynamic Balance" (New Orleans Meeting, 1916; Trans. Am. Soc. M.E., vol. 38, p. 367) was presented, certain improvements have been made by me in the machine therein described; also a machine based on new methods has been made.

The principle of the original machine is indicated in Fig. 1, which shows a lathe bed which takes the form of a beam hinged at one end and supported by a spring at the other. The body to be tested must first be brought into static balance, after which it is rotated in bearings supported by the beam. If the body is dynamically unbalanced its rotation will cause the beam to vibrate in a vertical plane with a period of oscillation equal to the period of rotation of the body.

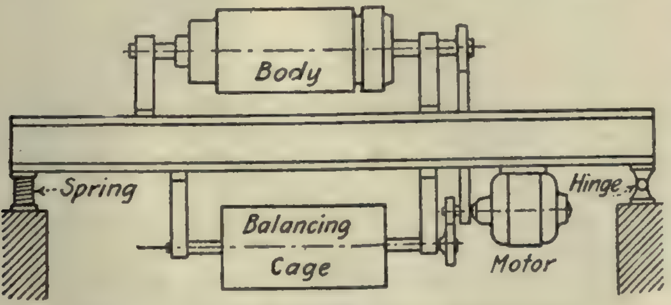


FIG. 1. SQUIRREL-CAGE TYPE OF DYNAMIC BALANCING MACHINE

Suspended from the beam is a second body in the form of a so-called squirrel cage consisting of two circular disks carrying an even number of rods so arranged as to slide in holes in the disks. The cage rotates in unison with the body to be tested, and a state of unbalance in this body introduces a centrifugal couple which is neutralized by displacing the rods in the cage until an equal compensating couple has been introduced. The distances that the rods are displaced serve as a measurement of the amount of unbalance to be provided for and counterbalanced in the piece under test.

The improvements upon this machine, referred to above, were as follows:

(1) The substitution for the cage of a two-point element consisting of two disks, *A* and *B*, each with a pin projecting from its face, as shown in Fig. 2. The disk *A* is fixed to its shaft and the disk *B* is arranged to slide on the shaft through the use of a feather key *f*. It is clear that when the two disks are in contact they will balance each other; but when separated they will introduce a certain centrifugal couple according to the weight of the pins and the distance between the disks, which latter can be varied while the apparatus is in motion.

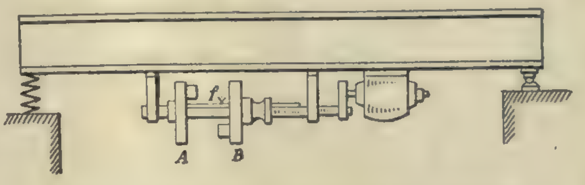


FIG. 2. TWO-POINT BALANCING ELEMENT

(2) A planetary arrangement by which the relative angular position of the body and the disks (or cage) can be varied while the machine is in operation.

(3) The application of a principle whereby the disks (or cage) may be arranged to answer the problem of static balance as well as dynamic balance.

New Methods

The new methods which have been developed and applied in a new type machine for combination static and dynamic balancing will now be described.

Static Balance

As a result of a great deal of study of the problem of static balance I have been forced to admit that too much has been taken for granted in relation to this subject. Static balance is not a trifling problem to be solved easily by placing a rotating body on parallel ways or rollers, as has commonly been supposed. While it is true that static balance can be found without much trouble in the case of bodies of light weight or where the operating speeds are comparatively slow, there are other cases which are much more difficult. For example, consider a gyroscope wheel whose weight is about 50 lb. running at, perhaps 10,000 r.p.m.; or a turbo-rotor whose weight is 10,000 lb. and whose speed is 3600 r.p.m. Neither of these extreme cases can possibly be handled with any degree of success by placing the bodies on ways; and yet, unless static balance is perfect, no dynamic balancing machine can be expected to give reliable results.

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*Extract from a paper presented at the annual meeting of the American Society of Mechanical Engineers, December, 1917.

STATIC BALANCE BY MEANS OF PARALLEL WAYS

It may be well to point out that in balancing by the aid of parallel ways there is a limit to the load which can be safely borne by the journals in contact with the ways. A safe load for each journal appears to be 750 lb. per inch of width per inch diameter of journal.[1] For instance, if the ways are 1½ in. wide and the journal diameter is 10 in., then each side will carry almost 12,000 lb. without any danger of forming permanent flat spots.

It would be of interest if one could estimate the sluggishness of action of a body on the ways under different conditions. The older theories of rolling friction, as proposed by Coulomb, Morin and Dupuit, do not seem to lead to very reliable results. Résal's formula (Résal, *Traité de Mécanique Générale*, T. 11, p. 6) is probably much more reliable and is here reproduced in simplified form (steel on steel):

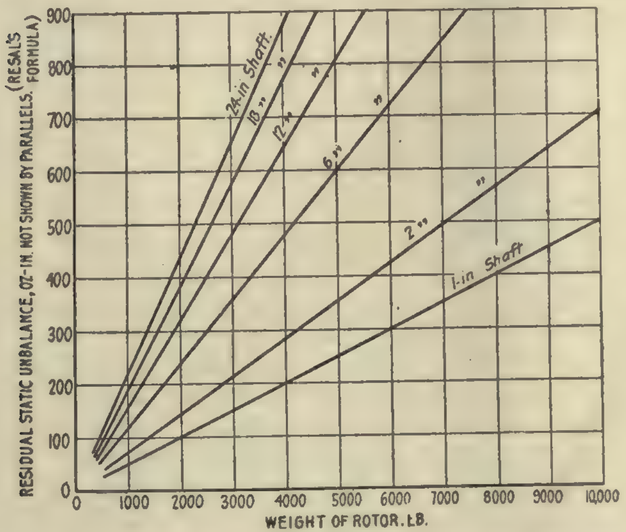

FIG. 3. DIAGRAM TO ILLUSTRATE PROBABLE RESIDUAL UNBALANCE OF BODIES BALANCED ON TESTING WAYS

$$f = 0.056 \sqrt{1/(1 + 79/D)}$$

where f is the length of the flat contact of shaft with the way, and D is the diameter of shaft, both in inches. It appears that the weight does not enter into the formula, and in general its results should not be considered as extending to extremes, but only as characterizing the average run of things as they are met with in practice.

The diagram in Fig. 3 has been roughly plotted to illustrate the probable sluggishness or residual unbalance which may remain in a body that has been brought into apparent balance by testing on ways. The chart is based on Résal's formula, and, as it is intended simply to illustrate the meaning of the formula, values have been exaggerated by plotting shafts of small diameter against weights altogether inconsistent therewith. The chart is easily read: For instance, if a rotor weighs 4000 lb. and the diameter of its shaft is 6 in., then the residual unbalance may be as great as 480 ounce-inches, or, say, 2½ lb. on a 12-in. radius. It is useless to put a body statically unbalanced to such an extent (or even to 50 per cent. of this) on any dynamic balancing machine. Satisfactory results cannot possibly be derived from such tests. An actual case of residual unbalance, typical of many others, is of a shaft having a diameter of 2⅛ in., a weight of 88 lb. and a residual unbalance of 0.915 ounce-inches. The width of the balancing ways was $\frac{5}{16}$ in. (cast iron chilled and ground).

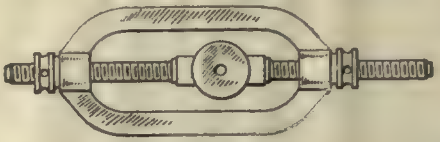

FIG. 4. CLAMP NOW USED IN SECURING STATIC AND DYNAMIC BALANCE

Considering the phenomenon of rolling friction from the standpoint of higher theories of elasticity (Hertz), the following tentative formula was derived for residual unbalance:

$$M = 0.0004648P \sqrt{PD}$$

where M is the residual moment in ounce-inches, P the weight per unit of contact length (that is, per inch of combined width of ways), and D the diameter of shaft in inches (steel on steel). The constant may be considered to be rather tentative, but with the advent of a machine capable of establishing perfect static balance it will not take long to find more reliable values for it.

According to this formula, if an armature weighed 12,000 lb. and had a shaft diameter of 8 in., the sluggishness or residual balance when placed on ways 1 in. wide, would be:

$$M = 0.0004648 \times 6000 \sqrt{6000 \times 8} = 614 \text{ oz.-in.}$$

or over 3 lb. on a 12-in. radius. At 3600 r.p.m. the centrifugal force due to such residual unbalance would be more than 14,000 lb.

As previously stated, my earlier machine for dynamic balancing was based on the introduction of centrifugal couples, created by the operator to offset the effect of the disturbing centrifugal couple, constituting unbalance in the rotating body. Likewise, a machine for static balancing can be based on the same principle, but long study of the subject has led me to the conclusion that the whole problem of balance, static and dynamic can be reduced to the principle of a single centrifugal

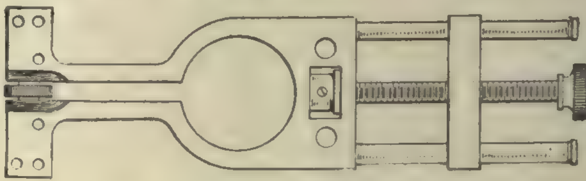

FIG. 5. A SECOND TYPE OF CLAMP

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[1] According to the writer's remembrance, this figure was first given him by the engineers of the Standard Roller Bearing Co. many years ago, and has since been revised by him in connection with other practical data which he was able to gather from different sources.

force acting on a properly constrained body. Such centrifugal force can be created by the operator, within a rotating body, by such means as, for instance, the clamps of which two designs are here shown, Figs. 4 and 5. As will be explained, such clamps may be used to offset the effect of static or dynamic unbalance in a rotating body, as the case may be, and to record the extent of such unbalance. They are carefully made and so calibrated that the centrifugal force may be given as a function of some linear dimension, read directly or measured by an accurate scale. The first clamp is easier to make and check for accuracy, while the second design is much handier for quick adjustment on the shaft of a rotating body.

Means for Securing Static Balance

In order to register the effect of static unbalance of a body, or the correction introduced by means of such a clamp as described, the body must be placed in such a condition that its oscillations are emphasized or magnified to an extent that will be visible to the eye; otherwise its unbalance, even if considerable, will not be noticeable and will only result in increased pressure on the bearings. Thus, in a badly unbalanced automobile engine it is most often possible to pick out a range of speeds where the engine will appear to work smoothly; and many an electric motor with badly unbalanced rotor will apparently run well, simply because its speed may be far away from that which would insure synchronism of the rotation with the oscillation of bearing supports.

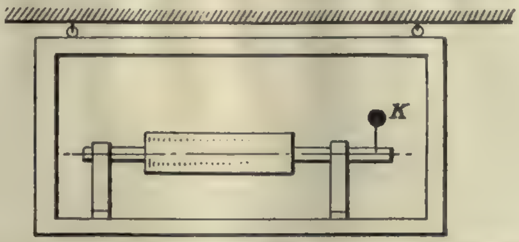

FIG. 6. BODY SUPPORTED IN SWINGING FRAME FOR SECURING STATIC BALANCE

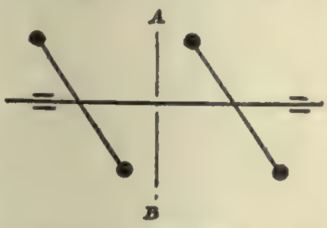

FIG. 7. UNBALANCED, CENTER OF GRAVITY IN AXIS

Now, suppose we have a frame, suspended as shown in Fig. 6 and capable of a certain period of swinging oscillation. If the body, statically unbalanced, is operated at a speed corresponding to the period of oscillation, the oscillations of the frame will become violent and can readily be registered by any suitable dial-gage indicator. Here the body is imposing its own period on the frame, which thus performs what are known as forced vibrations of the same period. Our task is then to adjust the speed of the body so that the period of such forced oscillation will be equal to that of the natural oscillation of the frame and body (at rest).

In Lord Rayleigh's remarkable book (Theory of Sound) a most lucid explanation is given of this phenomenon of "step" or synchronism. Lord Kelvin's well-known device called a "vibrometer" is likewise based on this very principle. Of course, it is easy enough to see that a clamp *K* can always be so adjusted, both angularly and as regards its off-center position, as to nullify the oscillations of the frame, thereby solving the problem of static balance. No matter how heavy the body, it is always possible to place it in most minute balance by this method, where ordinary parallels would be altogether inoperative.

Dynamic Balance

As regards dynamic balance due, in a statically balanced body, only to the presence of a centrifugal couple, the following remarks can be made: In the first place the "theory" that this centrifugal couple is due to the fact that the centers of gravity of both halves of the body, cut through its center of gravity, do not lie on the axis of rotation, is radically wrong. Take, for instance, a skeleton body shown in Fig. 7. Its center of gravity is exactly on the axis of rotation, as also are the individual centers of gravity of each half, to the right and to the left from *AB*. Yet such a body would be manifestly out of balance (dynamically). Inversely, a body could readily be imagined to be both in static and dynamic balance, although each of its halves were statically out of balance. The only correct way to characterize dynamic balance is to say that the products of inertia, containing the axis of rotation, vanish (Slocum, Theory and Practice of Mechanics, p. 297); or, to put it practically, that there is no centrifugal couple in any axial plane.

In the next place, if we constrain (pivot) one end of a rotating body (statically balanced but dynamically out of balance) while the other end is arranged to float in a bearing supported by springs so that it may move, say, in a horizontal plane, Fig. 8, then the oscillations of the body will be angular, as from *A* to *B*. Under these conditions the observer will be unable to tell whether the vibrations are due to a force (centrifugal) acting somewhere on the body, or to a centrifugal couple—unless he knows beforehand that the body is in perfect static balance, under which condition the vibratory effect can be due only to dynamic unbalance. This being the case, in view of the reaction of the constrained end, it is perfectly possible to balance the effect of a centrifugal couple by means of a centrifugal force. Thus, in Fig. 9 if it is assumed that the dynamic unbalance is due to the couble *a-b*, it will always be possible to select such a centrifugal force *c*, that it will quiet the vibrating body, and because of its known distance from the bearing *B*, establish the exact value, sign and angular position of the disturbing centrifugal couple *a-b*.

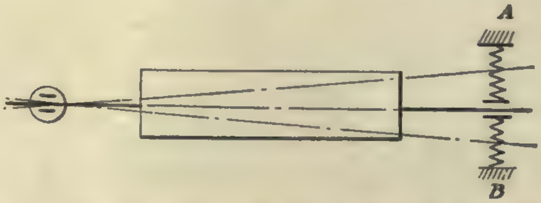

FIG. 8. ONE BEARING PIVOTED AND ONE FLOATING

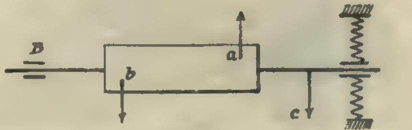

FIG. 9. CENTRIFUGAL COUPLE BALANCED

It is thus clearly seen that it is possible to utilize a centrifugal force to good advantage in finding both static and dynamic unbalance of bodies; and combining the principles illustrated in Figs. 6 and 8, we have a combination static and dynamic balancing machine, of which the scheme is as follows:

Description of Combination Balancing Machine

A frame *F*, Fig. 10, supports the bearings *B* and *C*, which carry the body. The frame has a swinging period of its own. The bearing *C* may either be locked, so that it acts exactly like the rigid bearing *B*, or else it may be allowed to float in a vertical plane, bringing into play certain resistances (springs) opposing its deflection from the neutral (vertical) position. The correcting centrifugal force is indicated by *K*. Such a system is known in dynamics as a system with two degrees of freedom, generally capable of two kinds of motion: Swinging of the frame, the bearing *C* being maintained rigid; and swinging of the bearing *C*, the frame *F* being maintained rigid by such means as brackets *S;* while the most general motion consists of a combination of these two motions. The operation of such a combination machine is very clear. In order to secure static balance we lock the bearing *C* and unlock the frame supports *S*. Then, by properly adjusting the magnitude and direction of *K* we can reduce to zero the bodily oscillations of the frame *F*, thus establishing the exact value and sign of static unbalance in ounce-inch units. As soon as this has been corrected, we lock the frame *F* and unlock the bearings *C*, when the same centrifugal force *K* created by a suitable adjustment of the clamp as explained above, can be made to correct the body for dynamic unbalance, as illustrated in Fig. 9. The advantage of basing the results on centrifugal force instead of on a centrifugal couple, is manifest, the former being a fundamental, and the latter a derived unit, so that the former is capable of much greater accuracy in adjustment and of more direct application, than the latter.

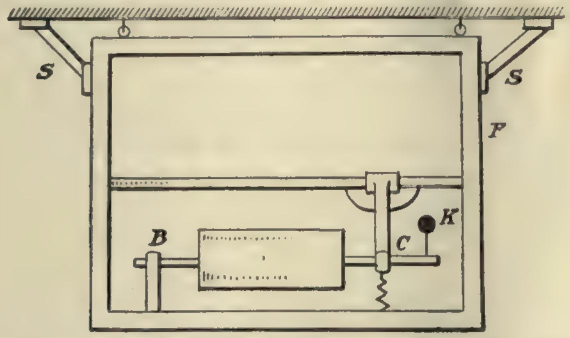

FIG. 10. BODY WITH ONE FLOATING BEARING, SUPPORTED IN RIGID FRAME FOR SECURING DYNAMIC BALANCE

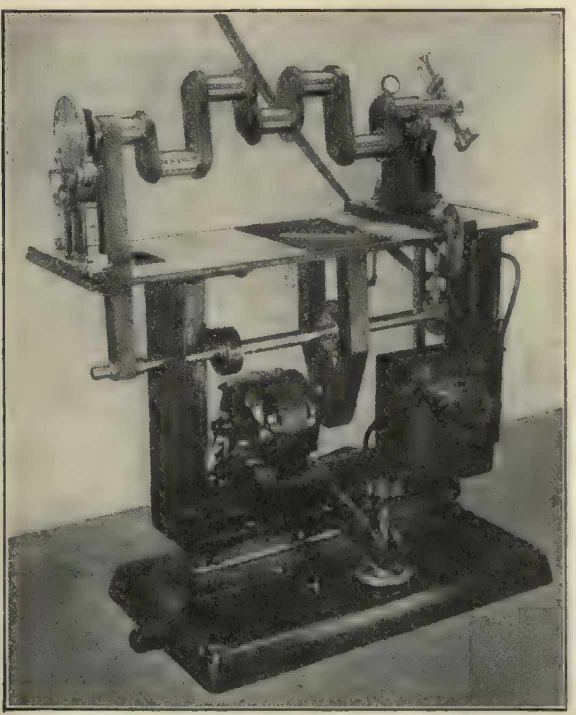

FIG. 11. COMBINED STATIC AND DYNAMIC BALANCING MACHINE

Fig. 11 illustrates a balancing machine built in accordance with the scheme of Fig. 10. The yielding support, clearly shown on the right, has means for easy adjustment of its period, as likewise has the frame itself. The motor is of ⅓ hp. capacity and operates the body, through a countershaft, by a rubber belt. The balancing clamp is seen on the extreme right of the crankshaft. The oscillations are read by means of ordinary Starrett dial gages, graduated in thousandths of an inch. The precision which can be secured on such a machine is almost uncanny; it enables one to see the sluggishness of the method of balancing on ways, and therefore the absolute lack of precision of dynamic balance that might be based on such results. A well-designed clamp is very easily handled and its correct position can be established in a few minutes. Its indications are capable of tabular interpretation, so that the operator has merely to carry out the simple instructions, worked out beforehand. Of course, it is clear that such a machine can be built for any size of body, or for any speed that may be desired.

The Engineer, the Cripple and the New Education*

By Frank B. Gilbreth and L. M. Gilbreth

This paper is a progress report and states definitely the work that the engineer should do to help the cripple to be independent of all charity. It states how the cripple can be enabled to compete successfully with normal workers in the trades at the present time. It calls attention to the fact that the cripple after receiving intensive education by means of micromotion study is able to earn more than normal workers who have not received such education.

The war has made an upheaval in many methods, particularly those of education. After the war the intensive methods now used in our emergency will be used permanently. These methods are not transitory. They will remain because they are more efficient.

The intensive education in motion study of the one best way to do work now being done for the cripple is the model for all intensive training of the nation's workers after peace comes—that they may be more efficient, more productive and less fatigued. The military cripple will thus have served his country doubly.

The purpose of this paper is to report progress in the solution of the problem of training the crippled soldier. At the present stage of this work, we are able to formulate certain conclusions that have a bearing upon the activities of this society and upon the part that the engineer should take in the crippled soldier work.

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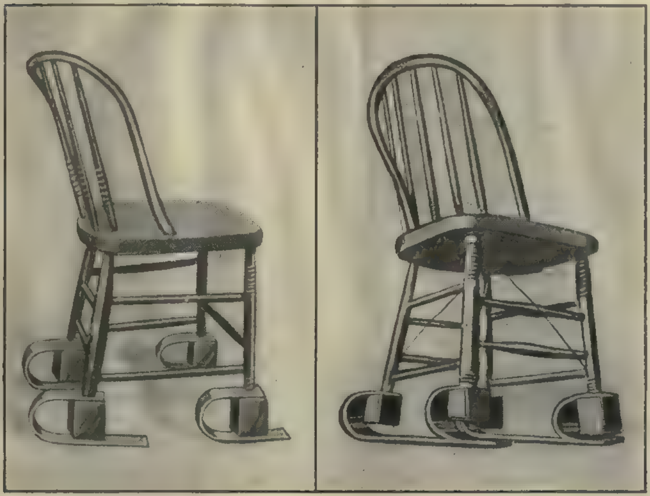
*Extracts from a paper presented at the annual meeting of the American Society of Mechanical Engineers, December, 1917.

These conclusions are as follows: (a) The crippled-soldier problem is practically identical with the problem of the cripple in general; (b) its solution lies in a new type of education; (c) this education is destined to be the education of the future; (d) it is based on [1] finding the one best way to do work, [2] adequate assignment to work, that is, intensive vocational guidance; (e) the engineer is best fitted to determine the one best way, to formulate it into a method, and to supply necessary devices and mechanical appliances.



FIGS. 1 AND 2. SPRING CHAIRS FOR RELIEVING WORKER FROM VIBRATION

All cripples, no matter what the cause of the crippling, require a training that will be mentally satisfying and physically beneficial. This training must be such as will enable them to become productive members of the community, and to remain on the world's payroll. This implies either competing with non-crippled workers in occupations open to all, or setting aside certain work for crippled workers exclusively, or both. It implies discovering and making available such opportunities for crippled workers, discovering which cripple is best fitted to utilize the oportunity, and training him to make the best possible use of it. It also implies not only opportunities for individual development, but such social opportunities as will enable the cripple to fit back into the ordinary social life with the greatest ease and the largest amount of durable satisfaction.

Those crippled in war furnish a small percentage of the total crippled as compared with those crippled from other causes, such as disease and accidents, especially in the industries. This is true even in Canada, which has furnished such a remarkable quota of fighting men in comparison with the total number of her population.

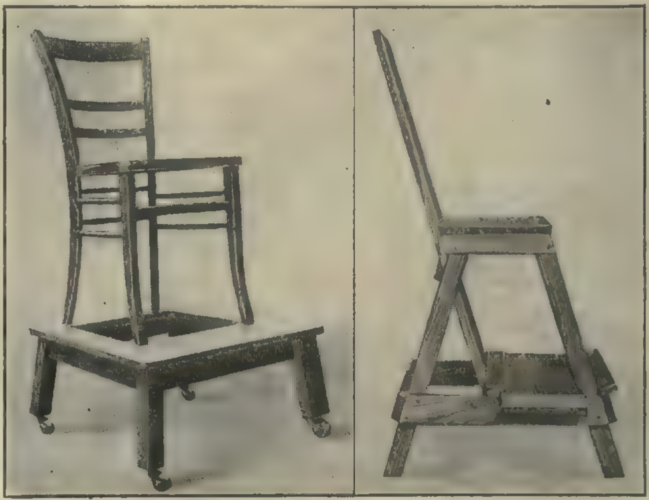
The solution of the crippled-soldier problem as outlined above consists of a type of education that is new in that it eliminates the greatest amount of waste possible in the educational process.

This new education is bound to be used in the future not only in the reëducation of cripples in what is to be their new life work, but in education in general. Just as the Montessori method of teaching children, which originated in an effort to discover the best method of training subnormals, proved so successful in that field and demonstrated such underlying principles of general applicability that it now occupies an important place in the training of normal and supernormal children, so this new method of education is spreading, through the general interest in reëducating military cripples, to the reëducation of all cripples, into the manual-training schools, corporation schools and the general educational fields.

The extent of the cripple problem is, then, practically unlimited. When we come to consider the subject closely we see that every one of us is in some degree a cripple, either through being actually maimed or through having some power or faculty which has not been developed or used to its fullest extent. The degree of crippling extends from the worker who, through some accident, has lost his eyesight, his hearing, and the use of his legs, arms and hands except for the use of one finger, to a man who is dependent upon glasses for reading—and by the way, the former is no imaginary illustration, as we have lately received a skillfully woven bag made by such a cripple maimed through a mining accident.

From an efficiency standpoint a policeman with corns on the soles of his feet or a golfer with the gout in his toe is more of a cripple during his working hours than a legless man while operating on a typewriter. We can, then, think of every member of the community as having been a cripple, as being a cripple, or as a potential cripple. Conversely, we can think of a badly mutilated man as not being a cripple during the period that he is at that work, the performance of which is not affected by the mutilation.

As to the nature of the problem of the cripple, it is a problem of education, as has been said. With the present state of the art of teaching, it is largely a problem of reëducation, since most of us, noncrippled as well as crippled, have received the wrong type of education and must be reëducated even in the fundamentals. As an example of the inefficient method of education, consider the practice of having foreign languages taught exclusively by teachers speaking dialects or worse, instead of by supplementing the best available teaching



FIGS. 3 AND 4. SPECIAL CHAIRS FOR INDIVIDUAL WORKERS

by talking-machine records of the experts in pronunciation! As education becomes more scientific the problems of reëducation will become simplified, and the process will become shortened.

The psychologists have appointed committees to investigate all branches of the subject that come within their field. The psychotherapists are working on their aspect of the problem, and Mr. George Edward Barton of the Consolation House at Clifton Springs, past president of the National Society for the Promotion of Occupational Therapy, has spent years in theoretical and practical work concerning the convalescence period, and is contributing his experience and energies toward helping this cause. Educators are considering not only the training of the necessary teachers but the training of the cripples themselves, notably Prof. Frank E. Sanborn of Ohio State University, and Prof. Wm. S. Ayars of Nova Scotia Technical College, an American engaged for years in teaching in Canada, both of whom are members of this Society.

A Government bureau for collecting and conserving all this data will come naturally as a development of the activity in other fields and of the present activity of various Government departments along various lines. This bureau should contain a museum that would include among its exhibits models of artificial limbs and appliances for cripples. This, supplemented by state and municipal museums along similar lines would bring first-hand knowledge to the cripple, who too often buys the first artificial limb that he sees, and usually averages three or four purchases before he gets the one best suited to him.

Such a national museum should also contain fatigue-eliminating devices, which would enable all workers to become more productive with less accompanying fatigue.

If the present chairs and work benches now to be found in all parts of this country as well as abroad were collected and put beside such efficient devices as the Barney chair and foot rest, and the Marshall traveling chair, they would look as out of place and cruel as do the devices of torture of the medieval period. Observing this, and with the cripple in mind, it will be noted that the principles underlying the adapting of chairs and foot rests to the industrial worker's measurements and to the needs of the cripple are identical. If this had been sooner realized more generally more people would have taken up fatigue study and the devising of chairs, foot rests and benches to meet the national after-the-war need for more efficient working conditions for cripple and non-cripple alike.

[In Figs. 1, 2, 3 and 4 are reproduced some of the types of chairs proposed by Mr. Gilbreth for elimination of fatigue; 1 and 2 are for reducing vibration either from the floor or building itself or that caused by the efforts of the worker; 3 and 4 are special chairs devised for use in individual cases.—Editor.].

Intermittent Worm Gear

By F. C. Mason

An interesting worm gear used in connection with an automatic wire-working machine seems to offer great possibilities and adaptability in connection with automatic-machine design.

Figs. 1 and 2 represent a three-piece intermittent gear, each section of which is intermittent and in which the length of dwell can be regulated to perform the required function. Fig. 1 represents the complete mechanism in section, Fig. 2 is an elevation. *A* shows the worm; *B*, *C* and *D* are three sections that constitute a full worm gear; spaces *L*, *M* and *N* show teeth of the gear cut away to produce the dwell; *H*, *I* and *J* show a crankshaft and eccentric cams to produce the necessary mechanical movements. These, of course, may be designed to meet requirements. At *K* are housings of the machine. Section *C* of the worm is keyed to the shaft. This section has adjustable stops on either side, marked *E*, movable in T-slots *G*. They are adjusted through openings in the side walls of *B* and *D*, which have the stops *F*. These stops may also be made adjustable.

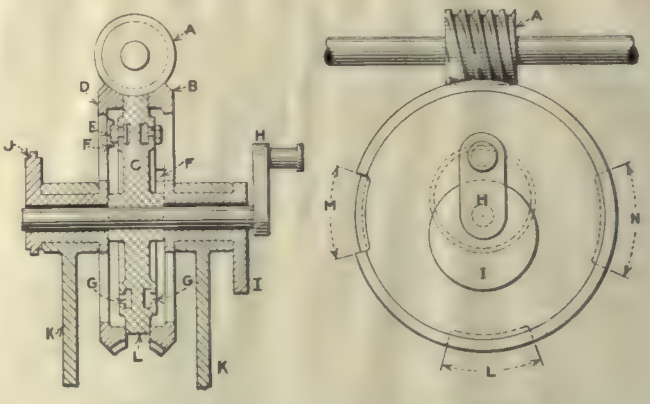


FIG. 1 FIG. 2

FIGS. 1 AND 2. CROSS-SECTION AND END VIEW OF INTERMITTENT WORM GEAR

Each section of the worm makes a full revolution and a dwell, the length of time depending upon the relation of the stops *E* and *F* to each other. The machine in question was used to weave wire fence.

Concealed Spring for Use on a Ratchet Pawl

By Joseph J. Fournier

While reading the article on page 123 by George Wood, I thought it would be a good idea if he would drill one hole in the pawl, after it had been counterbored, and one hole in the washer, Fig. 1, for receiving the bent ends of the spring. This would provide a means of adjusting the washer, which in this case is knurled. In placing the washer against the stud shoulder and tightening the nut, the washer will be held in place and may be adjusted to the desired degree.

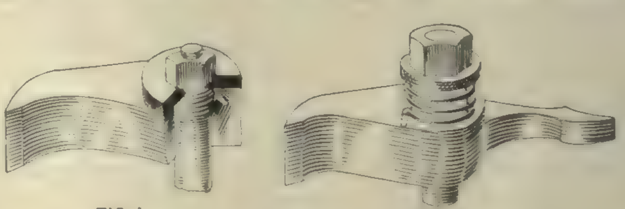


FIG. I FIG. 2

FIGS. 1 AND 2. CONCEALED RATCHET PAWL SPRING AND EXPOSED RATCHET PAWL SPRING

The illustration, Fig. 2, is on the same principle as the first, only the spring is not concealed. The collar is turned a loose fit for the spring.

What Are We Fighting For?*

BY HONORABLE WILLIAM H. TAFT
Former President of the United States

ONE cannot come before an intelligent audience like this and fail to talk about the war. I have talked about the war a good deal in various parts of the country, and I have been impressed with the feeling that the war could be talked about a good deal more about the country, throughout the country, to the people of the country, with very great advantage. There are so many who are doubtful—they are for the Government and they are for the war, but they are walking interrogation marks as to whether we did not make a mistake here, or did not make a mistake there, or whether we are fully and rightfully in the war, that I think an evangel ought to be preached on the subject to demonstrate that we are rightfully in the war, that we never have done anything that was not justified, and that the cause now presented to us is so righteous that if we are the people we claim to be we must win it if it costs the last man and the last dollar that we have. (Prolonged applause.)

You meet men who are now, after we have decided to go into the war, and after we are in it, who are now "judicially minded"—that is to say, they do not say they are neutral, but they are judicially minded. While I am in favor of being judicially minded, I am not in favor of masquerading under a judicial mind a lack of that fine edge of loyal patriotism that we need to carry this country through the war. (Applause.) I am opposed to apathy; I am in favor of team work, and of knowing why we are in, and what we are going to do, and in favor of being determined to do it. (Applause.)

The Judicially Minded Person

You will find this judicially minded person suggest that we were unneutral during the three years that we were not in the war, because we furnished ammunition and other supplies to the Allies. Well, we had a right to do that, under international law. Germany herself had agreed to that rule of international law with respect to the power and duties of neutrals—not that neutral governments could furnish such supplies, but that neutral governments could permit their citizens to do so, the citizens taking the risk of confiscation of those articles as contraband if found upon the high seas. And there were those who sympathized with Germany after the German commercial marine had been driven from the seas, and then they said it was unneutral for us to furnish one side. The fortune of war was not our fault. The President was right in insisting that we should stand by the rule of international law in that regard, because if by our acquiescence the rule of international law were to be changed, requiring every neutral government to suppress its citizens from carrying on such a trade, it would only make overwhelming the advantages of a military nation that devoted itself, as Germany did for fifty years, to getting ready for this war, a nation which has piled up the ammunition and supplies needed to carry her through years of war. We, if subjected to a war of aggression, would never be ready. We would always be unprepared, and as a consequence, when forced into war, we would have to look about to prepare suddenly, and then find denied to us the right to get our material and supplies from the citizens of neutral nations, under the new rule suggested. Therefore, it would have been the wildest lunacy for us to consent to a change of international law in that regard, and the merits were wholly with the President in taking that position.

But, notwithstanding the fact that we pursued the path of neutrality as laid down by the law, Germany sank an English commercial liner having three thousand persons on board, and sent to their death 114 American citizens by the murderous torpedo which her submarine hurled at this vessel. Then for a year we continued a discussion, arising from Germany's unfounded claim that the vessel was armed; then she sank another vessel under similar circumstances; then we said that we would sever our relations with Germany; then she said that she would discontinue that method of warfare until further notice; then on the 31st of January last Germany notified us, as she notified the world, that she intended to resume the ruthless submarine warfare; then shortly afterward we severed our diplomatic relations with Germany; then she sank four or five American vessels returning to this country in ballast and sent to their death some twenty-five or thirty American sailors; and then we declared that a state of war existed.

Our Duty as a Government

Now, my friends, is there anything else that we could do but that? That is where your judicially minded person would come in. The answer to my question depends, first, on the proposition of what were our rights, and what were the rights of our citizens? and secondly, what was our duty as a Government with respect to those rights? International law is indefinite in certain respects, but it is as definite as the law of promissory notes with reference to the rule of the capture of commercial vessels at sea. A beligerent may capture the commercial vessel of its enemy and sink that vessel. It may capture, under certain circumstances, a neutral vessel, violating a blockade, and possibly may sink it, but an incontestible rule for a hundred years has been that that right of capture and right of destruction is subject to one limitation; namely, that the ship's company of the captured vessel shall always be put in a place of safety before the vessel is sunk.

Admiral Semmes in the Civil War sank perhaps four hundred or five hundred vessels of the United States commercial marine, but he prided himself that in all that destruction not one single human life was lost. He was an internation lawyer of repute; he was also a naval commander, and his course in that regard is the strongest evidence of what international law is on that point. Therefore, Germany violated the rights of those citizens whom she exposed to death and whom she sent to death. When a man kills another deliberately, without right, it is murder, and there is no other word nor any other term in international law that can be applied to a case where a nation kills men and women and children without right. (Applause.)

Germany's Warning of Murder

Ah, but it is said these people had notice. That distinguished and eminent Christian statesman, Count von Bernstorff, had whispered over the telephone and had intimated very enigmatically that anyone who went aboard the "Lusitania" would run the risk of being torpedoed, and it is stated that those who went down in ships sunk afterward knew that Germany was on the sea with these murderous instruments. Well, that is a fine plea. Suppose a man in New York should warn a neighbor that he could not go down into the street upon which his house abutted, because if he did he would kill him; and suppose this man who was warned was a courageous American citizen, who knew what his rights were and he went down into the street, and the threatener did kill him. Suppose that man was indicted and haled into court and called upon to plead, and he pleaded "not guilty" on the ground that he had notified this man that if he would come down into the street he would kill him, and therefore he was not guilty because the man himself was guilty of contributory negligence in running into a bullet whose presence he ought to have anticipated on the street. (Applause.)

But Senator La Follette says—(hisses on the part of some persons in the audience), oh, don't hiss, it never helps to call names, no matter how poor an opinion you have of a man, it does not help the argument—but Senator La Follette says it is true they had the right to be where they were, but those were technical rights. It is too bad when a senator in Congress, sworn to obey the Constitution, should regard the rights of those poor victims on board the "Lusitania" to life and the right to protection against the invasion of a murderous nation as a technical right.

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*Address at the thirty-eighth annual meeting of the A. S. M. E., New York City, Dec. 4, 1917, on "The Nation's Call to the Professional Man."

We will now assume, therefore, that this was murder of our citizens. What was our duty? The Constitution as interpreted by the Supreme Court, indeed our general knowledge of government, would teach us that while we owe service, military and civil, to the Government, the Government owes us as a primary consideration, protection. Government is nothing but a partnership in which we are all members, and we all agree to contribute to the objects of a partnership by service; and then the partnership is to help us in enabling us to enjoy our rights. Therefore, when these citizens were actually deprived of their rights, why, it is very plain that it was the business of the Government to call for reparation in respect to those whose rights had been taken away, and security and an announcement of the policy which would prevent subsequent interference with similar rights of our citizens. Otherwise, if not, then we ought to go out of the government business, because that is the object of government.

Now, Germany announced that she not only justified what she had done, but intended to continue to murder our citizens on the high seas. Our citizens are entitled to the protection of the Government at home and on the high seas, and abroad. Abroad there is some qualification, because they voluntarily submit to another jurisdiction, but on the high seas, on an American vessel, and under an American flag, on that great road of the nations, they are just as much within the jurisdiction and within the protection of the Government at home as if they stood on the shores of New York, or Massachusetts, or New Jersey, and an invasion of their rights on the high seas by a foreign government is just as much an invasion as if Germany had landed a Uhlan regiment on our shores and shot into the homes of American citizens and killed them.

WHAT PRECIPITATED OUR WAR DECLARATION

Therefore, if we were to continue business as a government, there was nothing else for us to do—Germany did not leave it open—except to measure swords with her in protection of those rights. If this act had been committed by Venezuela or Costa Rica, if either of those countries had sunk an American ship with a loss of one hundred lives, the President would have promptly sent a message demanding reparation and security against further invasion, and might have sent a warship down to convey the message, just by way of suggestion, and every man, woman and child, Senator La Follette, and every pacifist, would have said, "Well done." Well, now, what is the difference between that case and the one we are considering? There is not any in principle, but there is this real difference, that Germany is the greatest military power in the world, and Venezuela is not, and therefore we are very urgently and strongly in favor of the protection of the rights of American citizens when invaded by a foreign country, provided the country is little enough, but when it is a great power—the greatest military power—then the rights are "technical." (Applause.)

Oh, my friends, there was not anything for us to do except to declare war, and a pacifist or anyone else who says otherwise or intimates otherwise, does not understand. The President has set a precedent by calling them stupid, and, after such an authority, I am willing to say I agree.

Now that brought us into the war, but when we got into the war we found what possibly we ought to have known before—some did know—that the particular cause which brought us in was only a phase of the far greater cause which the Allies were engaged in fighting. We found ourselves in the beginning ranged with democracies against autocracies. I know that our judicially minded friend will suggest that England is a monarchy and so is Italy. Yes, that is true, but a democracy is a country in which the people rule, in which the policies of the government are determined by the popular will. The proof of the pudding is in the eating of it. Anyone who knows anything about England and Italy cannot say otherwise than that the people rule in these countries, and where that is the case they are democracies. Where that is the case the question of kings is only a question of taste. As a matter of fact, the King of Italy and the King of Great Britain have not any more to do in determining acute questions of the policies of their respective countries than an ex-President of the United States has. (Applause.)

Now, the President has said that we are fighting this war to make the world safe for democracy. That is a truly exact statement. But it has been misconstrued. It does not mean that we are to force democracy on other countries, that we claim to have a patent for our form of government that we are going to drive down the throats of other people. That is not what it means. It only means that the power of a people with a military and foreign policy such as that of the Imperial German Empire, is dangerous to the continued and safe existence of smaller and less powerful countries that desire to have democracies and to work out the happiness of their people through that kind of government. That is what it means.

WE MUST UNDERSTAND GERMAN CHARACTER

We cannot understand the issues at stake without understanding the character of the German people. We cannot understand their character without following their training in the last fifty or sixty years. We all have known Germans. We have liked them. When in Germany we have enjoyed seeing them. They are a kindly people; at least they were some years ago when I visited Germany. They are a kindly people, who love their homes, they love their families, they love music and they love poetry, of which they have some of the greatest exponents in the world. They conform to authority with a kind of pleasure. They are an intellectual people, they are an earnest people, a little lacking in a sense of humor, but a great people, people capable of great effort.

The truth is, while I have a profound admiration for the English people and the history of England, because having been educated as a lawyer I believed she laid the foundations of true constitutional liberty, nevertheless I am bound to say that when I went to Europe and traveled in Europe, I would a great deal rather be closed up in a railway carriage with a German than with an Englishman; because the Englishman—I mean the regular Englishman—was constantly engaged in an affirmative effort to convince me that he did not know I was in the carriage, whereas the German was always courteous and friendly and anxious to engage in conversation.

A GLANCE AT GERMAN HISTORY

The Germans for a long time were divided into twenty-eight different states, Austria the greatest of them, Prussia the next, and twenty-six others, and everyone who longed for an improvement in the world, and an improvement among the Germans, wished for unity among them. There were liberty-loving Germans, and in '48 they rebelled against the Divine Right of Kings, and they had revolutions. They were not successful. They did get a constitutional monarchy for a little while in Prussia, and offered the crown to Frederick William, the great-uncle of the present emperor, and he said he would not take it, because he got it from God, and did not purpose to take it back again out of the mud, showing that the Divine Right of Kings came honestly down that line to its present exponent.

A large number of these liberty-loving Germans were driven out of Germany and came to this country, and made one of the most valuable elements of our citizenship here (applause), and when the Civil War came on, loving liberty as they did and hating slavery, they went into the war, enlisted in great numbers, and on every battlefield in that war the blood of our German citizens was shed.

Their descendants and others who have come here since have continued to make a valuable part of our citizenship, and during these three years when we were neutral they have naturally, because of the pride in the success and prosperity of their brethren at home, had a sympathy with Germany and listened to the arguments in her behalf which have been put forth in this war. And now the war between

America and Germany has come on, and their allegiance requires them to be loyal, and they are put in a sad position, and one in respect to which we should be considerate of them. But they are loyal, they have enlisted, they have gone into the draft, and contributed to the great patriotic funds; and while they are not vociferous—we could hardly expect them to be so—that they are going to be loyal I have not the slightest doubt (applause), and one of the things we ought to be most thankful for is that very thing. The reason why Germany treated us as she did was because she counted on dissension among our people, growing out of the disloyalty of that very element, and she has been disappointed in that regard as she has been disappointed in so many of those instances where she has attempted to read the motives of other people.

PRINCE VON BISMARCK'S POLICIES

Instead of founding a constitutional monarchy, with representative institutions, and bringing about unity, as those leaders of German thought, Carl Schurz and others hoped for, there came into the history of Germany a very different individual, Prince von Bismarck, who was the Premier of Prussia in 1862. His theory was that he would conquer and unite the German nation by blood and iron, and he developed the army, always a well-controlled body in Prussia, and he made the nation into an army, and an army into the nation, and then he planned the wars upon which he founded the unity of Germany. He became involved in a quarrel with Denmark, and induced Austria to go in with him, and took away Schleswig-Holstein from Denmark; and then when he got it, he found it was so easy that he annexed it forcibly to Prussia; and when Austria asked, in a diplomatic way, just what there had been in that war for her, he said there was not anything. And then he got into war with Austria, as he had intended, and in six weeks he wiped her off the map of Germany. Then in that war he annexed forcibly Hanover and Frankfort, and made an offensive and defensive alliance with Württemberg, and Baden, and several other German countries; and then he sat down to wait until that fakir, Napoleon III, in his pirouetting, would bring about an appearance of a war of aggression against Germany, which was exactly what Bismarck was waiting for, and he only had to wait four years for that; and if you will read his memoirs you will see how he brought that about. You will be interested in reading, I am sure, that interview between himself and von Roon and von Moltke. They received a telegram from the Emperor outlining an interview between him and Beneditti, Napoleon's ambassador, and they were thrown into gloom, because the interview was one which seemed so pacific to them that they thought its publication would prevent war; and Bismarck sat down and, without changing the body of the message, changed a few words in it and published it; and then von Moltke said, "Now we will have war." He said, "That telegram, when it came, sounded like a parley. As you have changed it, it sounds like the rattle of a drum." This was stated by Bismarck himself. So, true to his plan, Napoleon declared war, and then, in a short time, Bismarck defeated France and took Alsace-Lorraine and an indemnity of a billion dollars, which the Germans put into the army, and Bismarck crowned a Prussian King Emperor of Germany at Versailles, and he went back to Berlin and sat down as the head of the empire to digest the pieces of territory he had bitten off in the last three wars.

THE SEEDS OF KULTUR

He was not in favor of world domain. He wanted to raise Germany to a great power in Europe, and he succeeded. He made fun of the ideal of world dominion, but there was held out to the German people the idea that all the rest of the world would try to get back from them this territory which had been taken, and therefore they must defend themselves, and so they went on and provided greater and greater armies.

They also adopted in their wonderful way, as you gentlemen of science know, the principles of science to the manufacture of everything, and to every field of industry and business. They introduced a system which they called Kultur, and which brought about a prosperity in competition with the world that attracted the admiration of the world. Their population increased and pressed upon their borders, and with their marvelous successes in the three wars, with their wonderful administration and the demonstration of their efficiency in their prosperity, and with their increase of population, they acquired megalomania, and they learned to think that they were supermen. They believed they had invented Kultur, and it was their duty to spread it over the world and enlarge their borders and conquer the world for the purpose of spreading that Kultur.

And they soon, by reason of their elevation as a people, associated themselves with God. They regarded themselves as the agents of God. They are a people of an inexorable logic. If they begin with a false premise, as they often do, their confidence in logic is such that they wipe out any fact that is inconsistent with the conclusion reached by that logic. You remember the story of the old German who was in the California gold diggings and met a man out there whom he had seen only recently in New York; and anxious to find out how he had gotten there, he asked: "You came the plains across?" The man replied, "No." "Then you have come the Isthmus over?" "No." "Oh, then you come the Straits of Magellan through?" "No." "Oh, I see, you were seasick coming the Horn around?" The man replied, "No," and then the German's eyes opened and he looked at the man for a minute and he said: "Well, then, you have not arrived!" (Laughter and applause.)

Having established that Kultur was necessary for the world, and that they had invented it, they believed that they were the people to spread it; and then, with that inexorable logic, all of these other conclusions followed. The state, the German state, was to spread Kultur. It was to do God's work. Therefore, every consideration must yield to the doing of that work. The state was above everything. The state, engaged in this work, could do no wrong. Therefore, these considerations of honor and decency, and the performance of obligation, could play no part. International morality was eliminated. The only sin of a state was weakness; its virtue was power. And that doctrine, or its elements, the idea that Germany was over all, was preached in the schools, in the academies, in the universities, by the great lecturers, by the military writers; and the conviction grew with the people, first, that they must protect and defend themselves and give everything to the army necessary to accomplish that, and, secondly, that they must base their state on force and maintain that force in order that they should spread Kultur to the world by domination and conquest. They eliminated, as I say, international morality.

OBSESSED AS WITH INSANITY

Now, that is the nation and that is the people that we are engaged in fighting. They are obsessed as with insanity, otherwise you cannot explain what you see and read and know. "Why is it," you ask, "we did not know this before we got into the war?" Well, we read excerpts from the lectures and military writings, but we have cranks of our own—I need not mention them—but certainly we do not want to be held responsible for their writings and their statements and their actions, and we assumed that these people, thus speaking among the Germans, belonged to that necessary and conspicuous, but we hope with us unimportant, element. But it was not so in the case of Germany, and you can read now the books that have been prepared impartially showing these sermons and lectures, and showing that these lectures spoke for all the people. Consider, for a moment, that there was a writer who in one of his writings incorporated a prayer like this: "Oh, Thou, who presides over all, up above, high in the skies, up above the Cherubim and Seraphim—and the Zeppelins—"

Now, that association, if it did not shock your feelings as irreverent, would suggest a humorous view; but to the German mind, with the idea of what the Zeppelin was to do in spreading Kultur, it was the agency of God; the association between the cherubim and seraphim, which are supposed to be God's agents, with the Zeppelins, was entirely proper. They preached sermons on the German God.

It is the people of Germany we are fighting, with the characteristic they have of subordination to the authority of the Prussian military regime and the Kaiser, and we must not assume they are compelled against their will to do this fighting. They have made too many heroic sacrifices in loyalty to this false idea, and in loyalty to the leadership of the Kaiser, and therefore what the President says must not be misconstrued. What we are trying to do is to separate the people of Germany from the rulers of Germany, but the only way we can separate them from their rulers is by hitting them on the head with a club so that the psychology of the situation will be brought home to them. (Great and prolonged applause.)

If you look for proof of this position of Germany with reference to the abolition of international morality you can find it in their method of warfare. I do not think it necessary to go into a detail recital of the awful atrocities that have been proven before you can arrive at a general conclusion as to their violation of every rule of warfare. They bombarded unfortified towns, an act which is forbidden by international law, and the men who bombarded these unfortified towns on the east coast of England were rewarded by being decorated with the Iron Cross.

The Hague Conference provided certain rules with respect to the carrying on of war by means of aircraft, one of which was that belligerents were not to drop explosives from aircrafts on undefended towns; and the Germans promptly sent their Zeppelins, that were assembled for the purpose of carrying on war, and to which they turned for the purpose of carrying on the war, and they sent these Zeppelins to England and slaughtered innocent noncombatants. Of the thousands of victims of the Zeppelin raids, possibly not more than fifty soldiers and sailors were hit, and only one or two arsenals, but the great body of the victims is composed of women and children, and old men. The men who navigated the Zeppelins in these air raids were also rewarded with Iron Crosses.

KULTUR'S PATH IN BELGIUM AND ARMENIA

When the Germans entered Belgium they violated their treaties through which they had given their plighted faith for sixty years with the other nations. You would think, when they went into Belgium, under these circumstances, they would treat the people with some consideration, even in spite of their obsession. Did they? No. What they did was to take a district in Belgium and direct their soldiers to pursue the policy of "Schrecklichkeit"; that is, to stand up against a wall the leading citizens and shoot them, as well as the women and children. You ask for proof? Well, read the report of Lord Bryce. He is a lawyer, an able lawyer, and an historian, and he was on the committee with other lawyers and judges, and they took the evidence and dissected it and analyzed it. They rejected all the evidence as to the sporadic brutalities by soldiery which you encounter in every war, and took only the evidence of cases that could not have been committed except by the order of officers, and they showed that this was part of the military policy of Germany in terrorizing the rest of the innocent Belgians by such cruel atrocities in respect to the families of this particular little district.

But the worst thing they have done has been with respect to Armenia. When England brought over the Indian troops to help that small regular army of hers, and they came and made good soldiers, showing they had been well treated, the Germans held up their hands in holy horror and said, "They are sending Mohammedans to fight Christians," all the time having that eminently Christian Monarch, the Sultan of Turkey, in alliance with them. And after the alliance was secure, then Turkey proceeded to carry out a purpose that she had partially attempted to carry out years before in ridding herself of Armenian Christians in her empire. She proceeded, with Germany looking on, and with officers of the German army at hand, through her regular soldiery and her irregular soldiery, to murder 800,000 Armenians because they were Christians. Now that is an evidence of the false philosophy, the horrid philosophy, that there is no international morality, and that nothing should stand in the way of military success and the advance of the state in the spread of Kultur.

That is the kind of enemy we have to fight. That is the psychological state of the German people, and the only way in which we can change it, as I say, is by defeating them. If we defeat them, then they will appreciate the falseness of a philosophy which can be justified only by victory, and then when they are defeated, as we must defeat them, then they will relegate the Kaiser—it will not need any action on our part—they will relegate the Kaiser and the Prussian military regime to the place where they ought to go. (Applause.)

THEIR SIN HAS FOUND THEM OUT

It is a very satisfactory thing to see that the sin of the Germans in this regard has found them out. When the war began, good Christians hesitated about believing in a good God, when they saw that so many innocent men could be hurled into a vortex of destruction, agony, suffering and death like this. Now the thing is cleared away, and what we see is that the world has been suffering from a cancer of militarism, and Germany has been responsible for it, and she has led the world on to these great armies, and on her hands is the blood of this awful war—this war with fifteen or twenty times the number of men engaged in it, and with an equally increased amount of suffering and agony, compared with any other war—with 40,000,000 men engaged, 7,000,000 men dead, 6,000,000 men in the hospitals, and 6,000,000 men in prison camps. That is due to Germany. The cancer cannot be cut out but by suffering. God works by inexorable laws and the penality of sin must be paid.

This is a German war of aggression as any schoolboy can now see. The White Paper did not show any communications between Germany and Austria during that anxious time, and they have never been disclosed, but we know now that Russia was not prepared, and England not any more prepared than we are today, and France was very lacking in her preparation, and yet we are to believe that these three countries conspired to attack Germany who was ready to the last cannon and the last reservist. Why, that is enough to make a horse laugh. It is true that Germany did not advise the killing of the crown prince and his consort. That is not the way Germany has begun her wars. She gets ready. She plans a war. She gets ready, and then she waits for the opportunity so that it shall seem to be a war of aggression by other powers. That is true in every war she has waged since Prussia has been in power.

GERMANY'S WOEFUL BLUNDERS

So to go back to this sin of Germany finding her out. She has been perfect in military preparation; she has been perfect in military strategy, but where has she made her blunders? She has made her blunders, and her great blunders, in misreading other peoples, in her diplomacy, and she has made these blunders because she has eliminated from her own soul considerations of morality and motives of good, motives of service and allegiance and unselfishness, and therefore she has eliminated those from her judgment when she goes to judge of what other people will do, and so she made a mistake about Great Britain, and her conscience in respect to Belgium. She made a mistake as to the British possessions—I mean those independent dominions—she said, "The tie which binds the dominions to the mother country is very light. There is no reason why they should go in, there is nothing in it for them," and she was indignant and exasperated when she found that her judgment in that regard was wrong. That is because she could not appreciate the filial relation between those countries and Great Britain. She could not appreciate the daughter's loyalty to her mother that had protected her. Is there anything more noble in this world war than the way in which Canada and Australia have responded to the call of the mother country? Canada has sent 420,000 men, and Australia 400,000 men, Australia having a population of five millions and Canada six or seven millions. In proportion, we would have to send an army of seven millions. And then France. Germany said France was decadent, permeated with socialism, no patriotism, and deeply affected with frivolity. France was not prepared, but she rallied her legions, and is it not inspiring to think of the fight that she made, knowing that the German military staff was attempting to crush France first, and she stood up, and with that thin line of the British regular army, she hurled back the German hordes at the Marne and saved the world? (Great applause.)

The biggest mistake she has made has been with respect to this country. I remember some of the things the papers said—they said we were a tangoing nation. They said we were too fat to go into the trenches. They had a contempt for us because we had not prepared for war. They assumed our citizens of German origin would prevent the war, and political considerations would divide the people in that regard. They were also obsessed with the idea that they could end the war with this murderous weapon, this weapon they could not use except by accompanying its use with the murder of neutral people. So they went in.

Now, ten, fifteen or twenty years hence, when our grandchildren go to their fathers, after having read a history of this war, they will say, "Papa, why in the name of common sense did Germany force the United States into this war?" And papa will have a hard time to tell, unless he goes into all of the circumstances and treats the subject from a psychological standpoint, because the boy will say—any child would say—"Why they had been fighting this war for three years, exhausting as no other war has been before, so that they were all not exhausted, but nearly so, and at that time they deliberately forced into the war against them that gigantic young nation that could furnish what is absolutely necessary, and what must determine victory in the war, more food, more money, more fighting men than any nation in the world."

Now, that is what they have done, and nothing can explain it except the obsession that I have referred to—their failure to see things in other people, because they have eliminated from their own consideration those moral motives. Now what are we going to do about it? I have said, potentially we are the greatest power in the world. We are a potential military power, and we have got to make that thing which is potential actual, and that is no mean job. We have before us a war of two, three or four years. We have got to raise an army of five million or seven million, or possibly more. It is man-power that is going to win this war. Russia has become a pulpy mass, and it has got to work out its own salvation. There is one feature about that situation, and that is that the Germans will not know any more about what is going to happen in Russia than we do, but it is going to enable the Germans to bring back, doubtless, many of her divisions to the Western front; and we must fight the war out on the Western front, and it may be that the Western front will reach from the North Sea to the Adriatic. We have got to furnish to our Allies not only food, not only money, but we have got to furnish them the man-power that will give a predominance that will win this war. We have got to wear them out, it may be by attrition, as Grant wore Lee out, but we have got to do it, because civilization depends upon it, because our own independence depends upon it. The war is not in our souls yet, not as it will be when our boys are shot down and when we consult the casualty lists to see whether those dear to us have suffered. One of the great satisfactions is that when we are in it, when we meet disaster, as we are going to meet disaster, and we find there have been blunders, as there will be blunders—but from these blunders and from these disasters the American people are so constituted, with their inherited traits, that those disasters and blunders and defeats and humiliations will only make us stronger to carry out the struggle that is essential to liberty and Christian civilization. (Loud applause.)

Relation of Press Stroke to the Life of a Die[*]

By WILHELM A. SCHMIDT
Special Engineer, Remington Arms Co., Ilion, N. Y

This article discusses the views advanced in a recent article, and is offered in explanation of the cause of the increase in the life of a punch and die when the press stroke is shortened.

AN ARTICLE by E. F. Creager, entitled "Relation of Press Stroke to the Life of a Die," appeared on page 485, *American Machinist*. This subject engaged my attention a few years ago, and I believed that the shortening of the stroke of a press would materially increase the life of a punch and die. The results obtained in the first experiment were such that I changed the crankshafts of several presses to reduce the stroke from 1¼ to ⅝ of an inch.

I note in the first paragraph of the article, Mr. Creager states that in reply to his question, "Does it make any difference in the life of a punch and die if worked in a press of 3-in. stroke or in one of 1-in. stroke; all other things being equal?" received, almost invariably, the answer, "None at all; if the presses are run at the same speed." This answer is correct provided the proper interpretation is placed upon the phrase, "at the same speed." If by the same speed is meant the r.p.m. of the crankshaft the answer falls far short as the r.p.m. of the crankshaft is only one factor in the problem. The speed or velocity of the ram, the instant the punch strikes the metal, is quite important, and the writer believes the following will be of interest:

In a punch press let R be the radius of the crank, or one-half the stroke, b the length of the connecting rod, θ the angle between the radius R and the line of motion of the ram, and X the variable distance between the center of the crank and lower end of connecting rod b, see Fig. 1, then,

$$X = R \cos \theta + \sqrt{b^2 - R^2 \sin^2 \theta}$$

Differentiating the above equation with respect to X will give an expression or equation for the instantaneous velocity in the line of X of the ram for any value of θ; namely,

$$\frac{dX}{dt} = \left(-R \sin \theta - \frac{2\, R^2 \cos \theta \times \sin \theta}{2 \sqrt{b^2 - R^2 \sin^2 \theta}}\right)\frac{d\theta}{dt}$$

$$= -\left(R \sin \theta + \frac{R^2 \cos \theta \times \sin \theta}{\sqrt{b^2 - R^2 \sin^2 \theta}}\right)\frac{d\theta}{dt} \ldots Eq. (2)$$

in which $\frac{d\theta}{dt}$ is the angular velocity of the crank, depending upon the r.p.m. of the crankshaft. $\frac{d\theta}{dt}$ we may assume to be constant and measured in radians per sec. is equal to $\frac{2\pi \times \text{r.p.m.}}{60}$.

Now assume R 0.625 in. giving a stroke of 1¼ in.; b 8.00 in.; r.p.m. 120.

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Thickness of metal to be punched = 0.060 in., and allow the punch to be entered 0.010 in. in the die at the low point of the stroke, see Fig. 2. $\frac{d\theta}{dt}$ in this case $= \frac{2\pi \times 120}{60} = 4\pi$; $\cos\theta = \frac{R - 0.07}{R} = \frac{0.555}{0.625} = 0.888$ from which the value of sin θ is readily calculated and = 0.45984

$$R \sin\theta = 0.625 \times 0.45984 = 0.2874 \text{ in.}$$

$$R^2 \cos\theta \sin\theta = \tfrac{25}{64} \times 0.45984 \times 0.888 = 0.062307$$

$$R^2 \sin^2\theta = \tfrac{25}{64} \times 0.211456 = 0.0826$$

$$\sqrt{b^2 - R^2 \sin^2\theta} = \sqrt{64 - 0.0826} = \sqrt{63.9174} = 7.9948$$

$$\frac{R^2 \cos\theta \sin\theta}{\sqrt{b^2 - R^2 \sin^2\theta}} = \frac{0.062307}{7.9948} = 0.007794$$

then

$$-\left(R \sin\theta + \frac{R^2 \cos\theta \sin\theta}{\sqrt{b^2 - R^2 \sin^2\theta}}\right)\frac{d\theta}{dt} = -0.2952 \times 4\pi$$

= 3.709 *in. per sec.* or 18.548 *ft. per min.*

Now let all conditions remain the same except R = 0.3125 in. giving one-half the stroke as in the previous case. The connecting rod b lenghtened to 8.3125 in., which would be necessary for proper adjustment, then $\cos\theta = \frac{0.3125 - 0.07}{0.3125} = 0.776$ from which the value of sin θ is easily computed and = 0.63073.

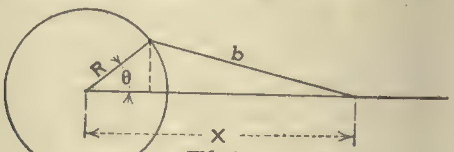


FIG. 1

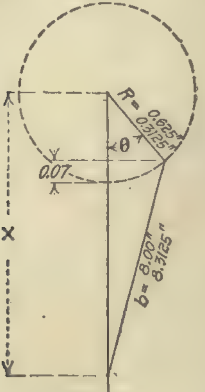


FIG. 2

FIGS. 1 AND 2. DIAGRAMS ILLUSTRATING LENGTH AND SPEED OF PRESS STROKE

Substituting all the corresponding values in equation (2) gives the instantaneous velocity of the ram when the metal is struck by the punch

4 × 3.1416 × 0.20285 = 2.549 *in. per sec.*
or 12.745 *ft. per min.*

Similarly with a press of 1¼-in. stroke and all other conditions the same except the thickness of the metal 0.030 in., allowing the punch to enter the die 0.010 in. at the lowest point of the stroke,

$$\cos\theta = \frac{0.625 - 0.04}{0.625} = \frac{0.585}{0.625} = 0.936$$

$$\sin\theta = 0.352$$

and the velocity of the ram at the instant the metal is struck is 4 × 3.1416 × 0.2361 = 2.96 in. per sec. or 14.834 ft. per min. While the same metal in a press of ⅝-in. stroke will be struck with the punch with a velocity of 4 × 3.1416 × 0.15798 = 1.98 in. per sec. or 9.926 ft. per min.

Again with all conditions the same with the press having 1¼-in. stroke and the metal 0.005 in. thick, allowing the punch to enter the die 0.005 in. $\cos\theta = \frac{0.625 - 0.01}{0.625} = \frac{0.615}{0.625} = 0.984$ and $\sin\theta = 0.17816$.

The metal will be struck with the punch at a velocity of 4 × 3.1416 × 0.1167 = 1.466 in. per sec. or 7.332 ft. per min. While in a press having ⅝-in. stroke punching the same metal $\cos\theta = \frac{0.3125 - 0.01}{0.3125} = \frac{0.3025}{0.3125} = 0.968$ and $\sin\theta = 0.25090$ the velocity of the punch at the instant the metal is struck is 4 × 3.1416 × 0.08127 = 1.021 in. per sec. or 5.106 ft. per min.

SUMMARIZING ALL THE PRECEDING RESULTS R.P.M. CONSTANT 120 PER MIN.

Stroke, In.	Thickness of Metal, In.	Velocity at Contact with Metal In. per Sec.	Velocity at Contact with Metal Ft. per Min.
1¼	0.060	3.709	18.548
⅝	0.060	2.549	12.745
1¼	0.030	2.966	14.834
⅝	0.030	1.985	9.926
1¼	0.005	1.466	7.332
⅝	0.005	1.021	5.106

When θ = 90 deg. sin θ = 1 and cos θ = *o* the second term of the member to the right of the equality sign in equation (2) becomes *o* and the velocity of the ram at that instant is $R\left(\frac{d\theta}{dt}\right)$; namely, the angular velocity of the crank times the radius and that of a press of ⅝-in. stroke is one-half that of a press having 1¼-in. stroke, r.p.m. the same in each case.

From the preceding method it will be readily observed that the difference in the cutting speeds between presses of 1¼-in. stroke and one ⅝-in. stroke will become less as angle θ approaches *O* consequently in cutting very thin metals the velocity, in either case, will be nearly the same at the instant the metal is struck by the punch but always slightly in favor or less in the press having the shorter stroke as the velocities are absolutely equal only when θ = *O* and 180 deg. at which times the velocities are also *O*.

The writer believes that the differences in the velocities as shown readily accounts for the increased life of the punch and die in the shorter stroke press running the same r.p.m. of the crankshaft as that of a press with the longer stroke.

Considerable time and study have been devoted to cutting speeds in other lines of work, but the press problem does not seem to have attracted much attention, perhaps for the reason that presses are used for such varieties of work other than plain stamping.

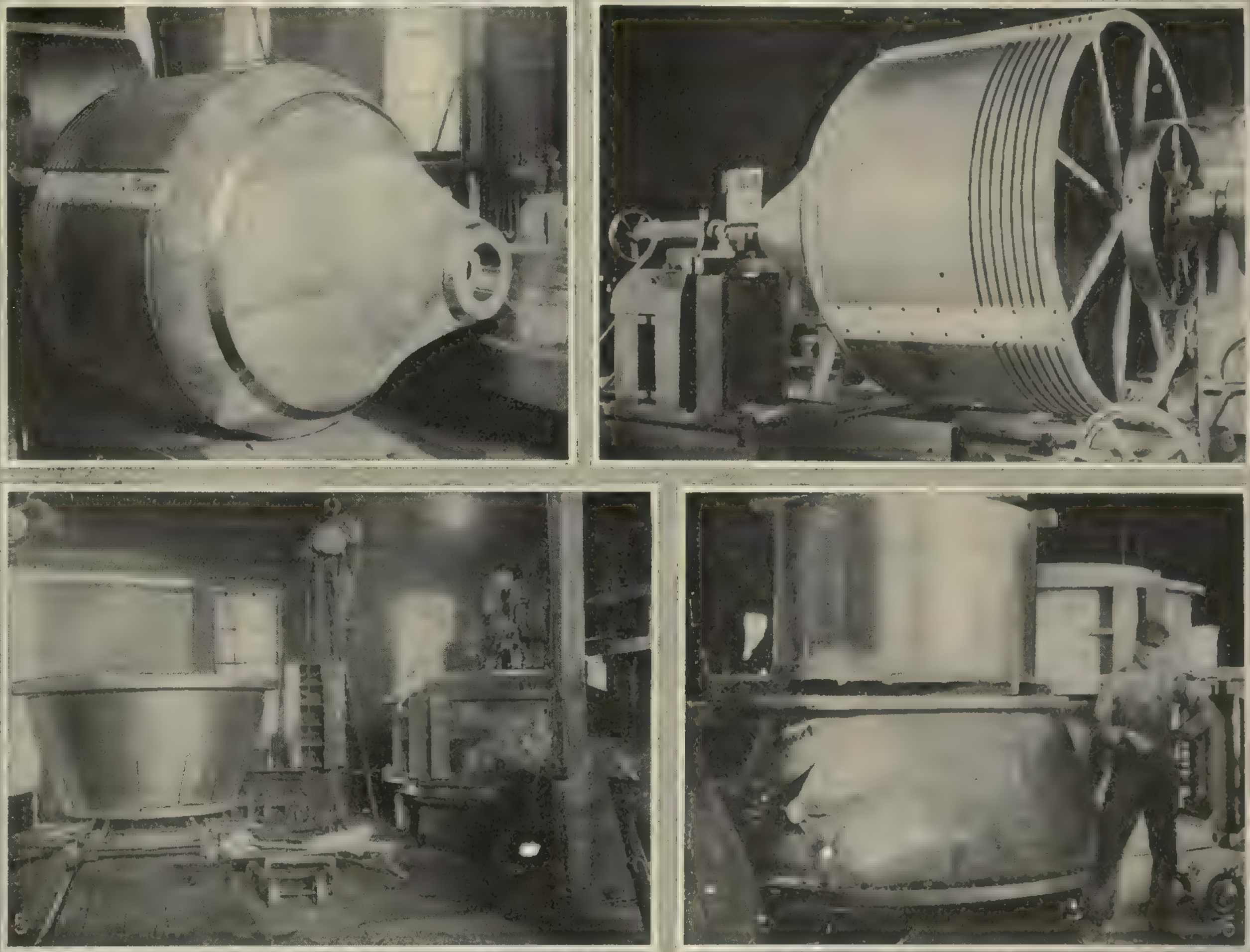
Suppose in a case wherein the press is constantly used for stamping metal 0.030 in. thick also that the press is equipped with a roll feed and has a stroke of 1¼ in. the cutting volocity of the punch is 2.966 in. per sec. Now assuming that this speed is such as will give a reasonable life to the punch and die, the same production per life of the punch and die should be obtained in a shorter period of time by using a press with ⅝ in. stroke, increasing the r.p.m. of the crankshaft until the cutting velocity of the punch is the same; namely, 2.966 in. per sec.

A Big Jobbing Shop and Foundry in Texas

By FRANK A. STANLEY

Some of the important methods of this plant as illustrated in the machining of big valves, mining machine parts, and other work. Turning, boring, and erecting operations are shown along with production of large bolts, and the handling of locomotive repairs.

ONE of the largest industrial plants in the Southwest is the El Paso Foundry and Machine Co.'s establishment at El Paso, Texas. This concern builds mining machinery, irrigation equipment and other heavy apparatus, and handles a varied line of repair work for mines, smelters, railroads, and other organizations, whose machinery and rolling stock require occasional overhauling.



FIGS. 1, 3, 5 AND 6. VIEWS IN THE SHOP OF THE EL PASO FOUNDRY AND MACHINE CO.
Fig. 1—A large needle valve for the Roosevelt dam. Fig. 3—The valve needle in the lathe. Fig. 5—The needle nozzle and case. Fig. 6—Bronze sleeves ready for fitting into the needle case

The shops and foundry of the company give employment to a force of several hundred workmen, and there are always many interesting jobs going through the plant which are well worth the attention of the visitor.

The accompanying illustrations show a few characteristic undertakings, and give a fair idea of the nature of the work taken care of by this plant.

One striking piece of work seen under way during a recent visit to El Paso was the construction of a number of big outlet valves for the Roosevelt Dam on the Salt River, Arizona. These valves are of the needle type, and are most interesting examples of shop work, because of their size and the methods employed in their construction.

In Fig. 1 is shown one of the big machine valves on the shop floor ready for the fitting of the needle tip, the valve guides, the bronze needle seat, the rings, etc. The body of the needle is a semi-steel casting turned to 66 in. diameter, and to 82 in. in length. For nearly one-half of this length the casting is turned to cylindrical form; the remainder, or nose, is formed to a curve of approximately 90 in. radius as illustrated.

The line drawing, Fig. 2, shows the proportions of the valve clearly, and here the needle is seen in place in the nozzle with the seats, the needle tip and the stem in position. It will be noticed that the valve is represented wide open, the needle being run back to the extreme end of its 27-in. travel.

This drawing also gives the sizes of the needle seat, the nozzle seat and the needle tip, all three of which are made of phosphor bronze. The internal diameter of the seats is 54⅝ in., and the tip is 35 in. long. It is provided with a large hub to fit a seat bored in the end of the cast-iron (steel mix) needle, and its outer surface is turned out to form a prolongation of the curved end of the needle body to which it is firmly attached by means of the threaded end of the stem which draws the tip fast against its seat. The stem is provided with a shoulder, which abuts against the rear hub of the needle casting, and after the tip has been drawn tight into its seat a retaining pin is put crosswise through the outer end of the stem as indicated in the drawing.

TURNING THE NEEDLE

The method of machining the big needle casting is illustrated in Fig. 3. A 30-in. lathe is shown in this view with the head and foot stocks jacked up on 12-in. blocks to give the increased swing required to allow the casting to clear the carriage. The needle is mounted on a long spindle or arbor 5 in. in diameter, which is supported at one end in the lathe chuck, while the outer end has an auxiliary support for the tail center in a journal bearing blocked up from the lathe shears, and thus taking the load directly on the shaft upon which the work is carried.

The cylindrical portion of the needle casting just clears the bridge of the lathe carriage, making it impossible to mount the tool slide upon any ordinary raising block to bring the tool to suitable height for the turning operation; therefore, a method was adopted, as shown in Fig. 4, to carry the tool slide in operative position.

A casting *A* was made to fit the front edge of the carriage to which it was rigidly bolted as shown; the bottom surfaces being planed out at right angles to bear at the top and front of the carriage, and the upper face finished at an angle as a guide for the tool slide so that when the latter was put in place as at *B* the edge of the turning tool came in suitable position in reference to the center of the work, the feed of the slide to the cut being approximately on the radial line through the center. The longitudinal movement of the carriage was operated in the usual manner.

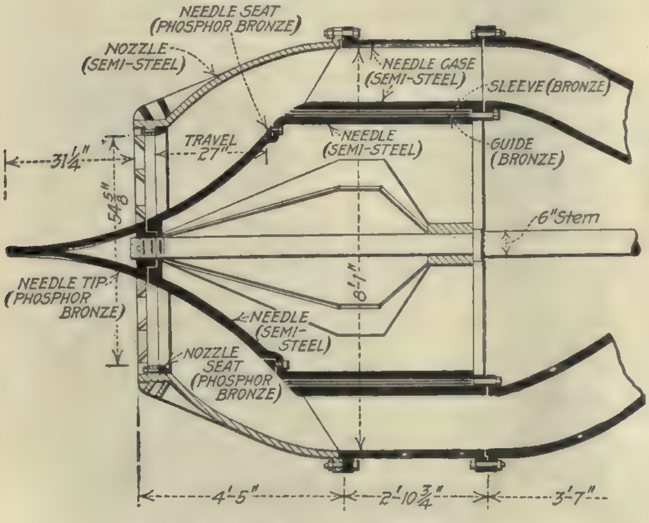


FIG. 2. DETAILS OF THE VALVE

Referring to the section Fig. 2 it will be seen that the phosphor bronze ring, which forms the needle seat, is fitted over a square seat turned in the curved face of the needle casting. The method of machining the seat is shown, together with the method for securing the ring. The needle on the floor, in Fig. 1, is shown with the bronze ring secured in place, and finished to size. The ring is bored out in the vertical mill, and then after its seat has been turned out in the big casting, it is forced into place and secured in the seat, and the outer surface of the ring then turned in the lathe to the required form.

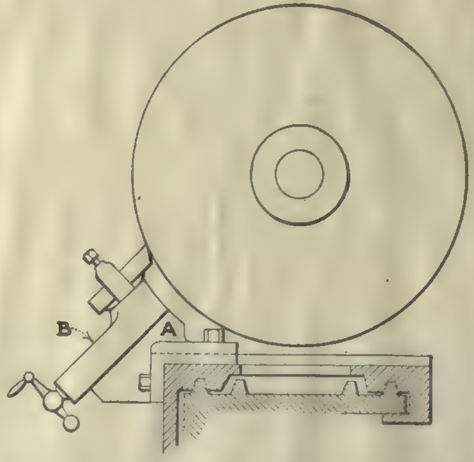


FIG. 4. HOW THE TOOL SLIDE WAS USED

Before the needle casting is removed from the lathe a series of packing ring grooves are cut near the rear end, and the work is then ready for planing the longitudinal slots for the guides which prevent the needle from turning, when the valve stem is operated to open or close the nozzle. One of these guide seats will be seen on the side of the needle, Fig. 1. The broad keys or feathers, which fit these seats, are of bronze and they measure 6 in. in width by 2 in. in thickness. There are four in the series, spaced equally about the circumference of the needle, and each secured by fourteen ¾-in. Tobin bronze flat-headed bolts and nuts.

OPERATIONS ON THE NOZZLE AND NEEDLE CASE

The sectional view, Fig. 2, shows the hemispherical form of the nozzle which is bored out at the mouth to receive the bronze seat, and which is finished at the rear end to form a flanged joint for connection with the front face of the needle case. The needle case itself is bored to receive a bronze sleeve or liner in which the needle proper slides in operation, and is faced parallel across the ends for the flange joints by which it is bolted to the nozzle casting in front, and to the casing at the rear. In facing the flanges for the joint a shallow shoulder is left on one casting, and a corresponding recess cut in the face of the matching surface so that the members fit together snugly across the joints.

The machining of these interior and outside surfaces of the heavy castings is accomplished on the vertical boring mill. In Fig. 5 a hemispherical nozzle is seen on the truck to the left ready for handling on the mill, while at the right will be noticed a needle case, which is just being finished on the vertical machine. The case measures more than 9 ft. over the flanges, and the extreme corners just clear the inner edge of the mill housings. The boring of the interior for the bronze sleeve which is 69 in. across by 44 in. high, or long, also taxes the capacity of the machine, particularly in the vertical travel of the boring heads.

The bolt holes are drilled in the flanges before the work is sent to the boring mill and the holes are used in bolting the casting to the rotary table. The job all the way through is one of those where the work can just be squeezed into the biggest machine tool in the shop. A number of casing parts, and their bronze sleeve ready to be pressed into place are seen in Fig. 6. Some idea of the size of the work may be gathered by comparison with the workman standing nearby.

The bronze sleeves, it may be stated, are machined by boring the interior on the vertical mill, and then turning the outside and ends by placing the work on a spider arbor in the lathe.

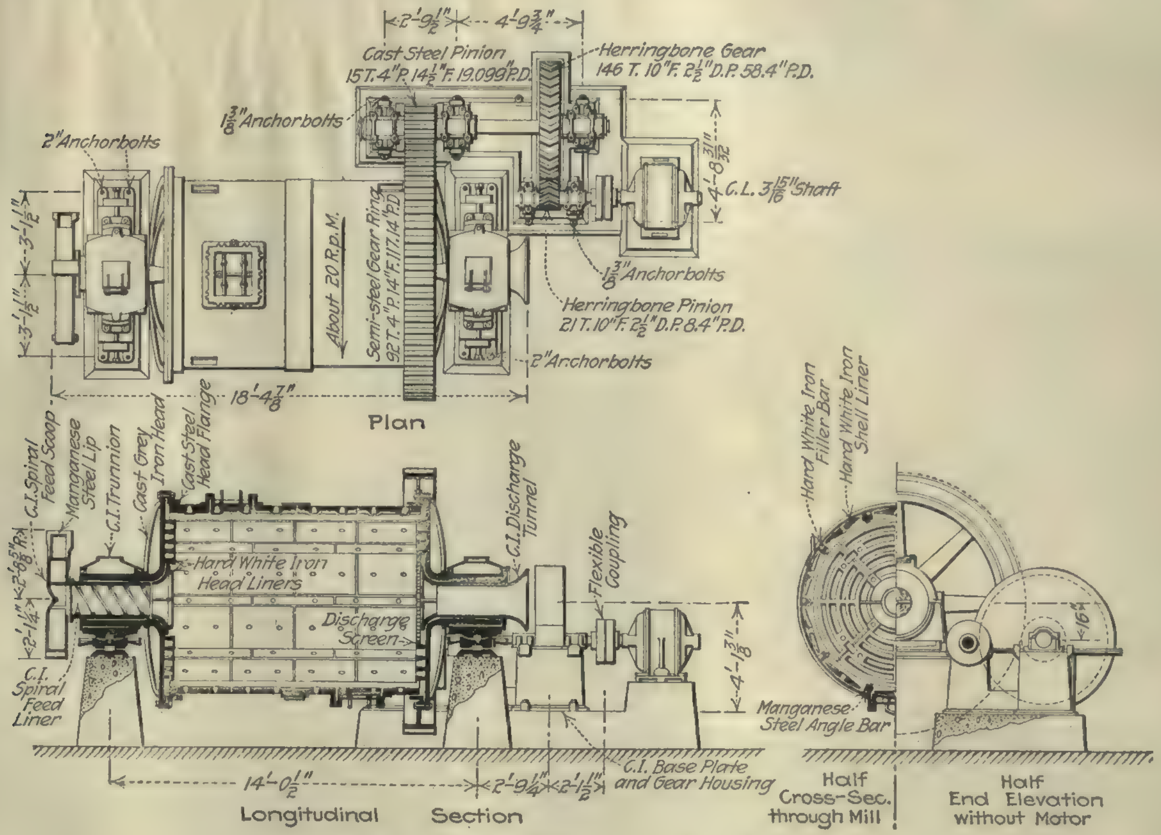


FIG. 7. CONSTRUCTION OF TUBE MILL

It may be of interest to note that these big needle valves are operated by means of a 5-hp. motor running at 500 r.p.m., and connected by worm reduction gearing to the valve stem.

Heavy Tube Mill Work

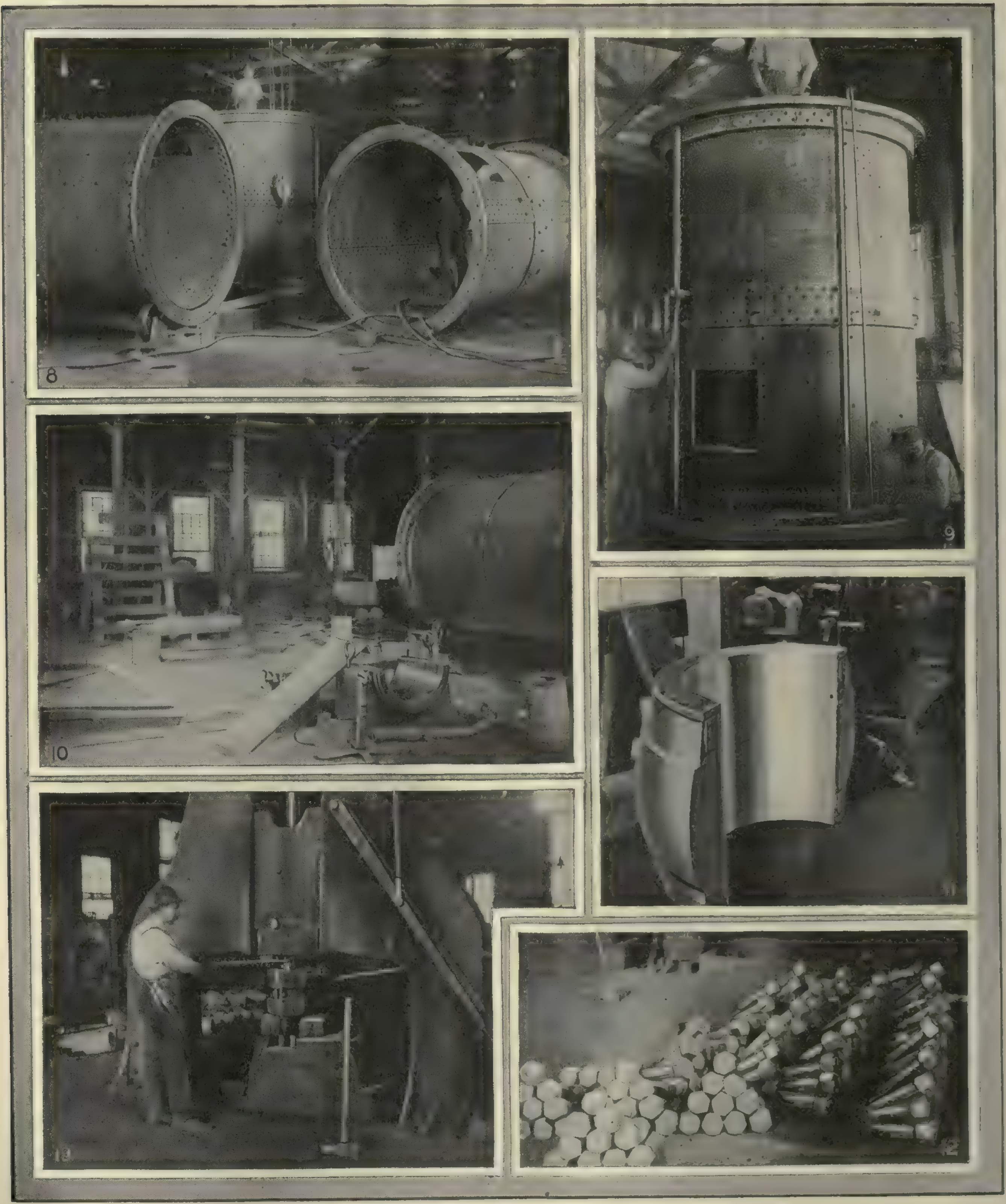
One heavy line of mining apparatus built by the firm is represented by the tube mill drawing reproduced in Fig. 7. This sectional view shows the cylindrical shell of the mill built up in two separate lengths, which are joined at the middle by a wide steel band riveted in place. The complete cylinder is very heavy, and it is rotated in operation upon big journals carried in swiveling and self-aligning bearings.

The points of especial interest to readers of this journal are the methods in erecting the two parts of the cylinder so that they will run true when mounted on their bearings, and the construction of the bearings themselves.

The cylinder shell is made up of ¾-in. plate, and each of the sections 5 ft. long has a cast-steel flange at the outer end for mounting the cast-iron heads. Owing to the length and weight of the mill it is important that the two flange joint faces should be perfectly true and parallel with each other, otherwise when in operation with a heavy load of material the whole apparatus would tend to run out of true more and more until eventually it would become seriously distorted. Trouble of this nature is avoided by making the end flanges and heads accurately to begin with.

Given a lathe of sufficient capacity, the easiest method of handling the job would seem to be to swing the whole cylinder on a special mandrel or drum, and face the flanges for the heads at one setting to insure parallelism. The length in this case made this process impracticable, and so it was decided to make the shell in two separate lengths and join them by the central band shown. Each flange was thus machined independently of the other, and an interesting method then employed for erecting the whole cylinder so that the flange faces should be parallel. In Fig. 8 are shown several of these tube mill shells in process of erection, and Fig. 9 illustrates the method of getting the ends square and parallel with each other. It should be noted that the inner faces of the flanges are machined at the same time as the outer surfaces, and this enables the work to be conveniently tested with gages during the erecting process.

In putting the two sections of the shell together, one end is placed upright with its flange resting on blocks on the floor and the joining band for the middle of the shell is put in place and held by a few bolts spaced at convenient points around the series of holes in shell and band. The other half of the shell is then placed in position as in Fig. 9 with its flange resting on a set of vertical spacing struts made to the right length required for the distance between the inner faces of the two flanges. A few retaining bolts are put through the band and the upper shell, and then with a long taper bar, which will enter the holes and allow the workmen to adjust the upper shell slightly, the work is ready for gaging and fastening rigidly together.



FIGS. 8 TO 13. METHODS USED IN VARIOUS KINDS OF WORK

Fig. 8—Tube-mill shells under erection. Fig. 9—Testing accuracy of flange setting. Fig. 10—Shell about ready for rolling into its bearings. Fig. 11—A big bearing with spherical seat for self-aligning. Fig. 12—A lot of big bolt work. Fig. 13—Heading the bolts under the steam hammer

The gage is applied as in Fig. 9. It consists of a light, but stiff rod bent at the top as shown to form a point to rest on the upper face of the top flange, while at the lower end there is an adjustable contact point to touch the upper face of the lower flange. The gage thus hangs like a pendulum from the top so that the workman below can swing its lower point across the flange with a light touch of the fingers. The gage is applied at numerous points around the circumference of the work, and the upper portion of the shell accordingly adjusted by the taper bars referred to, and secured by bolts fitting tight through certain holes. After the testing process has shown the flanged ends to be properly fixed in reference to each other enough rivets are fitted tight in place, and riveted over to hold the sections securely together, and the work is then placed in horizontal position on the cradle rolls, Fig. 8, for the completion of the riveting operation.

In Fig. 10 is represented one of the assembled cylinders with the work of riveting approaching completion. After this operation the cylinder is ready for the mounting of the driving gear, and the bolting on of the heads. The gear ring is a heavy piece of work by itself, as it has a 14-in. face, a pitch diameter of 117 in. and teeth of 4-in. pitch. This gear is a semi-steel casting. The assembled cylinder is run on its own trunnion journals before shipping by rolling it up on the blocks shown in Fig. 10 and lowering it into the pillow blocks. From this point the work is readily rolled up the inclined tracks at the back of the blocks to the shipping platform which in this case happens to be located just outside the building.

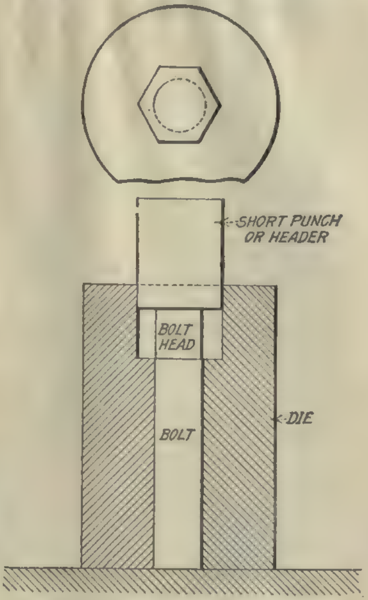


FIG. 14. THE HEADING DIE

The big bearings for these tube mills have already been mentioned as of the self-aligning type. They are of such unusual size as compared with the general run of work of this kind that a brief description should be worth while. One of the bearings is shown in Fig. 11, where its size in comparison with the wood horse, and the milling machine, at the rear is well brought out. This view also shows the spherical external surface, which has to be machined to correspond to the curvature of the seat, upon which it is carried when in operative position.

The diameter of the babbitt bearing in this box is 24 in., and the length of bearing is also 24 in. The distance from the center line to the spherical seat is 18 in. The machining of this spherical surface is accomplished in the big lathe with the aid of a special radius bar, which controls the in-and-out movement of the tool slide on the carriage, while the latter is fed along the shears in the usual manner. A similar process is followed in boring the corresponding seats in the blocks upon which the bearings are carried when in service.

Fig. 12 shows a large number of special bolts, which were made under the big hammer, as there was no heading machine in the shop powerful enough for the work. These bolts are 2½ in. diameter by 8 or 10 in. long under the head. The method of heading under the steam hammer is shown in Figs. 13 and 14, and gives a detail of the die for the work.

The die is a round steel block bored to allow the body of the bolt to pass through; the upper end of the hole being hexagonal to form the bolt head. The die is held under the hammer by a clamp rod, which is supported in such manner that a helper can readily turn the die bottom side up by a twist of the rod. When the hot bolt blank is placed in the die the smith holds a short hexagonal block or punch on top of the work as seen in Fig. 13, and a few blows then drive the hot metal into the die opening to form the hexagonal head. The helper then rolls the die over bottom up, and the blacksmith holds a short plug against the bolt end so that a blow of the hammer ejects the work. The die is then reversed again to bring it right end up for the heading of the next bolt.

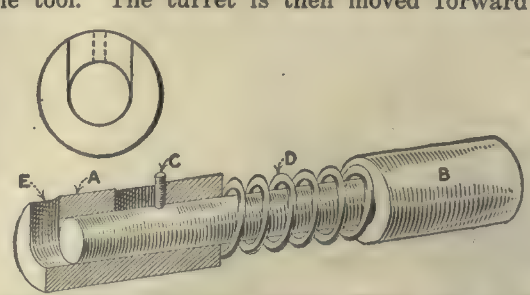
Tool for Removing Burrs from Jam Nuts

BY F. S. CULVER

Recently a batch of ⅜-in. jam nuts that had been produced on an automatic screw machine had such a burr on one side that it interfered greatly with the assembly of the apparatus of which they formed a part. It was decided to remove this burr with the hand screw machine, and the little tool shown was designed, which helped to do the trick.

The tool consists of three essential parts, a slotted sliding collar *A*, fitted to slide on the stem of the stud *B*, being held in normal position against the stop pin *C* by the spring *D*.

The tool is carried in one station of the turret and a suitable countersink in the other. The purpose of the tool is to place the jam nut in the collet while the machine is running. This is accomplished by first placing the jam nut in the slot *E* at the forward end of the tool. The turret is then moved forward until the collar comes into contact with the collet and the continued forward movement of the turret permits the stem of the stud to press the jam nut into the collet which is next quickly closed.



TOOL FOR REMOVING BURRS FROM JAM NUTS

A stationary rod is secured inside of the spindle to prevent the jam nut entering too far. The countersink is next moved up and the burr removed. The rod also acts as an ejector, for the moment the collet is released the jam nut is ejected. With this equipment a girl can burr about seven hundred nuts per hour.

Cutting Off Rings in Hand Screw Machines

By H. James

Making fuse rings in the quantities that have been demanded has developed several methods which have greatly accelerated the manufacture of these parts. In one shop the rings are cut off on hand screw machines, chucked on a New Britain semi-automatic, which faces one side and bores the ring out to size.

The facing operation requires a relatively wide cut. Consequently, if too much metal is left on the thickness, the rings will slip in the chucks, even though these are serrated. The thickness of the rings is not above $\frac{5}{8}$ in.; and as they must project beyond the face of the chucks, there is not much gripping area, which is in a measure responsible for some of the trouble experienced when the thickness varies.

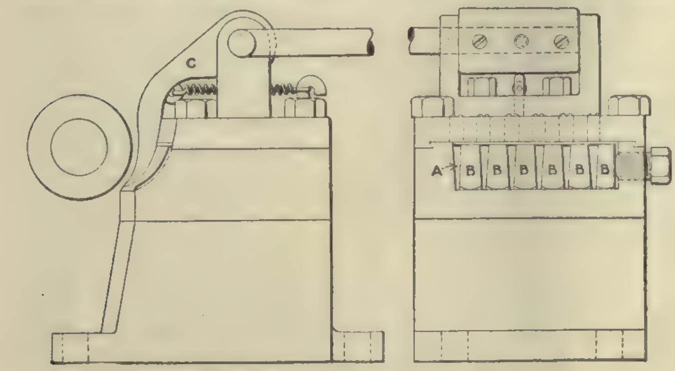


FIG. 1. GANG-TOOL BLOCK

The rings must be of uniform thickness, and they must be produced in quantities. Good hand screw machines are hard to get, so those which are available have to produce. The available ones in our shop were manufactured by Warner & Swasey. First, the turret feed handles were made about 4 ft. in diameter to facilitate drilling, the drill size being $1\frac{3}{32}$ in. Next, the crossfeed handle was made 16 in. in diameter, and gang cutters were used. Four top rings are cut off at a time, and five bottom rings. The cutting edges of the tools are set one a little behind the other, that when the first tool has cut through the ring, the last tool may just be starting. In this way the operator is not unduly tired.

On account of the hole being drilled first, it was found that a burr occurred in cutting off. This burr interfered with piling on trays, and it was necessary to eliminate it, which was accomplished by grinding the cutting edge of the tool at an angle of 5 deg. from parallel with the axis of the bar. The tools are separated with distance pieces *B*, Fig. 1, which are made exact to size and hardened. It was found that the rings, when cut off, would stick between the tools, so it was arranged to supply a kick-out *C*. In feeding the bars, stock would be cut up so quickly that the operator lost a lot of time adjusting the collar on the customary rack-feed arrangement. Consequently, it was decided to adopt a different arrangement, as shown, which proved satisfactory.

In Fig. 2 is illustrated a ball-bearing cap that must be put over the end of the bars. This is accomplished by affixing handles. As it is necessary to have an inspector in the vicinity, it is always possible for the operator to get assistance when needed to pull the weight up. Only 75 lb. is required; and when the bar sticks, the operator just pulls the rope and lets it go suddenly, which jars the bar. A turret stock stop was used, but the operator was required to make too many revolutions of the crossfeed handle in order to clear when using the turret feed. Therefore it was decided to mount the stop on the back end of the cross-slide, that, as the cutters were backed out, the stop might come into place ready for use. On account of the stock coming up fast and the stop necessarily being high up from the lathe bed, there was too great a turning movement for so narrow a slide, and a wider one had to be built.

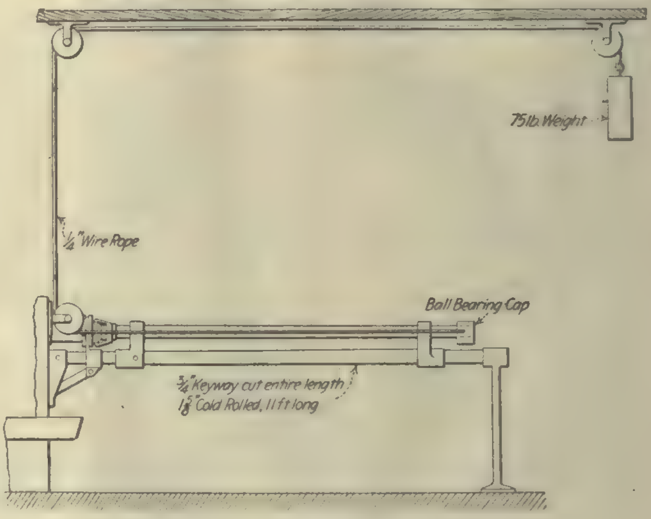


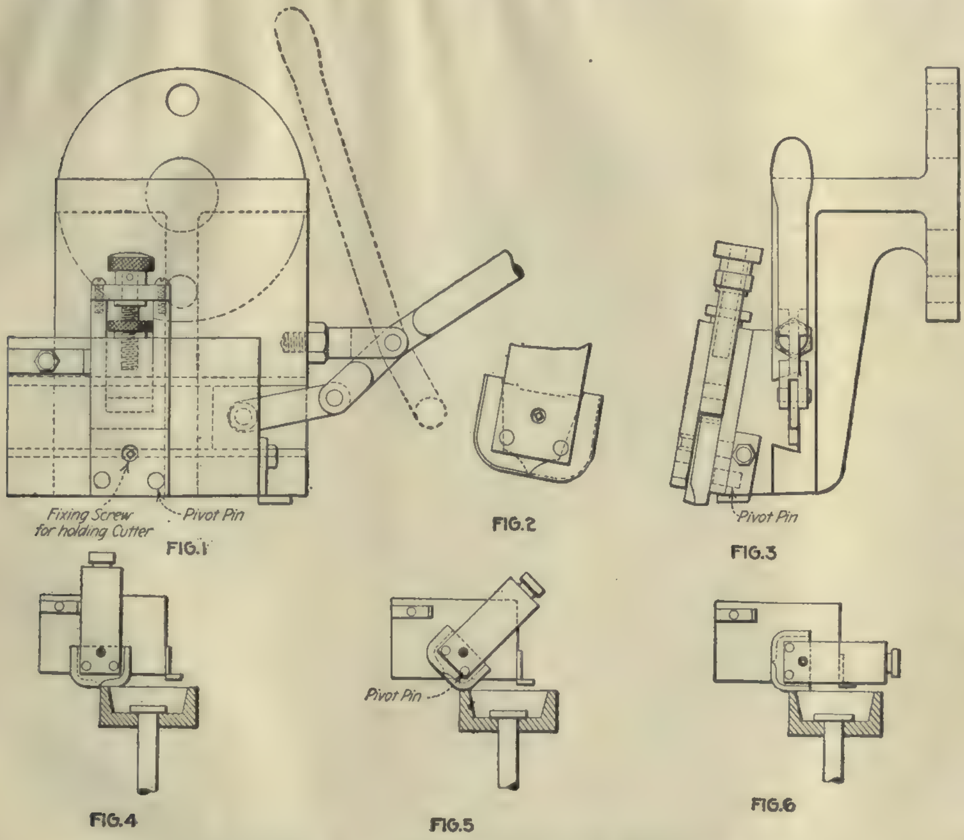
FIG. 2. WEIGHTED-BAR FEED

The tools at first gave trouble, as they would become dull and cut all sizes of rings, and it was very difficult to get hardened beveled stock. High-speed steel was at first used, but it was found that a special carbon steel, Atlas XXX, gave beter results and was considerably less expensive. To harden this stock, two cast-iron plates were employed. The steel was heated to the correct temperature; and instead of quenching, the stock was placed between these plates and allowed to cool. It was found that by this method it was possible to use every tool, as the warpage was very slight. An operator can cut off and drill 2800 rings per day when using these methods and when there are duplicate toolposts and spare drills ready to be put into place.

Radius Grinding Fixture

By A. A. O'Neel

The illustration shows a grinding fixture for forming cutters for British 18-lb. high-explosive shells. I designed and built this fixture a short time ago when I was with the Canada Western Manufacturing and Supply Co., at Medicine Hat, Alta. The results were so good that I decided to send in this description. It may help someone else who is having the same trouble we had before making the fixture.



FIGS. 1 TO 6. RADIUS-GRINDING FIXTURE

We had been grinding our cutters by hand and could not get them uniform. We also had trouble in getting smooth walls and radius in the bottom of the shell. The fixture gave us a good smooth bore, a good radius and bottom, and our cutters were all uniform and interchangeable, so that our production was increased about 35 per cent. The Government examiners sent samples of our shells to different shops as models for them to work to.

Fig. 1 is a top view of a fixture that can be fitted to any grinding machine. Fig. 2 shows the formed cutter, which is of flat ⅜-in. stock, 1⅜ in. long and 1.885 in. in width. The holder for the cutter is provided with a ⅜-in. slot, as in Fig. 3. The cutter is held in place by an Allen setscrew and located by a notch. The holder has two ¼-in. holes located from the center so as to give ½-in. radius when the cutter is 1.885 in. in width. The cutter is put in the holder; then the holder is placed on the locating pin in the fixture and worked in three different positions, as shown in Figs. 4, 5 and 6, giving us the bottoming edge, radius and wall cutting surface in one setting. Then the cutter holder is lifted off the locating pin and turned over. The positions 4, 5 and 6 are ground on the reverse side of the cutter. Thus we grind the cutter on all six cutting surfaces while it is held in one location in the holder.

Conservation vs. Efficiency

By John Bailey

It has always been the writer's idea, and I suppose the idea of ninety-nine out of a hundred other persons, that conservation and efficiency are synonymous as applied to industrial plants. A few examples which have recently come to the attention of the writer, have now lead him to think otherwise. One of the cases that comes to mind is metal wheelbarrows. In the plant in mind there are not a great many of these in use, and when some part breaks it is found cheaper to buy a new barrow than to repair the old one. Were there more in use, it would undoubtedly pay to repair them, but a man assigned to repair a single barrow will waste so much time thinking about starting and in puttering around that repairing is not a paying proposition. Efficiency in this case counsels, buy a new one; conservation would repair the old. Another case where a difference in these word meanings is illustrated is in the separation of oil from chips. The plant did not have a great many oily chips, but a man with a small separator was employed to take care of what there were. Careful calculation showed that the man's wages were about twice the value of the oil he recovered. Conservation all right, but not efficiency! Had the amount of chips been great enough to warrant the purchase of a goodly sized separator, the case, of course, would have been entirely different.

Another instance which illustrates this point is that of separating coke or coal from the ashes of a boiler plant. In one case of a stoker-driven boiler, it was noticed there was considerable coal burned to coke, pulled out when cleaning fires. A laborer getting $2.50 per day was put to work picking out the coke and got about 400 lb. per day. This, of course, did not pay his wages and the work was stopped; yet, when we think of the present shortage of coal it seems a pity to let even this amount go to waste.

A plant in the same vicinity has a man pick over the ashes and records the weight of coal recovered during each shift. This has a good effect on the fireman, and while the picker does not earn his wages in coal recovered, he earns them indirectly in the coal saved by more care on the part of the fireman.

There are doubtless many instances much more important than the trivial ones mentioned, and it would seem that in these times of shortage of materials, it might be loyal to sacrifice efficiency if necessary, for the sake of conservation.

Draw Tools for Automobile Side-Rails

By P. Baldus

A common form of automobile side-rail or bar, is shown in Fig. 1. The side-rail is completed in two operations—the blanking and the drawing operation. Special draw tools are generally required for the manufacture of the side rails. These tools, which are indicated in detail in Fig. 2, are being operated in a heavy Toledo drawing press provided with a knock-out arrangement. Referring to Fig. 2, it will be seen that the draw tools proper are assembled in a cast-iron die shoe *A*, which is bolted to the bolster plate of the drawing press. To the back of the die shoe are fastened securely, by means of the 1-in. hexagon-head screws *B*, the cast-iron back die walls *C*, *D* and *E*. The front die walls *F*, *G* and *H* are also made of cast iron and fastened with the cast-steel clamps *I* and the screws *J*. The front as well as the back die walls are well ribbed to withstand the pressure to which they are subjected.

Adjustability for the front die walls is necessary and is provided by the use of the 1-in. square-head setscrews *K*, which are locked by the hexagon locknuts *L*. These setscrews are spaced evenly along the die shoe about 2 in. apart. The location and the number of setscrews are determined by the shape of the front die walls and the drawing pressure. Cast steel is used for the punch sections *M*, *N* and *O*, which are lined up with keys as indicated at *P*. The front and rear parts of the punch sections are generally made solid, whereas the punch center section is usually made adjustable.

Such an adjustable punch center section is illustrated in Fig. 3. It consists of a punch holder *S*, the punch lining *T* and the shim *U*. All these parts are made of machine steel and screwed together with the filister-head screws *V*. It is evident that this style of construction enables the manufacturer to use the punch for many different side rails by merely changing the shim *U* so that it will fit the new rail. The knock-out *Q*, Fig. 2, is made of machine steel and operated by knock-out rods.

When drawing the metal across the edges of the die, the thickness of the metal makes a considerable difference in the size of the radius that can be used to advantage. The diagram and the table shown in Fig. 4 give the proper draw-edge radius for the various thicknesses of stock in common use. The radius of the punch is also important, and it is desirable to make the working edge *Y* of the punch equal to the thickness of the stock used.

Fig. 5 indicates the rear end of a side rail giving two formulas to determine the proper dimensions between the two radii and the kick-up. One formula gives the dimensions for *W* if the radii are alike, and the other gives the dimensions for *W* if the radii are different.

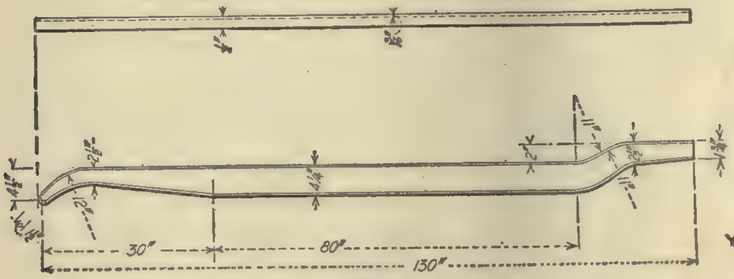


FIG. 1
Side Rail

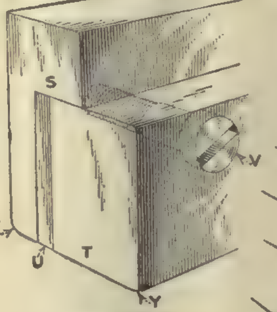


FIG. 3
Adjustable Punch Section

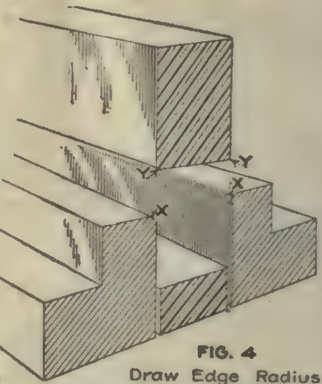


FIG. 4
Draw Edge Radius

DRAW EDGES FOR SIDE RAILS AND CROSS-BAR DIES	
Thickness of Stock	Radius "X" of Die Walls
1/8"	1/4"
5/32"	3/8"
3/16" and over	1/2"

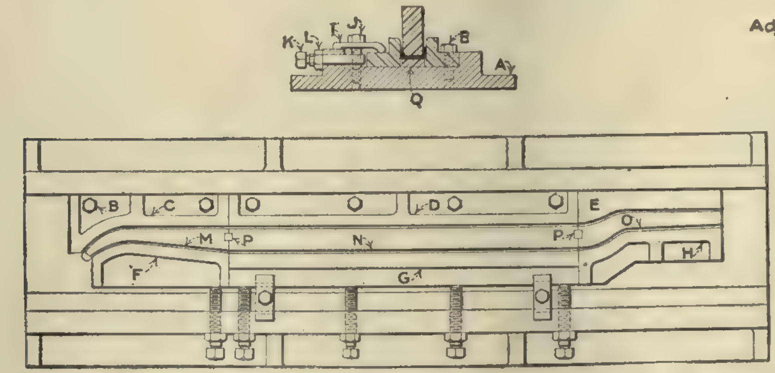


FIG. 2
Drawing Tools

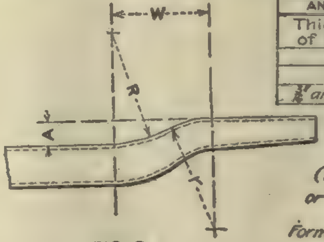


FIG. 5
Rear-End Radius Formula

Formula One if Both Radii are alike

$$(2R)^2 - (2R-A)^2 = W^2$$
$$\text{or} \quad W = \sqrt{4RA - A^2}$$

Formula Two if Both Radii are Different

$$(R+r)^2 = W^2 + (R+r-A)^2$$
$$\text{or} \quad W = \sqrt{(R+r)^2 - (R+r-A)^2}$$

FIGS. 1 TO 5. THE WORK AND SOME TOOLS USED IN PRODUCING IT

Problems that Confront Us

SPECIAL CORRESPONDENCE

These problems were outlined by various officials at the second editorial conference recently held in Washington. They are of great importance and worthy of attention at this time.

THE second editorial conference of business papers was held in Washington, Thursday, Dec. 13, 1917, and was the means of bringing out much valuable and helpful information from both Government officials and those who are endeavoring to keep things running smoothly during the present crisis. The conference was well attended, particularly when the inclement weather and the belated train schedules are considered, and that some of the editors came from Chicago and other distant points.

THE TARIFF COMMISSION

Mr. F. W. Taussig, chairman of the U. S. Tariff Board, was the first speaker, and began by disavowing all claim or intention of really settling the tariff question, which as he pointed out, is a matter for Congress, under the influence or the pressure of public opinion. His committee is a subordinate body formed to aid in the careful consideration of all tariff measures, to gather information which may be of service in the framing of suitable legislation, and to submit this to Congress, after having sifted the wheat from the chaff.

A tariff information catalog is being prepared to record pertinent information in regard to every article on the tariff list and comprises about 3000 articles; there is to be an auxiliary file which will be even more complete. The commission as such has no opinions in regard to tariff policy, although its individual members may have their own ideas as to what should be done. Anything which we can do to encourage this commission, as well as to aid it in securing correct information, is a step in the right direction and will be appreciated by the members of the board.

It is interesting to note that this board is well advanced with a revision of the administration of the tariff laws. They are endeavoring to express the acts of Congress in workable language, which is always an aid in securing prompt action and preventing misunderstanding. Technical papers are always welcome at the hearings, and can give valuable aid to the committee.

THE RED CROSS

A brief history of the Red Cross was given by Mr. Elliott Wadsworth, beginning with its organization at Geneva, Switzerland, in 1865, and agreed to by all countries. Rusia and Germany both took it under government protection, the former appropriating a certain percentage of the railway receipts for its maintenance. It was also very close to the government in Germany. Japan, however, according to Mr. Wadsworth, had possibly the best organization in the world. The American Red Cross added civilian relief to its work, and as is well known, has been very active in cases of relieving distress caused by calamities of fire and flood.

During the present war the number of chapters in this country have increased from 250 to 3200, and the membership from 278,000 to over one-half million. The country is now divided into 13 divisions in the efforts to decentralize the work and so secure close coöperation in the various sections. The staff was increased from almost nothing to 800 last July, but the decentralization has now reduced this force to four hundred.

The new organization has a man in every camp and cantonment to add to the comfort and health of the troopers. The knitting which has been, and is being done is adding materially to the comfort of both army and navy; but in addition to the garments knitted, the Rer Cross has bought over 550,000 sweaters.

Major Murphy, one of the War Council, has gone to France to look after and prevent the spread of tuberculosis in the families of the French soldiers. They are paying particular attention to children in the shelled area, taking them to other and safer localities where it is no longer necessary to wear a gas mask. These refugees sometimes number 500 per day, and have to be fed, examined, and clothed. In many cases it is the first time in three years that they have received proper attention in any of these directions. Major Murphy now has over 2000 ambulances and has appropriated $22,000,000 for France alone.

Russia and Roumania are also getting help in the belief that both countries will eventually right themselves. Millions of cans of condensed milk have been sent to those countries, in some cases under extreme difficulties. The Red Cross representative in Roumania went personally to Archangel, 2000 miles away, and finally succeeded in having two trains of supplies, of 28 cars each, brought through all the congestion of Russia to the Red Cross headquarters in Roumania. These condensed milk cans are doing excellent propaganda by means of special labels, which have been placed on them. These labels, in addition to having the flag of the country, as well as the American flag, also contain interesting facts as to the aims of the United States, and the work that is being done for the suffering countries.

One item of great expense was the replacing of hospital equipment lost by the Italians during their retreat. This loss amounted to 86 hospitals containing 46,000 beds. Ambulances, surgical dressings, American drivers and attendants were immediately sent to Italy from Paris, in this way making good some of the losses with the least possible delay. The present aim of the Red Cross is to secure 20,000,000 members.

THE COAL SITUATION

The very serious problem of fuel was discussed by both Dr. Harry A. Garfield, the Fuel Administrator, and Mr. Morrow, the secretary of the bituminous operators. The administration of fuel control is done through state, county, and municipal officers who have power in their own localities. These are all coördinated under the Federal head, as the problem of fuel is a national, and not a local problem.

The three factors governing the fuel situation are, the operators, the miners, and the railroads, all of which must work in harmony if coal production and distribution is to be secured.

Dr. Garfield pointed out that the main thing was the production of coal, and that everything else must be adjusted to this end; that nothing must interfere. This, incidentally, also applies to all essential products which have to do with this war. Dr. Garfield also stated that labor had caught this idea, and that a utilitarian spirit was now shared by the people, and will abide with them. He pointed out that all failures to handle the situation in a way to meet the exigencies of the time were due to the radical element which cropped out in every walk of life; that while radicalism has its good points, an emergency like this demands the middle road, and the extremes must be made to meet.

The present production of anthracite is from 20 to 22 per cent. more than last year, with 25,000 less men and boys at work in the coal fields—a condition which reflects credit on both our management and spirit. He deprecated the selfishness of both housholders and factories in overstocking themselves with coal. He pointed out that the waterways are not doing their full share of the carrying traffic, largely because of past habits and the fact that they have not sufficient equipment with which to meet the demands upon them. It must not be forgotten, however, that transportation by water is more expensive than formerly, owing to the increase in wages and all material entering into carrying and upkeep. Arrangements have been made to supply the Atlantic coast towns by means of ships and barges, tugs being supplied in some cases by different branches of the service which could spare them.

Means for Assisting Distribution

Dr. Garfield outlined some of the means which had been used to assist distribution, such as the Ohio pool, which is a terminal pool, designed to relieve the congestion of cars in terminal ports, and although this has not worked out perfectly, as was indicated by the recent coal shortage in a number of important cities, it did relieve the congestion to some extent and will probably be more helpful in the future.

When asked concerning the relation of price to the production of coal, it was pointed out that the production increased after the price had been fixed at a lower rate, and that production was greater than the previous year.

As viewed by Mr. Morrow of the bituminous operators, the biggest difficulty in the coal situation can be traced to transportation, which, at the time of his address, was hourly growing worse. This he attributed largely to the manner in which the railroads have habitually handled the coal situation, and that the shortage is due neither to the operatives nor the miners. When people are in danger of freezing to death within forty or fifty miles of a mine, when factories cannot run because coal is not supplied to them, it is a serious situation, and Mr. Morrow pointed to the railroad tradition of supplying cars for every other kind of freight, and of moving everything else, ahead of coal.

He also attributed much of the delay to the issuance of priority orders which place railroad fuel first on the list, coal for byproducts next, followed by munition plants approved by the War Department, munitions for the Allies, coal for ordinary industries, and finally coal for domestic use.

Mr. Morrow read telegrams from various mining centers showing that mines had to be closed two and three days per week because no cars were supplied for hauling the coal to its destination. One reason for this shortage of cars is attributed to the failure to move coal after it was loaded, which in effect tied up thousands of coal cars in yards, and on sidings. He advocated an order to move at once all coal which was loaded, and to give preference to the coal movement for thirty days.

War-Saving Certificates

Mr. Frederick A. Delano of the Federal Reserve Board explained the workings of the war-saving certificates which are in effect, small bonds on which the interest is permitted to accumulate, becoming payable Jan. 1, 1923. The object of issuing these certificates is of course to interest the people who cannot afford to invest in the regular bonds. The advantage and necessity of doing this is made clear when we realize that all the bonds issued have been purchased by less than ten million people, leaving ninety-five million, including men, women and children, as possible purchasers of the war-saving certificates.

Mr. Delano pointed out that this was a modification of the English plan which allows the certificates to mature in five years from the date of purchase, whereas our certificates all mature at the same time. One objcet of this is to induce reinvestment in a larger bond at the expiration of the five years, in the belief that purchasers of these certificates will accumulate a number of them before they mature.

It is thought probable that the Government will offer cash, bonds or annuity, when these certificates mature, the two latter methods being preferred as it maintains for certificate holders a direct interest in the finances of the Government, and that is highly desirable. This Federal credit is along the lines of French practice, which resulted at the outbreak of the war in six million holders of annuities out of a population of thirty-five million. The details that belong to the issuance of these certificates have been so widely published that they are probably fully understood by all our readers.

Interstate Commerce Commission

The Hon. Francis G. Newlands of the Interstate Commerce Commision gave an outline of the development of railroad control, and pointed out that the abuses of the past were responsible for the present antagonistic attitude on the part of much of the public. It is his belief that nearly all these abuses have been corrected and that an era of constructiveness has come. This necessitates public credit in some form, as the reduction of expenditures in the name of economy has demanded an initial cost of several billion dollars—which will add much to the cost of the war and of living expenses. The necessary capital must in all probability be supplied by the Government, as the Liberty Loan monopolizes investments at the present time.

In Mr. Newland's opinion there is an urgent need, during the war and after, to coördinate transportation by rail and water. River transportation has been sadly neglected and should be greatly developed by the building of inter-communicating canals such as is done in European countries. Even at the present time Austria and Germany are building a canal to connect the head waters of the Rhine and of the Danube, which will give a continuous waterway from the North Sea to the Black Sea.

Our great difficulty has been that although some six hundred million dollars have been spent for waterway improvement, the sum has been expended in a disjointed manner as the result of the spoils system in which selfish interests have prevailed. All development has been local instead of part of a comprehensive plan. The cause of this has to some extent been the desire of Congress to retain the power of appropriations for their own localities, and the opposition of the railways to any competition of this kind.

Mr. Newlands referred briefly to his bill for improving navigation, irrigation and water power as well as the development of swamp lands. This bill carries an expenditure of sixty million dollars a year for a period of ten years under a comprehensive and coördinated plan of national scope. The great difficulty at present is that although much excellent work has been accomplished, it has been done independently by different departments.

SHIPS FOR THE EMERGENCY FLEET

If Mr. E. N. Hurley, Chairman of the Shipping Board, could handle all business and can secure ships with the same expedition as he showed at this conference, there would be no question of having sufficient shipping in the near future. In something like three minutes he mentioned his hesitancy in talking about what was going to be done, and suggested that he be allowed to wait until something had been accomplished, when he would be very glad to come to the conference and tell them all about it. Thanks to the fact of the Shipping Board being a Government institution, there are no dividends to pay and nothing to do but to get ships. The output of every shipyard which is at all efficient has been contracted for and it is his belief that satisfactory progress is being made.

Mr. Horning of the Automotive Section pointed out three important factors in present-day production. The lack of coal cars prevents coal from being shipped to steel mills and factories, which prevents steel being made or fabricated, which in turn delays ships and shipping. He called attention to experiments which are being made with transportation by motor truck, and suggested a schedule somewhat as follows: Let the railroads cut out all transportation of material for a shorter distance than ten miles for one month; the next month extend this to twenty miles and the third month to thirty miles. By relieving these short hauls, much of the cause of delay from loading and unloading will be eliminated, and in this way a very considerable tonnage can be hauled by motor trucks, as is being done in England.

PRICE-FIXING

The Hon. Atlee Pomerene took up the question of price-fixing and showed how it had been made necessary by a desire for unreasonable profits on the part of some dealers and manufacturers. He outlined several of the extraordinary increases, as in the case of coal, steel, coke and pig iron and pointed out that the interest of the country as a whole must always be kept paramount to those of any individual or set of business men. He gave specific instances of coal contracts having been broken at the original price, on the pretense of coal shortage, and afterward renewed at a greatly advanced price.

He pointed out how all of these things had a direct relation to our boys in France, and that nothing must be allowed to interfere with their welfare, progress and protection. He contended that Government control was absolutely necessary because these abnormal times developed abnormal individuals as well as extreme patriots. A day of reckoning is sure to come—at the end of the war if not before—and blind and unintelligent selfishness are sure to meet their Waterloo. This selfishness is not confined to any class or to any locality, some of his own constituents being among the profiteers who must be curbed.

EXCESS-PROFITS TAX

Mr. Dan C. Roper of the Internal Revenue, outlined briefly the workings of the new internal revenue taxes, including income and excess-profits tax. A large portion of our fighting funds must be raised in this way, our liberty and those of our allies depending upon it. The reduction in the taxable limit adds about six million new taxpayers this year, as it will include many workers in munition and other shops.

There is evidently a careful attempt to interpret the operation of the bill so as to be fair to partnerships and individuals, as well as to corporations. Every effort will be made to have all desirable information available, so as to make compliance with the law an easy matter. Some taxpayers are bound to be displeased, but war imposes sacrifices on us all and they must be met as cheerfully as possible.

COMMERCIAL ECONOMY BOARD

Mr. A. W. Shaw, chairman of the Commercial Economy Board expressed the desire to secure the understanding and coöperation of all business papers. The function of his Board is to bring about a readjustment of his business so as to release both men and capital, to give priority of fighters over civilians. The curtailing of nonessential industries is being considered but has not yet been accomplished. Many changes have been made, however, in improving business either by introducing new methods or new machinery which release men for active war service.

Cutting out unnecessary deliveries of merchandise, installing coöperative delivery systems in small towns and preventing unnecessary returns in merchandise, has resulted in a large saving. It is the desire of this committee to have this saving passed on to the consumer in the shape of reduced prices, although this is not always done.

The work of this committee also reduces shipping of material, and by affecting the design of clothing so as to secure economy of cutting and a standardization of patterns, a saving of forty-two per cent. has been effected in army work. When it is realized that the army formerly used thirteen times as much material per individual as it uses now, this becomes more significant.

By coöperating with tailors and clothing manufacturers and reducing the size of samples, there has been a definite saving of one-and-a-half million yards of cloth, or enough to make uniforms for seven hundred thousand soldiers. Unnecessary use of cloth in the cuffs of men's trousers, in belts and other unnecessary parts has secured a coresponding economy. Their efforts have not been confined to any one branch of industry but have gone for example, to the makers of plows, and has resulted in the elimination of the left-handed plow, which has long been manufactured. The shades of paint have been reduced from over one hundred to less than forty, and the same careful attention has been extended to the containers in which the paints are carried. All these things tie up less capital and make more material and men available for war purposes.

WOMEN IN INDUSTRY

This important topic was handled in a masterly fashion by Dr. Anna Howard Shaw, Chairman of the Woman's Committee of the Council of National Defense, better known for her work for suffrage for women. Immediately on entering the war the importance of woman's work was recognized, and America has profited by the experience of Great Britain, where it became necessary for fifty thousand women to march on Parliament and demand work for their government. The object of the Woman's Committee is to coördinate all women's societies in war work, so as to prevent duplication, and to divide work among the different women's organizations which number over one thousand.

Dr. Shaw deprecated the natural desire of women to do unusual and spectacular work, and urged that periodicals impress upon manufacturers that it is not the spectacular work which counts most in a crisis like this. It is not a question of what woman can do, but what will be of most service to the country. She pointed out the need for college women to do not only stenography but drafting and other technical work, and at the same time the failure of many institutions of learning to provide such courses for women. All colleges should teach the subjects needed; while the question of housing women workers who are called to Washington and other points, is of vital importance.

The maintaining of existing charitable societies is absolutely necessary to prevent degeneracy in many lines and we can avoid the mistakes of England and other countries by organized effort in this direction. The shortening of the school year is a very harmful suggestion as it is absolutely necessary to uphold our intellectual standards not only for the present but after the war. The suggestion of putting school truants at work has much to condemn it, and nothing in its favor.

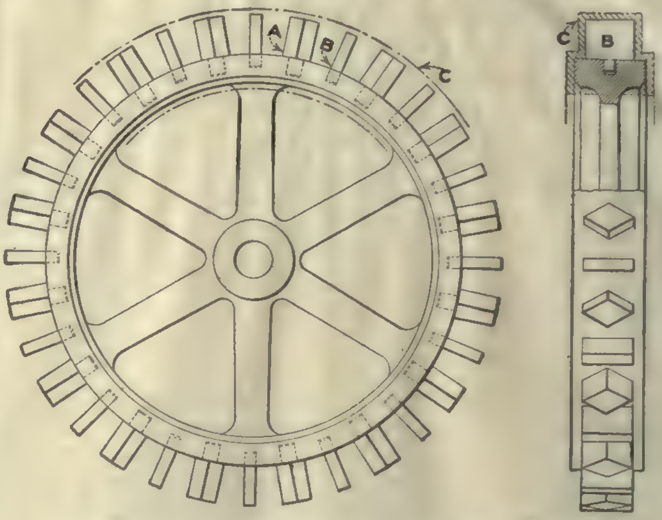
Great care should be taken to train women along the lines of service needed. They should be taught conservation, the Americanization of children, health and recreation. All the social agencies must be preserved as the future of the country depends upon it. There is the same right to conscript women as men, but they must not be neglected either in industry or in any other line in which they may be called to serve.

Temporary Babbitt Supporting Ring

BY G. E. MELLEN

In building a large number of machines for manufacturing a product from wood fiber, we ran across several difficult problems in machining, one of which is herewith described. If we were building one machine, it would not make much difference; but where hundreds enter into the proposition, every moment saved on every part counts, especially where efficiency is aimed at.

The illustration shows a cast-iron wheel (one of three hundred of various sizes) on the outer circumference of which are mounted flat steel radial leaves *B* between which diamond-shaped steel beaters *A* are placed. Leaves and beaters are driven into reamed holes. The wheel revolves at a high velocity in a housing having tongues that register with the leaves and beaters, and the clearance sidewise and circumferentially is very small, necessitating the truing up of leaves and beaters after assembling.



BABBITT RING HOLDS WORK TO BE TURNED

The proposition looks simple, but we found that truing up by hand with hammer and file was expensive and unsatisfactory. Realizing that the only efficient method was by turning in the lathe or boring mill (a skim or truing cut), we made forms and cast a ring of babbitt metal *C* around the circumference, completely shrouding the wheel rim and projections. This held the parts *A* and *B* perfectly rigid and free from chatter while turning. The babbitt was afterward knocked or melted off, and a perfectly true and effective job was accomplished.

Why Our Issues Are Sometimes Late

War is no respecter of persons. Uncle Sam himself is not exempt from its inconveniences. This, in a word, accounts for the slow and irregluar deliveries of issues of the *American Machinist*, concerning which some of our readers have written us. Upon making a careful investigation into the causes for these complaints, we find that they are traceable to the unprecedented congestion of the mails due in part to the war program of curtailing train schedules, but mostly to the reduction of the post office force on account of many thousands of postal clerks going into military service. The post office authorities assure us that no stone will be left unturned to get back to normal service at as early a date as possible. Meanwhile, until the necessary readjustments in service are made and new clerks are trained to take the place of the enlisted men, will you not be a little patient? We are helping Uncle Sam all we can to deliver your papers on time.

Editorials

Difficult Manufacturing Conditions

THE demand for machine tools at the present time is unpdecedented, and exceeds that existing under normal conditions about ten to one. Large planing machines, large vertical and horizontal boring mills, and large slotting and grinding machines are not to be had, and deliveries of any character whatever on these machines will not be promised or even approximated. It is also practically impossible to buy a second-hand machine in the class referred to.

Plate benders, punches, shears, plate rolls, all so essential to ship construction are as scarce as the heavy machine tools, and it is probable that an adequate supply cannot be obtained for many months to come. In the smaller sizes of machine tools deliveries are set from five to seven months ahead, and with all shops running at fullest capacity and working overtime, and in hundreds of instances working double-shift, such a thing as a stock tool is an unknown quantity.

Wherever possible shipments of tools intended for export are commandeered, and placed at the disposal of shops engaged on Government work, but the number of these shipments so taken over is negligible, and has no appreciable effect in relieving present necessities. Plants admirably equipped with the last word in up-to-date machinery, and in every way in a position to turn out Government work expeditiously, and in all respects satisfactorily, after submitting prices to Washington are compelled to wait six or eight weeks, and even longer for a decision. In the meantime, the plants are idle as other work cannot be solicited or estimated, it not being possible to give even a promise that it can be undertaken.

On the other hand, plants producing a product needed to supply the pressing requirements of the establishments operating on Government contracts are given work on certain classes of munitions, while in reality these plants should be devoting their entire time and capacity in turning out their own specialty so urgently needed by those engaged in munitions production.

Complaint is made in numerous quarters that orders have been frequently given to certain concerns for machine-shop equipment, which properly should have gone direct to the manufacturers.

Manufacturers and dealers alike, in view of the enormous demands upon them, are compelled to resort to considerable financing to conduct their operations, and the delay in receiving payment on Government work or goods sold is proving one of considerable embarrassment. As an example: A machine tool may be ordered from one source and promptly delivered; payment becomes due at the end of 30 days, but if the motor which is to operate the tool, and is ordered from another concern, fails to arrive for three or four months payment on the former is withheld pending such arrival and due acceptance. Conditions like these make it very hard to progress satisfactorily.

Using Cripples in Industry

ONE of the problems which are emphasized by the war, is that of training wounded or crippled men for industrial pursuits. It is, unfortunately, equally a problem of peace times, but one which we have too long ignored; and it is one of the many byproducts of the war which will in some small way act as compensation for the great sacrifice, if the problem is solved.

The work of training the man handicapped by mutilation has assumed fairly large proportions in England and Canada, and that we are already at work on the problem is largely due to the persistent efforts of Major Frank B. Gilbreth and his wife, Lillian M. Gilbreth. The training covers a wide range of occupations, depending both on what the man did before and on what he is capable of doing now.

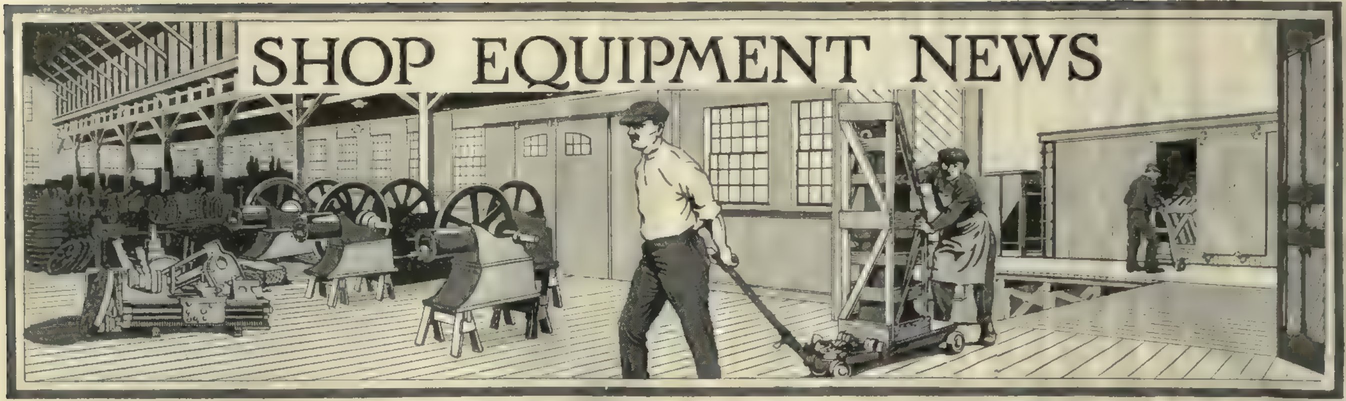
Machine-shop work is being taught in the technical schools, the shop equipment being used and instructors drawn from the shops, and some interesting results have been secured. The Gilbreths, utilizing their motion-picture method of analyzing operations, have worked out ways in which people who have lost most of their appendages can do work—and do it well.

One can hardly overestimate the value of this work for the crippled or for the community as a whole. Its effect on the individual is particularly beneficial as it makes him a useful member of society instead of a burden to relations or friends or the state. The advantages of independence react favorably on his mind and offset the very natural tendency to despondency.

We must not only train these crippled men, victims both of war and of industrial pursuits, but we must educate ourselves to think of them as a part of our industrial army, and not in any way as a special segregated class. We must not look upon either the training or the work as in any sense a charity on our part. Such training belongs in the same category as the training we must give apprentices and others.

We must guard also against the feeling that we are employing the cripple out of the goodness of our hearts instead of because he is useful in our shops and elsewhere. We need the work of such men as much as they need us, and they must be fully paid for the work they do. Any discrimination against them would be a sorry commentary on the patriotism of those for whom these men went to war and became crippled.

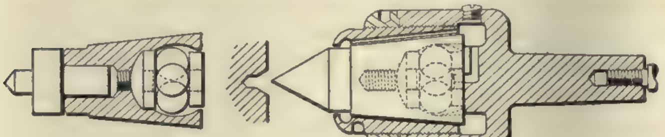
It is our part to provide employment after they are trained, so to arrange our operations that a certain number can be employed. They should not be segregated, but work beside other men wherever possible, as comradeship and sensible competition have the stimulating, wholesome effect of preserving individuality. We have much to learn; perhaps as much as they, since it has become our duty as well as theirs to adjust ourselves to the new order of things. This is one of the many readjustments which must be made after, as well as during the war.



SHOP EQUIPMENT NEWS

Moller Ball-Bearing Centers

In answer to the demand for ball-bearing centers for lathes and other machines, J. A. Moller, 57 Lawton St., Box 242, New Rochelle, N. Y., has placed on the market a line of centers as illustrated. It will be noticed that the revolving center is cone shaped, being held in the body by means of a bushing. The revolving center is supported on a three-ball thrust bearing which tends to distribute the radial stresses on the stem. The stem cap or bushing is provided with oil channels and a drip retainer. It is adjustable in the housing or body and is provided with a lockring. A number of different style points are furnished. The shank and housing are in one piece and are supplied with an extension rod for knockout.



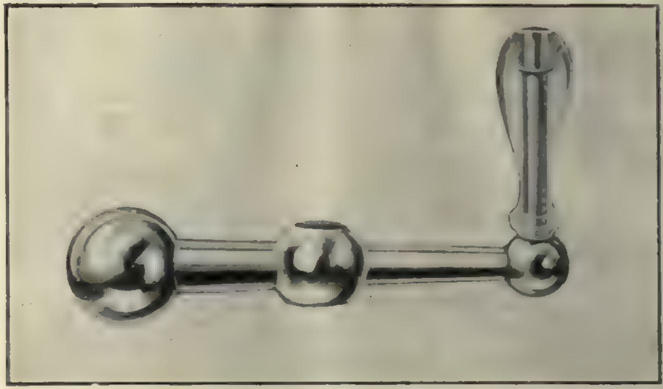
BALL-BEARING MACHINE CENTERS

Bilton Formed Milling Cutters

The Bilton Machine Tool Co., Bridgeport, Conn., is now marketing a considerable line of milling cutters, these being made in both the plain and formed types. The illustration shows a few of the line and includes regular spiral mills, bayonet grooving cutters, cutters for milling teeth in pliers, thread milling cutters for shells, cutters for small pinions, concave cutters and a number of formed cutters for munition work.

Cincinnati Quick-Action Ball Cranks

The Cincinnati Ball Crank Co., Oakley, Cincinnati, Ohio, has recently placed on the market a line of quick-action ball cranks, one of which is illustrated. As shown by this phantom view, the spool or swivel type of handle is used, allowing heavy work to be brought to proper position with a minimum of effort. These cranks are built in various sizes, the largest having an over-all length of 13 in. If desired the handles can be furnished separately for installation on cranks or wheels of machines already built and in everyday use.

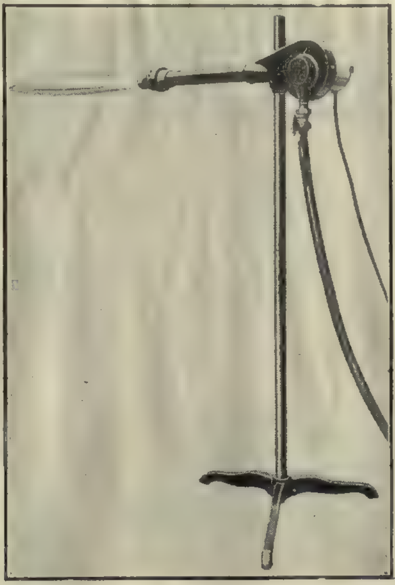


BALL CRANK WITH SWIVEL HANDLE

SOME OF THE MILLING CUTTERS MANUFACTURED BY THE BILTON MACHINE TOOL CO.

Naab "Gaselectric" Torch

The Naab Manufacturing Co., 1384 Hird St., Cleveland, Ohio, is now manufacturing the torch illustrated, which will operate on either natural or manufactured gas. The torch is entirely self-contained, an electric pressure fan being attached directly to the burner in order to eliminate all air leakage. The flame may be adjusted to any length from 3 to 24 in., and the temperatures attained are up to 2500 deg. F. When operating at maximum capacity the gas consumption is 180 cu.ft. per hour, and the electric consumption is 80 watts per hour. A universal-type motor is used, being adapted for either direct or alternating current. The torch can be located at any height or angle on a supporting standard and the complete outfit weighs 23 lb.



SELF-CONTAINED BLOW TORCH

Men Wanted—Who Will Get Ahead

By Entropy

There are two unsatisfied demands now, and always has been. One by men who want to get ahead; the other is the employers who want men who will get ahead. It seems like the simplest thing in the world to bring the two together, yet a study of men who are successful shows that often they seemed to have success forced upon them when they were somewhat reluctant. In other words, ambition is not the only essential to success, in fact, it is not wholly essential.

More successes, if one is to believe the many newspaper interviews with prominent men, have come from the ability to take unexpected jobs and carry them through than from any single other ability. If that is the case, then all-aroundness would appear to be a valuable attribute. All-aroundness, however, may easily make a man a jack-at-all-trades and good at none. Where is the line to be drawn? How can a man discover what the next step ahead is in order that he may prepare for it? In some industries the next step upward is apparent, but oftentimes is dependent on the death or disability of the man sitting on it. He has nothing ahead of him which induces or allows him to get out of the way. The best advice to a man who finds himself waiting for someone to die is to get out and make a fresh start somewhere else. The first thing to do is to get a position with a concern that is growing and where openings do occur, or else one that is stagnated, but has openings, which can be pried open to the good of the *prier* and the *priee.*

The next essential is to have a good vision, so that an opportunity is not lost through low visibility. Visionary dreamers are very essential to progress, but they must be able to wake up, and wake up others or their progress is apt to stop with the dream and let someone else cash in. The two things, vision and ability to work it out, are essential, but to this must be added a certain measure of versatility so that advantage may be taken of differing opportunities which may come.

The old notion that opportunity knocks but once at any man's door is fallacious. Opportunities are knocking all the time. The question is, who will hear them knock? A man working at a planing machine may be ambitious to own the shop. His immediate opportunity may consist in the chance to keep his machine looking neat, and getting his work set up on the machine so that it will not be sprung. This does not resemble owning a shop, but it may be the one step which would start him on his way. Nevertheless, too many of us throw away just such simple opportunities. One of the essentials necessary to get ahead in many lines is executive ability. The ability to get other people to do your work, and do it right. If a man cannot get in on time every morning and keep out of bad company, the chances are he will never be able to get others to do so. It is these little things that often prevent a man from getting that essential start.

Another thing that handicaps many men is the almost absolute certainty that he cannot be "a prophet in his own country." The obvious remedy is to make his reputation in a distant country. It does no harm to move around a little, in fact, it does a great deal of good, both to the one that moves and to those among whom he moves, because both get a broader idea of mankind. If one cannot move himself, he can always get the effect of moving by making a reputation through writing for publication. The man in Kalamazoo, who reads an article by a man from Podunk does not know or care anything regarding the author's antecedents; he reads the article on its merits. If it has merit he makes a mental note that sometime he may want to know the author, and may be one of the numerous readers will want to hire a man with just that kind of knowledge. It is really about the only kind of advertising a man is paid for and gets the results himself.

On the employer's side there is always this same quandary: "Where can I get a man?" The man he wants may be just outside the office door seeking appreciation of his services. He may not have done any self-advertising, yet he may have the ability of a man with a press agent, but unless the employer accidentally stumbles over him there is little chance of his being recognized. There is really no way that goods or labor can be sold without some kind of advertising or salesmanship. It is up to the employee to sell his own labor in a market where self-appraisal has a great deal to do with the purchase price, and where real ability is the only thing that will make the goods stay sold.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Dec. 22, 1917—One of the steps taken recently has been outlined by the Council of National Defense. As is generally known, this council was established to bring about the coördination of industries and resources for the national welfare. The work of the council began before the entry of this country into war, with the object of mobilizing the industries of the country so they could render effective assistance if it became necessary to do so. Many industries which had not been previously organized, were in this way brought together for more effective work.

In order to do this work quickly, the Council of National Defense authorized the formation under its direction, of coöperative committees of industry composed of men representative of each line. No other machinery was in existence, nor could have been created at that time, for the accomplishment of this end; and though these committees were hurriedly organized they have rapidly multiplied and given invaluable assistance in many ways. To many of the individuals, serving on these committees has meant great personal and financial sacrifice, and the thanks of the entire country are due them.

* * *

The council however, was an emergency machine, and was not the ideal means for a permanent organization, and while it has proved very effective, the committees were placed in a position unfair both to themselves and to the Government. After careful consideration it has been decided that a new arrangement must be made for meeting the Government's needs, and this is to be done through the appointment of especially qualified individuals as Government employees and expert advisers. These, it is believed, will meet the needs of industry and assist the Government by creating committees within the industries themselves. The present coöperative committees are therefore being dissolved, not as a result of criticism of their work but in order to secure a more effective working body than was possible under the old organization. New committees are to be so formed as to entitle them to speak with authority for their entire industries, and in this way they will render immediately available valuable sources of information upon which the Government can draw in connection with the countless business and industrial problems attendant upon the conduct of the war.

* * *

In spite of some of the pessimistic remarks which are being made in various quarters concerning the Liberty motor, there is apparently nothing about it which calls for discouragement of any kind. In fact, there seems to be every reason for congratulation, not only as to the performance of the engine itself, but the way in which its manufacture is progressing.

While there is no particular reason for a gallon of gasoline developing very much more power in one engine than in another, considering in each case the best design of which we have knowledge, it may be safely stated that the new Liberty motor has given an excellent account of itself in the various tests to which it has been subjected. These tests include rapid climbing, extremely high altitudes, and other performances of a highly creditable nature.

Just as an indication of the preparation for its manufacture, and the satisfactory way in which preparation is progressing, it seems timely to give a few details concerning one of the new plants which is rapidly nearing completion—somewhere in motordom.

This plant is in charge of men who understand high-grade work, coupled with extremely rapid production, and who can be absolutely counted upon to turn out nothing less than standard work. Cylinder forging machines are in place, much of the machinery is already installed, and it will be only a short time before this particular plant is turning out 12-cylinder Liberty motors at an extremely gratifying rate. The new shop has been designed especially with a view of rapid production, and the magnitude of the plant, as well as some of its interesting details, give a good idea of the output which may be expected.

Just as an example of thoroughness on the part of the manufacturers, it is interesting to note that the engines to be turned out will consume so much gas on their long test runs that the use of gasoline is practically out of the question. In consequence, there is a special gas-producing plant being built to supply sufficient gas for this test, and a 12-in. main is required in order that gas enough may get to the test stands. When it is considered that the gas plant being erected solely to supply fuel for this test, is large enough to supply all the gas needed by a city of 75,000 people, some idea may be gained of the output of Liberty motors in this one plant.

* * *

The Congressional hearing on the conduct of the war has, for the most part, brought out nothing new. The delays in securing rifles are acknowledged and it is frankly admitted that none of the new machine guns are likely to be delivered before April. Even then it must be remembered that our machine gun is a new gun and has not proved itself on the field of battle. Everyone hopes that it will prove the best gun ever built, but it seems to be a case of not only putting all your eggs in one basket, but in a basket which has not been tested with its full load of eggs.

A very different method of procedure was pursued by the Aircraft Section of the Signal Corps. The master minds of this corps developed the new Liberty motor in record time but they did not pin their faith to it to the extent of depending on it entirely. Instead they began to build motors of several other types which have proved successful on the Western front, and they are having a large supply of motors of various kinds built to use in conjunction with the Liberty motor. Not that they lack faith in their new product, but they do not consider this a time to take chances with untested devices to the extent of depending on them entirely.

The aircraft engineers did another thing in a somewhat different manner than the Ordnance Department of the Army. They did not confine their aircraft purchases to any one or even to a few concerns, but ordered all the machines which could be built by almost every airplane builder who had ever turned out machines that flew. The urgent need for flying machines made them realize that, while uniformity was highly desirable, it was much more important to have machines that would fly, and plenty of them.

* * *

This same situation would seem to apply equally to rifle and machine guns, the main requirement being that they shoot the same cartridge. This need was covered to some extent in much the same way, so far as the machine gun is concerned, but instead of ordering all that could be built, as in the case of the airplane, comparatively small orders were placed with two builders of light machine guns. While these guns have been delivered, it is not quite clear what has become of them. General Crozier testified that the men in France were to be equipped with French guns until the Browning guns were ready. Yet the tales persist that the various cantonments or training camps are not well equipped with machine guns and that some machine-gun companies have been abandoned or changed to other branches of the service on account of no machine guns being available.

* * *

There is also one thing a bit misleading, or that might be easily misunderstood, in the statement attributed to Secretary Baker, "that the whole capacity of every machine gun establishment in the country is being utilized in turning out machine guns for the army." This capacity, however, is not being used in making the types of guns with which they are most familiar or for which they are best fitted. They are being fitted up to make the new Browning gun, instead of their regular product, and this, as pointed out by General Crozier, means that it will be early spring before the finished product will begin to come out in any quantity.

It was also shown, there was time lost in getting production started on the new rifles; that the rifle manufacturers in some cases allowed their organization to go to pieces to some extent during the period when the details were being discussed and finally determined on, among them the question of absolute interchangeability which has been so often given as a reason for delay. The startling feature of the whole hearing was the charge by General Crozier that Secretary Baker was responsible for the delays and the assumption of this responsibility by the Secretary.

* * *

The hopeful statements recently made regarding the centralization of the gage designing, gage making and inspection under a central bureau, seem to have been premature. For something has slipped a cog and each section or division again wants a little gage department all its own, with designers and inspectors under its direct orders.

It is difficult to see how any such course can be justified by anyone who is at all familiar with efficient manfacturing. Not only does it increase the number of men necessary to handle the work, but increases the difficulty of getting gages and decreases the capacity of the plants making either gages or munitions.

With a centralized control of gage design and inspection, the capacity of each gage making shop can be utilized to its best advantage, which is impossible where the work is divided and where it often happens that different sections are competing for product if not in price.

With the control centralized, the capacity of every gage making shop in the country can be tabulated, and this capacity utilized to its best advantage. Instead of having a small shop make a variety of gages, a few of each for the different divisions, it could be kept on the kind of gage it can make best and so secure maximum output of the highest quality.

The effect of the present, haphazard plan is to waste a portion of the gage making capacity, and to work a hardship in many of the gage making shops. With the control in the hands of one central board or committee, the different shops could be told to get ready for certain kinds of work, so that they could prepare their shop and men, prevent disorganization and get into production in the shortest possible time. All this is utterly impossible with the present, independent gaging departments for each division of the Ordnance Bureau.

The Canadian method was to centralize under one head, to order the gages through that head and to distribute them to the manufacturers as needed. This utilized the gage making capacity of each shop much more satisfactorily than is possible in any other way. This, in the hands of Capt. Durley and a corps of able assistants, has worked out very satisfactorily to all concerned.

This method allowed one shop to specialize on thread gages, and another on plug and ring gages, while a third could make form or contour gages in large quantities. It also allowed many gages which were rejected by the inspectors for master or checking gages on account of finish, to be utilized as shop or work gages by the manufacturers. This saved not only money but time, and is in line with the rational utilization of all the resources of the country.

This whole gage proposition simply reflects the lack of coöperation which still exists in too many cases, between the various branches of the war departments. There have been many improvements during the past six months, but there is still room for much more.

It all comes back to the question of having the engineering and productive work of the army handled by engineers and production men as we have pointed out on numerous occasions. The problems connected with supplying an army with guns, ammunition and transport are many, which makes it all the more desirable if not absolutely necessary, to have them handled by men who understand engineering and production problems. One big engineering manager at the head, enough able lieutenants to each handle a department, and we could look for the same results as in a large and successful manufacturing establishment. One man and his department would handle the gages for all sections, another the inspection and so on, instead of each section maintaining a gage and a manufacturing department of its own, as is now done. As it is, one division has its inspection headquarters in Washington, another division maintains one in New York, all of which means more men and more office expense than necessary, and at a time when we are trying to conserve both.

Another live problem of the present is the standardization or lack of it, of both the aircraft and army truck committee. This refers especially to the great discrepancy in the proposed screw thread standards of these two branches of the service. It is particularly unfortunate at a time when the standardization of screw threads is so important and the work of the American Society of Mechanical Engineers' screw thread tolerance committee is being made public.

In some of the sizes given in the tables proposed, the tap drill is smaller than the bottom of the threads and in others it is larger than the outside diameter.

The Railroads War Board has another important duty to perform and one which will add both to the efficiency of the railroads, the economy of fuel and the soothing of the ruffled feelings of the belated traveler.

We realize the necessity of giving important freight the right of way, we willingly wait for the passing of a troop train or a supply train. But we rise in wrath, we squirm with indignation and we emit sounds that might be taken to resemble cuss words, when we are delayed because a railroad official insists in having his private car on the tail end of a train which is already late from being too heavy for the only locomotive available.

The private car is an imposition in peace times, it becomes a crime and a menace in the present state of railroad congestion. We are asked to use day coaches and so save the cost of hauling a limited number of passengers in a very heavy parlor car. And we do it with a very fair imitation of cheerfulness. And then comes along the president of the railroad, or some lesser light, and hitches on a 50-ton car to carry himself and secretary in all the exclusiveness of the ex-Czar of all the Russias. Then to make matters worse he tells in the next morning's paper that the road simply must have an increase in rates to pay for the increased cost of operation.

If every private car of every railway official was relegated to the back track during the war, Mr. Garfield, Mr. Hoover and the Railroads War Board would be entitled to a vote of thanks. The chair car can also be dispensed with without hardship. The sleeper expedites travel and relieves hotel accommodations, but neither the private nor the chair car have much excuse for existence in these days of war time economy.

An Appropriate Holiday Gift

You can hit upon no finer expression of your good will to your responsible men than to make them a gift of a year's subscription for the paper that is published to help them to improve and to get economical results in their work.

Most holiday gifts are outworn and forgotten in a few months; but here is one that lives and grows with each week—one that will be a constant reminder to your men of your interest in them.

We have prepared an appropriate card announcing your gift. This will be mailed at once to each recipient, his subscription being entered as paid up to Jan. 1, 1919. The time is growing short—so let us have your list without delay.

Business Items

The Nagle Corliss Engine Works, Erie, Penn., builder of air compressors, vacuum pumps and engines, has opened an office in the Bourse Bldg., Philadelphia.

The Black & Decker Manufacturing Co., Baltimore, Md., has recently completed a new plant to be devoted exclusively to the manufacture of air pumps and drills. This company has recently received some large orders from England.

Personal

G. F. Matteson has been appointed department superintendent at the Watertown Arsenal, Watertown, Massachusetts.

H. H. Pinney, vice president in charge of the Bridgeport works of the Remington Arms-Union Metallic Cartridge Co., has been granted an indefinite leave of absence.

L. S. Love has resigned as sales manager of the Sherritt & Stoer Co., Philadelphia, to become general manager of the Machine Tool Engineering Co., Singer Building, New York City.

Howard Emery, formerly general manager of the Manitowoc, Wis., foundries of the Aluminum Castings Co., Cleveland, has been promoted to general manager of the company's works at Detroit. The promotion will become effective on Jan. 1.

Mr. Alfred D. Flinn, deputy engineer of the Board of Water Supply, New York Cty, has recently been elected to the secretaryship of the United Engineering Societies. This office combined with those of secretary of the Engineering Council and secretary of the Engineering Foundation, centers important engineerng activities in one man. This is one of the first fruits of the migration of the civil engineers to Thirty-ninth Street.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Feb. 7, 8 and 9. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

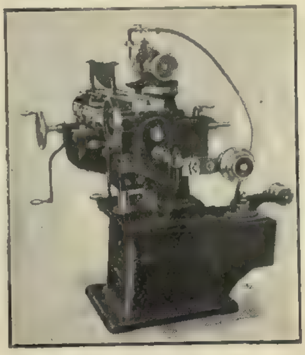
Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Grinding Machine, Cutter and Tool, No. 2

Oakley Machine Tool Co., Cincinnati, Ohio



"American Machinist," Dec. 6, 1917

This machine is similar to those previously manufactured by this company except that it is equipped with longitudinal power feed and with a wet-grinding attachment. The power feed is operated through a table feed screw. The table pauses slightly before reversing and the three speeds are 6, 10½ and 18 in. per minute. This machine is very similar to that described on page 85, volume 47

Switch, Drum Reverse, Type 810

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.

"American Machinist," Dec. 6, 1917

A drum reverse switch intended for use with motors in shops where it is necessary to reverse machines of comparatively small size. The stationary contacts are mounted on the back board while the movable ones are carried on cast-brass brackets clamped on the shaft but insulated from it. Good contacts are insured by the use of phosphor bronze springs on the movable contacts. All live parts are protected by the sheet steel cover lined with asbestos. For use on either direct or alternate-current service

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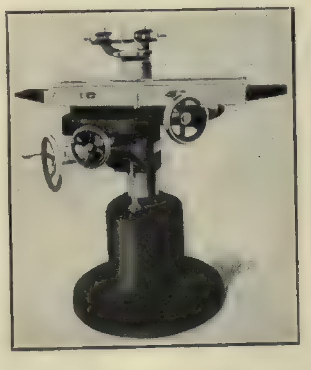
Grinding Machine, Universal Tool and Cutter No. 2

Woods Engineering Co., Alliance, Ohio



"American Machinist," Dec. 13, 1917

Furnished either for belt drive as shown or with self-contained motor drive. The knee is of the box section type and entirely encircles the column, sliding on a V-key. The head may be swiveled through 180 deg. Longitudinal travel, 22 in. cross travel, 7½ in.; vertical travel, 10 in.; maximum distance between centers, 22 in.; swing on centers, 9 in.; opening between vise jaws, 2¾ in.; weight, 1000 lb.

Punch, "Samson" No. 3

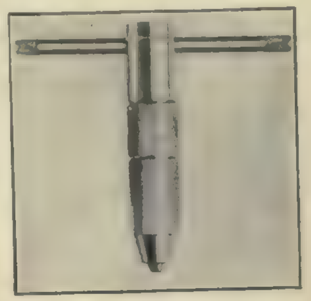
Machine Appliance Corporation, 351 Jay St., Brooklyn, N. Y.

"American Machinist," Dec. 13, 1917

This bench punch is fitted with a compound lever and is of heavy construction, being adapted for sheet iron and steel up to ⅛ in. thick. Punches and dies are furnished from $\frac{3}{16}$ to ½ in. in diameter, the opening between them being ⅝ in. The depth of throat is 3 in. Extra dies may be furnished in sizes from $\frac{3}{16}$ to ½ in. in steps of $\frac{1}{16}$ in.

Tap Wrench, Ratchet

Moss-Ochs Co., 3387 East 116th St., Cleveland, Ohio



"American Machinist," Dec. 13, 1917

This tap wrench is made in two sizes: No. 1, with a capacity of ¼ in.; No. 2, with a capacity from ¼ to ½ in. The T-handle is made sliding to permit operation in corners, but may be held in the center by means of a dog which automatically fits on a flat-milled surface on the handle. The ratchet adjustment for right- or left-hand motion is accomplished by turning the knurled sleeve. The chuck and ratchet are hardened to prevent wear

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Punch, "Samson" No. 1

Machine Appliance Corporation, 351 Jay St., Brooklyn, N. Y.

"American Machinist," Dec. 13, 1917

Made in sizes from $\frac{1}{16}$ to ¼ in. in diameter with an opening between the dies of ¼ in. The throat is 1⅜ in. deep, and the capacity of the punch in sheet iron or soft steel is up to 20 gage. Paper, cardboard, leather, etc., up to ¼ in. thick may be handled. If desired, the punch may be furnished with interchangeable dies for various sized holes within the limits specified

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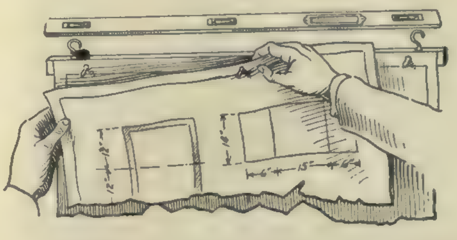
Blueprint and Drawing Holder "Presto"

The National Co., 273-279 Congress St., Boston, Mass.



"American Machinist," Dec. 13, 1917

A holder for blueprints, records, charts, drawings or newspapers. Is provided with three adjustable catches and will hold from 1 to 60 prints or papers. May be suspended by the hooks shown at the top and is made in three sizes, 30, 36 and 42 in. long

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Reamers, Critchley Expanding

Cutter & Wood Supply Co., 68-70 Pearl St., Boston, Mass.

"American Machinist," Dec. 13, 1917

These improved Critchley reamers are fitted with six adjustable blades which enable the use of a micrometer for setting to size. The adjustment is made by means of the nuts at the ends of the blades which slide in inclined slots. Each reamer will expand from 0.010 to 0.015 in. over its maximum listed size, which permits considerable grinding before new blades are necessary. The adjustment is such that a set of 17 reamers will ream all sizes of holes from $\frac{15}{32}$ to 4$\frac{1}{16}$ in.

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Dec. 21, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$23.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	30.00
*Bessemer, Pittsburgh	37.25	36.30	35.95
*Basic, Pittsburgh	33.00	33.00	30.95
No. 2X, Philadelphia.................	33.75	33.75	29.50
*No. 2, Valley.......................	33.00	33.00	31.00
No. 2, Southern Cincinnati...........	35.90	35.00	25.90
Basic, Eastern Pennsylvania..........	33.95	30.00	30.00

*Delivered Pittsburgh; f.o.b. Vallley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Dec. 21, 1917	One Month Ago	One Year Ago	Dec. 21, 1917	One Year Ago	Dec. 21, 1917	One Year Ago
Structural shapes ...	$4.20	$4.20	$3.75	$4–4.04	$3.85	$4.20	$3.70
Soft steel bars......	4.10	4.10	3.75	4–4.04	3.85	4.10	3.60
Soft steel bar shapes.	4.10	4.10	3.75	4.14	3.85	4.10	3.60
Plates, ¼ to 1 in. thick	4.45	4.45	4.75	4.39	4.50	4.20	3.60

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Dec. 21, 1917	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York..............	4.25	3.75
Warehouse, Cleveland	3.98½	3.70
Warehouse, Chicago	4.10	3.65

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

		New York			Cleveland		Chicago	
	Pittsburgh, Mill, in Carloads	Dec. 21, 1917	One Month Ago	One Year Ago	Dec. 21, 1917	One Year Ago	Dec. 21, 1917	One Year Ago
*No. 28 black......	5.00	6.445	6.445	5.25	6.45	4.75	6.445	4.75
*No. 26 black......	4.90	6.345	6.345	5.15	6.35	4.65	6.345	4.65
*Nos. 22 and 24 black	4.85	6.295	6.295	5.10	6.30	4.60	6.295	4.60
Nos. 18 and 20 black.	4.80	6.245	6.245	5.05	6.25	4.55	6.245	4.50
No. 16 blue annealed.	4.45	5.645	5.645	4.85	5.65	4.45	5.645	4.50
No. 14 blue annealed.	4.35	5.545	5.545	4.75	5.55	4.35	5.545	4.40
No. 12 blue annealed.	4.30	5.495	5.495	4.70	5.50	4.30	5.495	4.30
No. 10 blue annealed.	4.25	5.445	5.445	4.65	5.45	4.25	5.445	4.25
*No. 28 galvanized..	6.25	7.695	7.695	7.25	7.70	6.50	7.695	6.75
*No. 26 galvanized..	5.95	7.395	7.395	6.95	7.40	6.20	7.395	6.45
No. 24 galvanized...	5.80	7.245	7.245	6.80	7.25	6.05	7.245	6.30

*For corrugated sheets add 25c. per 100 lb.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Dec. 21, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Dec. 21, 1917	One Year Ago
New York	$15.00	$7.50
Cleveland	15.30	7.50
Chicago	15.00	5.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16..	
No. 18	
No. 20	

¹ Very scarce.

Cast-Iron Welding Rods	
3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Dec. 14, 1917	Cleveland Dec. 14, 1917	Chicago Dec. 14, 1917
Tire	5.00	5.00	4.04
Toe calk	5.70	5.50	4.35
Openhearth spring steel...	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Coppered bessemer rods....	7.00	....	....
Hoop steel	4.04½	....	....
Cold-rolled strip steel.....	9.00	....	....
Floor plates	6.19½	....	....

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe.

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%
BUTT WELD EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4.......	29%	17%
4½ to 6......	44%	32½%	4½ to 6.......	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Dec. 21, 1917	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	36.00
Tin, in 5-ton lots.................	86.00	74.00	43.00
Lead	6.50	7.25	8.00
Spelter	7.75	7.88	11.75

*Government price.

ST. LOUIS

	Dec. 21, 1917	One Month Ago	One Year Ago
Lead	6.37½	7.13	7.80
Spelter	7.50	7.63	11.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Dec. 21, 1917	One Month Ago	One Year Ago	Dec. 21, 1917	One Year Ago	Dec. 21, 1917	One Year Ago
Copper sheets, base.	35.00–37.00	35–37	41.00	32.50	45.00	35–36	42.00
Copper wire (carload lots)	36.00	36.00	36.00	28.50	44.00	33.50	36.50
Brass pipe, base...	38.50	38.50	47.50	40.00	52.00	41.00	46.50
Brass sheets	35.75	35.75	45.50	33.00	47.00	35.00	44.00
Solder ½ and ½ (case lots)	40.50	40.50	27.50	43.25	28.25	41.00	28.25

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Dec. 21, 1917	One Year Ago
Mill	$29.00	$42.00
New York	30.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.. 19.00

	In Casks		Broken Lots	
	Dec. 21, 1917	One Year Ago	Dec. 21, 1917	One Year Ago
Cleveland	21.00	23.00	21.25	23.25
New York	20.00	22.00	20.50	23.00
Chicago	21.00	22.75	21.50	23.25

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Dec. 21, 1917	One Year Ago
New York	15.50	14.75
Cleveland	17.75	16.00
Chicago	16.00	15.00

Author Vol. 47, July-Dec/17 146674

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